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Department of Economics

Temporary layoffs, short-time work and COVID-19: the case of a dual labour market*

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Abstract

This paper examines the type of short-time work schemes implemented in Spain to preserve jobs and worker's incomes during the COVID-19 crisis. These policies have typically involved some degree of subsidization of payroll taxes for firms and also subsidies to workers. For this purpose, we simulate the impact of the COVID-19 crisis in 2020 on labor market outcomes. The steady-state results show that the availability of short-time work schemes and temporary layoffs does not necessarily prevent a large increase in unemployment and job destruction. The effects of these measures depend on the degree of subsidization of payroll taxes and on the design of the policy. The heavily subsidized short-time work schemes provide incentives to preserve workers on payroll working very few hours that would not have been employed in the benchmark situation, generating deadweight costs and inefficiencies. The transition exercise shows that an scenario with a moderate degree of subsidization of payroll taxes, and where the subsidy is independent of the reduction in hours worked, is the least harmful for both welfare and fiscal deficit. However, this is not the scenario that maximizes the number of jobs preserved. A more generous short-time work scheme, similar to the one implemented in the first year of the pandemic, accomplishes that goal instead. The drawbacks, though, are fiscal sustainability and deadweight costs. The winners and losers exercise shows that more than 50% of the workers are hit negatively in terms of average income and very few workers are better off after this shock: less than 3% in the scenarios which heavily subsidizes short-time work as a result of this generous work sharing strategy. The category that experiences the strongest distributional changes is the one composed of unemployed workers. In the heavily subsidized short-time work scenarios they are the ones who improve more in terms of the proportion of workers affected and also in terms of the average increase in annual income, but among the losers, they are also the ones who lose more in both respects.

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1 Introduction

There is great consensus about the fact that the COVID-19 crisis has been an unprecedented shock to all economies around the world. The huge drop in aggregate demand and in GDP in most countries have triggered significant workforce adjustments. Most governments in the developed world have put in place a battery of policies to prevent massive layoffs and sharp declines in worker's incomes by subsidizing furloughs and short-time work (STW), providing benefits to workers and loans to firms. The Spanish government is not an exception. Contrary to what happened during the "Great Recession", where the lack of internal flexibility together with the dual structure present in the Spanish labour market led to the highest rates of unemployment and job destruction in the Euro Area (EA), the picture looks now very different. However, this might be misleading. It is true that the unemployment rate has only experienced a modest rise, but this is partly due to the changes in the legal treatment of short-time work introduced in the 2012 labor market reform[1], to the generosity of the subsidies provided for short-time work and temporary layoffs, and to the fact that many workers have left the labour force due to difficulties in finding jobs.

In this paper we examine the type of short-time work schemes that have been implemented in Spain to prevent jobs and labor incomes from falling too much. These policies have typically involved some degree of subsidization of payroll taxes for firms, and also subsidies to workers (paid from the Unemployment Benefit System) so that their wages did not fall proportionally with the fall in hours. The objective of this paper is twofold. First, we simulate the impact of the COVID-19 crisis during the first year of the pandemic on labor market outcomes. We compute the steady-state effects for the unemployment rate, job destruction and the tenure distribution for different scenarios depending on the type of short-time work scheme used to illustrate their differences. Second, we perform a transition exercise to evaluate the changes in welfare, the costs of these policies and the distributional effects.

Accordingly, we use an equilibrium model of job creation and destruction of the search and matching type, similar to the one proposed in García-Pérez and Osuna (2015). The ingredients of that model, which intended to capture the specific features of the Spanish economy, are (i) the existence of a *segmented labour market* with two types of jobs (permanent and temporary) that differ in productivity, in the maximum length of the contract and in the associated severance costs; (ii) endogenous job conversion of temporary contracts (TCs) into permanent contracts (PCs); (iii) severance costs modelled as a transfer from the firm to the worker and as a function of seniority; (iv) downward wage rigidities such that severance costs have real effects[2] and (v) availability of STW schemes. In this paper, we add the possibility of using temporary layoffs (TL) as an alternative mechanism of adjustment, and we also add the institutional details of the policies implemented during the COVID-19 crisis. In this labour market, firms will be heterogeneous agents and use these two types of contracts as well as the number of hours worked to endogenously adjust their employment levels. We follow Mortensen and Pissarides (1994) by assuming one-job firms.

There are only a few papers that address the theoretical effects of STW mechanisms. In most of them, the presence of production technologies that allow for some substitutability between workers

[1] This reform made STW mechanisms easier to implement due to the elimination of administrative approval for working-week reductions due to economic reasons of between 10% and 70%.

[2] Lazear (1990) notes that if contracts were perfect, severance payments would be neutral. If the government forced employers to make payments to workers in the case of dismissal, perfect contracts would undo those transfers by specifying opposite payments from workers to employers. Thus, for severance pay to have an effect, some form of incompleteness is needed. Most studies have avoided this problem by modelling dismissal costs as firing taxes; thus, the effects cannot be undone by private arrangements.

and hours worked per employee imply that in the absence of STW arrangements, shocks that temporarily reduce demand are typically accommodated by reducing the number of workers rather than by work-sharing, inducing excessive layoffs from an efficiency point of view (see Boeri and Brucker, 2011; Burdett and Wright, 1989; and Fitzroy and Hart, 1985). In addition, Abraham and Houseman (1994), Walsh et al. (2007) and Vroman and Brusentev (2009) emphasize that STW schemes are more equitable because they distribute the adjustment burden over a large number of workers. These studies also note that STW schemes are likely to have more of an impact in the presence of relatively large fixed costs per worker, such as strong employment protection or experience-rated unemployment benefits, which increase the relative costs of external adjustment, whereas generous unemployment benefits would operate in the opposite direction. More recently, Cahuc et al. (2021), using a search and matching framework, show that short-time work may save jobs in firms hit by strong negative revenue shocks, but not in less severely-hit firms, where hours work are reduced, without saving jobs.

On the contrary, the empirical literature is large, and results are mixed. Most papers address the effectiveness of STW in stabilising employment focusing on the "Great Recession" and on how well Germany has coped with it in comparison with other countries (see, e.g, Arpaia et al., 2010). In contrast, Bellman et al. (2012) for Germany and Calavrezo et al. (2010) for France find no evidence that STW increased labour hoarding by reducing layoffs. Boeri and Brucker (2011) and Hijzen and Venn (2011) find that the number of jobs saved is smaller than the full-time equivalent jobs involved in these programmes pointing, in some cases, to sizeable deadweight costs. In addition, Brenke et al. (2012) indicate that the astonishing results of the German case cannot be transferable to other countries due to differences in other labour market institutions, such as employment protection legislation (EPL) and collective bargaining, which interact with STW. Möller (2010) adds to this examination the different weight that German firms may attribute to the loss of human capital given their export-oriented character, the scarcity of high-skilled workers and the high training costs. On the contrary, Cahuc and Carcillo (2011) indicate that countries that do not have these programmes could benefit from their introduction and favour including an experience-rating component in their design to reduce inefficient reductions in working hours that could hinder the necessary reallocation and future growth and to eliminate the perverse consequences on the prospects of outsiders if used too intensively. Hijzen and Venn (2011) warn about the increase in labour market segmentation induced by these measures, whereas Scholz (2012) finds that fears that STW is mainly applied to a certain group of workers are not confirmed.

To our knowledge, the effectiveness of STW schemes in dual labour markets using a search and matching dynamic framework has only been theoretically analyzed by García-Pérez and Osuna (2015). The previously mentioned literature has emphasised the importance of the dynamic dimension to understand firms' labour adjustment decisions in the face of temporary shocks to demand when dismissal costs and those associated with losing firms' human capital are relevant. Furthermore, there is no consensus about the effects of these measures for outsiders in a dual labour market. Therefore, it is not straightforward that STW is beneficial for the Spanish labour market because of the significant labour segmentation between PCs and TCs,[3] which introduces interesting distributional considerations. It may be the case that the availability of STW makes firms more prone to convert TCs into PCs because of the possibility of adjusting hours instead of adjusting permanent employment, which is very costly. By contrast, as Hijzen and Venn (2011) pointed out, firms may end up using STW schemes only for workers on PCs and use TCs to adjust employment because they are very cheap. This is precisely where the dynamic considerations presented above play a

[3]According to the European Labour Force Survey, the share of temporary workers over total employment in the last decade was 32.1% in Spain, whereas it was only 14.4% in the European Union.

central role. The answer may depend on the structural characteristics of a particular economy and on the nature of the crisis. In this paper, we address these distributional issues for the case of the COVID-19 crisis taking as a benchmark a dual labor market like the Spanish one.

The steady-state results show that the COVID-19 crisis would have generated a 42% unemployment rate in the absence of STW policies. In particular, the temporary job destruction would have doubled due to the large gap in severance costs between permanent and temporary contracts. Adding the availability of short-time work and temporary layoffs results in a lower increase in both the unemployment and job destruction rates. Moreover, when payroll taxes are subsidized, and the subsidy is independent of the reduction in hours worked, firms find it more profitable to use STW schemes and keep temporary layoffs to a minimum. However, only when these schemes are heavily subsidized, and the subsidies are proportional to the reduction in working time, the rise in the unemployment rate is moderate, from 13.7% in the baseline to 19.4%. Furthermore, the duality in the labour market, measured as the reduction in the temporary job destruction rate, strongly decreases, and the tenure distribution becomes much smoother. The drawback, though, is that these generous subsidies generate incentives to preserve workers on payroll working very few hours (or even zero hours) that would not be employed in the benchmark situation. This implies deadweight costs and inefficiencies from a fiscal point of view.

Obviously, without a measurement of welfare and of the cost of these policies, it is not possible to provide a policy recommendation. This is why a transition exercise is performed. We compute the equivalent variation to gauge the welfare changes and the net cost that each individual generates for the public system. We find that an scenario with a moderate degree of subsidization of payroll taxes, and where the subsidy is independent of the reduction in hours worked, is the least harmful for both welfare and fiscal deficit. However, this is not the scenario that maximizes the number of jobs preserved. A more generous short-time work scheme, similar to the one implemented in the first year of the pandemic, accomplishes that goal instead. The main drawbacks, though, are fiscal sustainability and deadweight costs. Finally, we accomplish a winners and losers exercise to show the redistribution effects. More than 50% of the workers are hit negatively in terms of average income and very few workers are better off after this shock: less than 3% in the scenarios which heavily subsidizes short-time work as a result of this generous work sharing strategy. The category that experiences the strongest distributional changes is the one composed of unemployed workers. In the heavily subsidized short-time work scenarios they are the ones who improve more in terms of the proportion of workers affected and also in terms of the average increase in annual income, but among the losers, they are also the ones who lose more in both respects.

The paper is organised as follows. In Section 2, the model is presented. In Section 3, we discuss its calibration. In Section 4, the results are shown. Finally, Section 5 concludes.

2 The Model

2.1 Population

The economy is populated by a continuum of workers with a unit mass and a continuum of firms. Workers can either be employed or unemployed. Hence, we do not consider being out of the labour force an additional state. Unemployed workers look for employment opportunities; employed workers produce and do not search for jobs. Firms post vacancies or produce. The cost of having a vacancy open is c_v. Posting a vacancy is not job creation unless it is filled. Each firm is a one-job firm, and the job may be occupied and producing or vacant. We assume free entry.

The source of heterogeneity is due to the existence of matches with different quality levels and durations. Therefore, the state space that describes the situation of a particular worker is $S =$

$\{\{0,1\} \times \mathscr{E} \times D\}$, where $\mathscr{E} = \{\varepsilon_1, ..., \varepsilon_n\}$ is a discrete set for the quality levels and $D = \{1, ..., N\}$ is also a discrete set denoting the duration of a job (worker's seniority). Each triple indicates whether the worker is unemployed (0) or employed (1), the quality and the duration of the match.

2.2 Preferences

Workers have identical preferences, live infinitely and maximise their utility, which is taken to be linear in consumption. We assume that they supply work inelastically, that is, they will accept any opportunity that arises. Thus, each worker has preferences defined by $\sum_{t=1}^{\infty} \beta^t c_t$, where β is the discount factor ($0 \leq \beta < 1$) and c_t is individual consumption. Firms are further assumed to be risk neutral.

2.3 Technologies

Production technology

Each job is characterised by an irreversible technology and produces one unit of a differentiated product per period whose price is $z_t y(\varepsilon_t)$, where z_t denotes the state of aggregate demand and ε_t is an idiosyncratic component, i.e., the quality of the match. z_t is set to one in normal times and will fall below one to capture the extent of the crisis. The idiosyncratic component is modelled as a stationary and finite Markov chain. This process is the same for each match, and the realisations ε_{t+1} are independent and identically distributed with conditional transition probabilities $\Gamma(\varepsilon'|\varepsilon) = Pr\{\varepsilon_{t+1}|\varepsilon_t\}$, where $\varepsilon, \varepsilon' \in \mathscr{E} = \{1, 2, ..., n_\varepsilon\}$. Each new match starts with the same entry level ε_e, and from this initial condition, the quality of the match evolves stochastically due to these idiosyncratic shocks. We assume that agents know the law of motion of the process and observe their realisations at the beginning of the period.

Matching technology

In each period, vacancies and unemployed workers are stochastically matched. We assume the existence of a homogeneous of degree one matching function $m = m(u, v)$, increasing and concave in both arguments, where v is the number of vacancies and u is the number of unemployed workers, both normalised by the fixed labour force. Given the properties of the matching function, the transition rates for vacancies, q, and unemployed workers, α, depend only on $\theta = v/u$, a measure of tightness in the labour market. The vacancy transition rate, q, is defined as the probability of filling a vacancy, and the transition rate for unemployed workers, α, is defined as the probability of finding a job. These are given by

$$q(\theta) = \tfrac{m(v,u)}{v} = m\left(1, \tfrac{u}{v}\right) \; ; \; \alpha(\theta) = \tfrac{m(v,u)}{u} = m\left(\tfrac{v}{u}, 1\right).$$

2.4 Equilibrium

The concept of equilibrium as used herein is recursive equilibrium. Before showing the problems that agents solve, it is convenient to explain the timing and the agents' decisions. Given the state of aggregate demand, z_t, firms' idiosyncratic shocks for existing matches are revealed at the beginning of the period. Firms and workers then renegotiate wages. Given these wages, firms choose between four options: i) to continue producing with the current match, working at standard hours, ii) to continue producing with the current match at a reduced number of hours, iii) to temporary lay off the worker, or iv) to terminate the match and dismiss the worker. The nature of the problem depends on whether the firm has a PC or a TC. PCs entail high severance costs that depend on the quality of the match and on the duration of the contract, whereas severance costs for TCs also depend on both dimensions but are, in comparison, very low. In addition, the problem is not the same for all firms with a TC. Let d denote the duration of the contract. We will assume that a TC cannot last more than d^t_{max} periods, and thus the maximum number of renewals is $d^t_{max} - 1$. Therefore, firms whose TCs cannot be renewed decide between these three options: i) to convert the TC into a full-time PC, taking into account the consequences regarding future severance costs, ii) to convert the TC into a PC at a reduced number of hours or even at zero hours (temporary layoff), or iii) to terminate the match. Once all these decisions have been made, production starts in firms where workers have not been fired during this period and in those that were matched with unemployed workers at the end of the last period. Finally, search decisions are made, and firms post vacancies for which unemployed workers apply. This search process generates new matches that will be productive over the next period. Accordingly, there follows a formal description of the problems faced by both firms and workers.

2.4.1 Vacancy creation

Every job is created as a temporary job according to the following equation:

$$V = -c_v + \beta[q(\theta)J^{tc}(\varepsilon_e, 1) + (1-q(\theta))V], \tag{1}$$

where V is the value of a vacant job, $J^{tc}(\varepsilon_e, 1)$ is the value function of a firm with a first-period TC, and ε_e is the entry level match quality. All vacancies lead to temporary jobs, which may later be transformed to permanent jobs.

2.4.2 The Firm's problem

The problem of firms with TCs

The problem of a firm with a TC, whose length at the end of the last period was less than d^t_{max}, is

$$\begin{aligned} J^{tc}(\varepsilon,d) \quad = \quad & max\{zy(\varepsilon)(1-\gamma)h_{ft} - w^{tc}_{ft}(\varepsilon,d) - \xi^{tc}(w^{tc}_{ft}, w^{tc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{tc}(\varepsilon\prime,d\prime), \\ & zy(\varepsilon)(1-\gamma)h_{pt} - w^{tc}_{pt}(\varepsilon,d) - \xi^{tc}(w^{tc}_{ft}, w^{tc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{tc}(\varepsilon\prime,d\prime), \\ & -\xi^{tc}(w^{tc}_{ft}, w^{tc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{tc}(\varepsilon\prime,d\prime), \\ & -s^{tc}(\varepsilon,d-1) - c_v + \beta(q(\theta)J^{tc}(\varepsilon_e,1) + (1-q(\theta))V)\} \end{aligned} \tag{2}$$

$$g^{tc}(\varepsilon,d) = \begin{cases} h_{ft} & \text{if the full-time match continues} \\ h_{pt} & \text{if the match continues at a reduced number of hours} \\ h_{tl} & \text{if the worker is on a temporary layoff} \\ 0 & \text{if the worker is fired} \end{cases}$$

where $J^{tc}(\varepsilon,d)$ and $J^{tc}(\varepsilon\prime,d\prime)$ are, respectively, the firm's value function for this period and the next period when there is a TC, $zy(\varepsilon)(1-\gamma)$ is output, h_{ft} are standard hours in a full-time, h_{pt} are reduced hours in a part-time job, h_{tl} means that a worker is on a temporary layoff where hours worked are temporarily zero, $w^{tc}_{ft}(\varepsilon,d)$ and $w^{tc}_{pt}(\varepsilon,d)$ are full-time and part-time wages, $\xi^{tc}(w^{tc}_{ft}, w^{tc}_{pt})$ is a function that represents social security taxes paid by the firm in TCs, $\Gamma(\varepsilon\prime|\varepsilon)$ is the conditional transition probability for the match quality and $s^{tc}(\varepsilon, d-1)$ is the severance cost. As in García-Pérez and Osuna (2014) and based on Spanish evidence (Albert et al. (2005) or Dolado et al. (2012)), we assume that temporary workers are less productive than permanent workers, and we introduce this feature through a productivity gap, γ. Note that a greater value of the idiosyncratic productivity, ε, increases output, and that wages and severance costs are both increasing in ε and in d.

If it is more profitable to continue with the actual match working standard hours (first row greater than second, third and four rows in Equation 2), the decision rule will be $g^{tc}(\varepsilon, d) = h_{ft}$, and the full-time match will continue. If it is more profitable to continue with the actual match at a reduced number of hours, $g^{tc}(\varepsilon, d) = h_{pt}$. If it is more profitable to put the worker on a temporary lay off, $g^{tc}(\varepsilon, d) = h_{tl}$. Otherwise, $g^{tc}(\varepsilon, d) = 0$, and the worker will be fired, whereby the firm incurs the severance cost, $s^{tc}(\varepsilon, d-1)$, plus the vacancy cost. With probability $q(\theta)$ at the end of this period, the firm will fill the vacant job with a TC that will be productive in the next period.

The problem of firms with prospective permanent contracts (PPCs)

The problem is slightly different for a firm whose TC has reached its maximum length at the end of the previous period. If the worker is not fired at the beginning of this period, the TC will be automatically transformed into a PC. Note that in this case, $d = d^t_{max} + 1$, where $d^t_{max} + 1$ denotes the first period in a PC, and severance costs are given by $s^{tc}(\varepsilon, d-1)$ because if the worker is not promoted, the severance cost corresponds to the period the worker has spent on a TC. As in García-Pérez and Osuna (2014), based on the evidence (see Albert et al. (2005), for example), we assume that firms incur a training cost, τ, in the first period of a PC that reduces the productivity of the job in that period. This problem can thus be written as

$$\begin{aligned} J^{ppc}(\varepsilon,d) \quad = \quad & max\{zy(\varepsilon)(1-\tau)h_{ft} - w^{ppc}_{ft}(\varepsilon,d) - \xi^{pc}(w^{ppc}_{ft}, w^{ppc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime), \\ & zy(\varepsilon)(1-\tau)h_{pt} - w^{ppc}_{pt}(\varepsilon,d) - \xi^{pc}(w^{ppc}_{ft}, w^{ppc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime), \\ & -\xi^{pc}(w^{ppc}_{ft}, w^{ppc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime), \\ & -s^{tc}(\varepsilon,d-1) - c_v + \beta(q(\theta)J^{tc}(\varepsilon_e,1) + (1-q(\theta))V)\} \end{aligned} \qquad (3)$$

$$g^{ppc}(\varepsilon,d) = \begin{cases} h_{ft} & \text{if the firm promotes the worker to a full-time job} \\ h_{pt} & \text{if the firm promotes the worker to a part-time job} \\ h_{tl} & \text{if the worker is on a temporary layoff} \\ 0 & \text{if the worker is fired} \end{cases}$$

where $J^{ppc}(\varepsilon,d)$ and $J^{pc}(\varepsilon\prime,d\prime)$ are, respectively, the firm's value function for this and the next period, $zy(\varepsilon)(1-\tau)$ is output, $\xi^{pc}(w^{ppc}_{ft}, w^{ppc}_{pt})$ represents social security taxes paid by the firm and $w^{ppc}(\varepsilon,d)$ is the wage. This equation has an analogous interpretation to the previous one. If it is more profitable to continue with the actual match working standard hours, the decision rule will be $g^{ppc}(\varepsilon,d) = h_{ft}$, and the TC will be converted to a full-time PC. If it is more profitable to continue with the actual match at a reduced number of hours, $g^{ppc}(\varepsilon,d) = h_{pt}$. If it is more profitable to continue with the actual match at zero hours (temporary lay off), $g^{ppc}(\varepsilon,d) = h_{tl}$. Otherwise, $g^{ppc}(\varepsilon,d) = 0$, and the worker will be fired.

The problem of firms with existing PCs

A firm with a PC must decide whether to continue with the actual match, either at the standard or reduced number of hours, or to dismiss the worker and search for a new one. This problem can be written as

$$\begin{aligned} J^{pc}(\varepsilon,d) \quad = \quad & max\{zy(\varepsilon)\Lambda(d)h_{ft} - w^{pc}_{ft}(\varepsilon,d) - \xi^{pc}(w^{pc}_{ft},w^{pc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime), \\ & zy(\varepsilon)\Lambda(d)h_{pt} - w^{pc}_{pt}(\varepsilon,d) - \xi^{pc}(w^{pc}_{ft},w^{pc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime), \\ & -\xi^{pc}(w^{pc}_{ft},w^{pc}_{pt}) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime), \\ & -s^{pc}(\varepsilon,d-1) - c_v + \beta(q(\theta)J^{tc}(\varepsilon_e,1) + (1-q(\theta))V)\} \end{aligned} \tag{4}$$

$$g^{pc}(\varepsilon,d) = \begin{cases} h_{ft} & \text{if the full-time match continues} \\ h_{pt} & \text{if the match continues at a reduced number of hours} \\ h_{tl} & \text{if the worker is on a temporary layoff} \\ 0 & \text{if the worker is fired} \end{cases}$$

where $J^{pc}(\varepsilon,d)$ and $J^{pc}(\varepsilon\prime,d\prime)$ are, respectively, the firm's value function for this period and the next period when there is a PC, $zy(\varepsilon)$ is output, $\Lambda(d)$ is an experience function, $w^{pc}(\varepsilon,d)$ is the wage and $s^{pc}(\varepsilon,d-1)$ is the severance cost. As in García-Pérez and Osuna (2014), based on the evidence (Albert et al. (2005), for example), it is assumed that permanent workers are more productive as tenure increases. This feature is introduced through the experience function $\Lambda(d)$. Therefore, for a given value of ε, more tenure on the job makes the job even more productive. The interpretation of this equation is again analogous to the previous ones. If it is more profitable to continue with the actual full-time match, the decision rule will be $g^{pc}(\varepsilon,d) = h_{ft}$, and the match will continue. If it is more profitable to continue with the actual match but at a reduced number of hours, the decision rule will be $g^{pc}(\varepsilon,d) = h_{pt}$, and the match will continue. If it is more profitable to continue with the actual match but at zero hours (temporary layoff), the decision rule will be $g^{pc}(\varepsilon,d) = h_{tl}$, and the match will continue. Otherwise, $g^{pc}(\varepsilon,d) = 0$, and the worker will be fired.

2.4.3 The Worker's problem

The value functions of workers in TCs, PPCs and PCs can be written as follows

$$\begin{aligned} W^{tc}(\varepsilon,d) \quad = \quad & \tilde{\Phi}(g^{tc} = h_{ft})[w^{tc}_{ft}(\varepsilon,d) + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{tc}(\varepsilon\prime,d\prime)] + \\ & \tilde{\Phi}(g^{tc} = h_{pt})[w^{tc}_{pt}(\varepsilon,d) + (1-h_{pt})w^{tc}_{ft}(\varepsilon,d)\omega + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{tc}(\varepsilon\prime,d\prime)] + \\ & \tilde{\Phi}(g^{tc} = h_{tl})[w^{tc}_{ft}(\varepsilon,d)\omega + \beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{tc}(\varepsilon\prime,d\prime)] + \\ & \tilde{\Phi}(g^{tc} = 0)[U + s^{tc}(\varepsilon,d-1)] \end{aligned} \tag{5}$$

$$\begin{aligned} W^{ppc}(\varepsilon,d) \quad = \quad & \tilde{\Phi}(g^{ppc}=h_{ft})[w_{ft}^{ppc}(\varepsilon,d)+\beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime)]+ \\ & \tilde{\Phi}(g^{ppc}=h_{pt})[w_{pt}^{ppc}(\varepsilon,d)(1-h_{pt})w_{ft}^{ppc}(\varepsilon,d)\omega+\beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime)]+ \\ & \tilde{\Phi}(g^{ppc}=h_{tl})[w_{ft}^{ppc}(\varepsilon,d)\omega+\beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime)]+ \\ & \tilde{\Phi}(g^{ppc}=0)[U+s^{tc}(\varepsilon,d-1)] \end{aligned} \tag{6}$$

$$\begin{aligned} W^{pc}(\varepsilon,d) \quad = \quad & \tilde{\Phi}(g^{pc}=h_{ft})[w_{ft}^{pc}(\varepsilon,d)+\beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime)]+ \\ & \tilde{\Phi}(g^{pc}=h_{pt})[w_{pt}^{pc}(\varepsilon,d)+(1-h_{pt})w_{ft}^{pc}(\varepsilon,d)\omega+\beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime)]+ \\ & \tilde{\Phi}(g^{ppc}=h_{tl})[w_{ft}^{pc}(\varepsilon,d)\omega+\beta\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime)]+ \\ & \tilde{\Phi}(g^{pc}=0)[U+s^{pc}(\varepsilon,d-1)] \end{aligned} \tag{7}$$

where $W^{tc}(\varepsilon,d)$, $W^{ppc}(\varepsilon,d)$ and $W^{pc}(\varepsilon,d)$ denote workers' value functions in TCs, PPCs and PCs, $\tilde{\Phi}(x)$ is an indicator function that takes the value 1 if the assessment is true and zero otherwise, ω is a subsidy to which workers on short time are entitled, and U is the value function of an unemployed worker, whose equation is

$$U=b+\beta(\alpha(\theta)W^{tc}(\varepsilon_e,1)+(1-\alpha(\theta))U), \tag{8}$$

where $W^{tc}(\varepsilon_e,1)$ is the value function of a worker in a first-period TC, and the parameter b can be interpreted as an unemployment subsidy. Hence, an unemployed worker receives b today, and, by the end of the period, the probability that the worker will find a job is $\alpha(\theta)$, whereas the probability that the worker will remain unemployed is $1-\alpha(\theta)$.

2.4.4 Law of motion for unemployment

Given the previously shown policy rules, the law of motion for unemployment is

$$U_t=U_{t-1}+\sum_{i=1}^{N_{t-1}^{pc}}(\tilde{\Phi}(g^{pc}=0))+\sum_{i=1}^{N_{t-1}^{ppc}}(\tilde{\Phi}(g^{ppc}=0))+\sum_{i=1}^{N_{t-1}^{tc}}(\tilde{\Phi}(g^{tc}=0))-\alpha(\theta)U_{t-1}, \tag{9}$$

where N_{t-1}^{pc}, N_{t-1}^{ppc} and N_{t-1}^{tc} denote the beginning of period-t employment levels in PCs, PPCs and TCs, respectively, and U_t is the level of unemployment at the end of period t. The interpretation of the equation is the following: unemployment at the end of period t, U_t, is given by the sum of the stock of unemployment at the beginning of period t, U_{t-1}, plus the inflows into unemployment (the three terms with indicator functions) during period t minus the outflow from unemployment during period t, $\alpha(\theta)U_{t-1}$. Note that the second RHS term sums up the values of the $g_i^{pc}(\varepsilon,d)$ for every worker holding a PC at the beginning of period t, when the decision to continue or to fire takes place. For instance, for those workers fired at the beginning of period t, $g_i^{pc}(\varepsilon,d)=0$; therefore, they will be part of the unemployment pool. The third and fourth RHS terms have a similar interpretation, but for workers with prospective PCs and TCs, respectively.

2.4.5 Wage determination

Wages are the result of bilateral bargaining between the worker and the firm unless the legally imposed minimum wage, w_{min}, is binding.[4] Bargaining is dynamic; that is, wages are revised for each period based upon the occurrence of new shocks. The assumption of bilateral bargaining is reasonable due to the existence of sunk costs (search costs) once the match has been produced. This creates local monopoly power and generates a surplus to be split among the participants in the match. In TCs, this surplus is defined as

$$S^{tc}(\varepsilon,d) = [J^{tc}(\varepsilon,d) - (V - s^{tc}(\varepsilon,d-1))] + [W^{tc}(\varepsilon,d) - (U + s^{tc}(\varepsilon,d-1))]. \tag{10}$$

Wages are the result of maximising the following Nash product with respect to the wage:

$$[J^{tc}(\varepsilon,d) - (V - s^{tc}(\varepsilon,d-1))]^{1-\pi}[W^{tc}(\varepsilon,d) - (U + s^{tc}(\varepsilon,d-1))]^{\pi}. \tag{11}$$

The first-order condition of this maximisation is such that the surplus is split into fixed proportions according to the worker's bargaining power, π

$$(1-\pi)S^{tc}(\varepsilon,d) = J^{tc}(\varepsilon,d) + s^{tc}(\varepsilon,d-1) \tag{12}$$

$$\pi S^{tc}(\varepsilon,d) = W^{tc}(\varepsilon,d) - (U + s^{tc}(\varepsilon,d-1)). \tag{13}$$

By making the appropriate substitutions of firms' and workers' value functions, the wage in a full-time TC can be computed as

$$\begin{aligned} w^{tc}(\varepsilon,d) = max\{w_{min} \quad , \quad & \pi z y(\varepsilon)(1-\gamma)h_{ft} + (1-\pi)U + s^{tc}(\varepsilon,d-1) + \\ & \beta(\pi\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{tc}(\varepsilon\prime,d\prime) - (1-\pi)\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{tc}(\varepsilon\prime,d\prime))\}. \end{aligned}$$

Following the same procedure, the wage in firms with full-time PPCs turns out to be[5]

$$\begin{aligned} w^{ppc}(\varepsilon,d) = max\{w_{min} \quad , \quad & \pi z y(\varepsilon)(1-\tau)h_{ft} + (1-\pi)U + s^{tc}(\varepsilon,d-1) + \\ & \beta(\pi\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime) - (1-\pi)\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime))\}. \end{aligned}$$

Finally, in firms with PCs,

$$\begin{aligned} w^{pc}(\varepsilon,d) = max\{w_{min} \quad , \quad & \pi z y(\varepsilon)\Lambda(d)h_{ft} + (1-\pi)U + s^{pc}(\varepsilon,d-1) + \\ & \beta(\pi\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)J^{pc}(\varepsilon\prime,d\prime) - (1-\pi)\sum_{\varepsilon\prime}\Gamma(\varepsilon\prime|\varepsilon)W^{pc}(\varepsilon\prime,d\prime))\}. \end{aligned}$$

Note that wages in PPCs are lower than those that prevail in the following periods because of the associated training costs and because, as in Osuna (2005), firms attempt to internalise higher future wages (due to higher future severance costs) by pushing down wages in first-period PCs. Moreover, for any given productivity level, wages in TCs are lower than in existing PCs because of the assumed productivity gap.

[4]Downward wage rigidity is modelled here as a lower bound on the outcome of the wage negotiations. We need to impose a wage floor to prevent too much internalisation of severance payments.

[5]Part-time wages are adjusted accordingly, that is, they are reduced in the same proportion as hours worked.

2.4.6 Definition of Equilibrium

A recursive equilibrium is a list of value functions $J^{tc}(\varepsilon,d)$, $J^{ppc}(\varepsilon,d)$, $J^{pc}(\varepsilon,d)$, $W^{tc}(\varepsilon,d)$, $W^{ppc}(\varepsilon,d)$, $W^{pc}(\varepsilon,d)$, V, U, transition rates $q(\theta)$, $\alpha(\theta)$, wages $w^{tc}(\varepsilon,d)$, $w^{ppc}(\varepsilon,d)$ and $w^{pc}(\varepsilon,d)$, and decision rules $g^{tc}(\varepsilon,d)$, $g^{ppc}(\varepsilon,d)$, $g^{pc}(\varepsilon,d)$ such that[6]

1. *Optimality*: Given functions $q(\theta)$, $\alpha(\theta)$, $w^{tc}(\varepsilon,d)$, $w^{ppc}(\varepsilon,d)$ and $w^{pc}(\varepsilon,d)$ the value functions $J^{tc}(\varepsilon,d)$, $J^{ppc}(\varepsilon,d)$, $J^{pc}(\varepsilon,d)$, $W^{tc}(\varepsilon,d)$, $W^{ppc}(\varepsilon,d)$ and $W^{pc}(\varepsilon,d)$ satisfy the Bellman equations.
2. *Free entry:* This condition and the profit maximisation condition guarantee that, in equilibrium, the number of vacancies adjusts to eliminate all the rents associated with holding a vacancy; that is, $V = 0$, implying $c_v = \beta q(\nu) J^{tc}(\varepsilon_e, 1)$.
3. *Wage bargaining:* The equilibrium conditions from maximising the surplus in existing TCs are given in equations (12) and (13). Similar conditions hold for other types of contracts.

3 Calibration

In this section, we explain the data set, the procedure for assigning values to the model's parameters and the selection of functional forms.

3.1 The data set and model period

To calibrate the main parameters of the model we use the Spanish Labour Force Survey, administrative data from the Spanish Employment Service (SEPE) and Spanish administrative data from the "Muestra Continua de Vidas laborales" (MCVL). The calibration sample comes from the 2006 to 2019 waves and includes the complete labour market career for a sample of more than 700,000 workers for the 2016-2019 period, a reasonable time span for measuring job transitions in steady state since the annual growth rate is 2.85, a value close to the equilibrium one for the Spanish economy once the "Great Recession" was overcome. All employment (and unemployment) spells lasting more than six (three) months are used. We exclude employees who are not enrolled in the general regime of the Social Security Administration and restrict also the sample to those aged 16-64.

3.2 Calibrated parameters and functional forms

There are two types of calibrated parameters in our model: those that have a clear counterpart in the real economy and those that do not. For the former, we use the implied parameter values. For some of the latter, we use the values estimated in empirical studies, and for the rest, we use the simulated method of moments to calibrate their values.

Preferences

The utility function is linear in consumption, as is usual in this literature. The value of the discount factor, $\beta = .97$, is fixed so that it is consistent with the mean annual real interest rate in the reference period, 3%.

[6]Cole and Rogerson (1999) show that an equilibrium always exists when wages do not depend on the unemployment rate but only on the idiosyncratic shock. The intuition is that, given free entry, vacancies adjust to the number of unemployed, and the relevant variable becomes the ratio of unemployed workers to vacancies.

Production Technology

The production function depends on an aggregate shock, z, and on an idiosyncratic shock, ε. The aggregate shock is set to 1 in normal times, and it is calibrated to a lower value, $z = .91$, such that the model reproduces the annual rate of variation of aggregate consumption due to COVID-19 crisis in 2020.

The idiosyncratic shock is modelled as a Markov chain, $\Gamma[(\varepsilon')|(\varepsilon)]$. We assume five possible quality levels. These assumptions would imply 20 restrictions to fix the values of the conditional transition probabilities between different quality levels. Assuming that the expected duration of good and bad idiosyncratic shocks coincides, $\Gamma[(\varepsilon_1)|(\varepsilon_2)] = \Gamma[(\varepsilon_2)|(\varepsilon_1)]$, we only need to estimate 15 transition probabilities. Given that we do not have direct information on the quality of the match, we use the procedure described in Tauchen (1986) to parameterise the five quality levels and the transition probabilities. To apply this procedure, we need to know the mean (μ), the standard deviation (σ) and the autocorrelation coefficient (ρ) of the underlying idiosyncratic process. We use data from the Wage Data Survey in 2018 to approximate this process.[7] We normalise μ to the value of 1 to make the calibration more intuitive and more easily interpretable. Using the calibration sample, the productivity gap parameter is set to 13.5% based on the ratio between wages for permanent and temporary workers with equal experience.[8] Finally, the positive experience effect on the productivity of permanent workers is parameterized through the function $\Lambda(d) = (1 + \lambda(d-3))$ for $d > 3$.

Matching technology

We assume a Cobb-Douglas homogeneous of degree one matching function, $m = m(v,u) = Av^{\eta}u^{1-\eta}$, where A is the degree of mismatch and η is the value of the elasticity of the number of matches with respect to vacancies.

Unemployment benefits

The parameter b is interpreted as the income flow of unemployment. This parameter is set as the product of unemployment benefits and coverage in 2020, normalised by average productivity.[9]

Minimum wage

The parameter w_{min} is set using information on the statury minimum wage in 2020, which is 1108 euros a month. Given a median wage of 1434 Euros a month, the ratio between the two is 0.77, which is the ratio that we impose in the model to parameterise w_{min}.

To summarise, the calibration exercise involves the assignment of values to two types of parameters. The discount rate, β, the parameters of the idiosyncratic process, (μ, σ and ρ), the productivity gap parameter, γ, unemployment benefits, b, and the minimum wage, w_{min}, are set independently from the rest as they have clear counterparts in the real economy (See Table 1). In contrast, the workers' bargaining power, π, the value for the elasticity of new matches with respect to the vacancy input, η, and the cost of posting a vacancy, c_v, are set using the values estimated in the empirical studies. Abowd and Lemieux (1993) estimate $\pi = 0.33$, the value for η usually lies in the range of $[0.4-0.6]$, and we set c_v as 26% of the average worker productivity, which is roughly

[7] See INE Database, https://www.ine.es/jaxiT3/Tabla.htm?t=28191.

[8] See García-Pérez and Osuna (2014) for a discussion on the robustness of this choice.

[9] In 2020, the monthly average unemployment benefits and coverages are, respectively, 864 euros and 30%. The sources of these data are the Spanish Labour Force Survey and the National Employment Office.

Table 1: **Calibrated parameters**

Discount factor	β	0.97
Productivity shock (mean)	μ	1
Productivity shock (autocorrelation)	ρ	0.75
Productivity shock (standard deviation)	σ	0.11
Productivity gap	γ	0.135
Unemployment benefit	b	0.2
Minimum wage	w_{min}	0.77
Bargaining power	π	0.33
Matching elasticity	η	0.51
Vacancy cost	c_v	0.26
Training cost	τ	0.6
Experience effect on productivity	λ	0.007
Mismatch degree	A	0.64

the midpoint of the estimates suggested in the literature (see Costain et al., 2010).

The three remaining parameters, training cost, τ, experience, λ, and mismatch, A, are calibrated using the method of simulated moments. Table 2 displays the three conditions that are imposed to set these parameters. This calibration exercise shows that the baseline is a good starting point for investigating the behaviour of this economy because it matches the Spanish data fairly closely.

Table 2: **Calibration results**

Statistics	Spanish Data	Baseline
u	14.6	13.7
JD	12.3	10.8
JDp	8.5	8.2

JD and JDp stand for aggregate and permanent job destruction, and u denotes unemployment.

3.3 Severance cost and social security functions

Severance cost function

To compute equilibrium we need a severance cost function that represents the severance costs in Spain for the period under study. PCs entail a severance cost of 33 days of wages per year of seniority (p.y.o.s)[10], $s^{pc} = 33\frac{w}{365}(d-1)$, while TCs entail a severance cost of twelve days of wages p.y.o.s, $s^{tc} = 12\frac{w}{365}(d-1)$. Because making the severance cost function depend on wages is computationally very difficult, we take the quality of the match as an approximation of the wage. Following Güell and Petrongolo (2007), we have set $d^t_{max} = 3$, which has been the usual practice in Spain since the introduction of TCs in 1984.

Social security and wage subsidy parameters

Social security taxes in PCs and TCs are, respectively, 29.9% and 31.1% of the wage. We will refer to the proportion of social security taxes that is used to pay for the health and the public pension system as "payroll taxes" (ξ_{cc}) to distinguish it from the rest, "unemployment taxes" (ξ_u), which are used to pay for unemployment benefits. This distinction will matter when we consider STW and TL schemes because only payroll taxes may be subsidized. The general function presented in the model section, that is used to represent social security taxes, $\xi^{pc}(w^{pc}_{ft}, w^{pc}_{pt})$ and $\xi^{tc}(w^{tc}_{ft}, w^{tc}_{pt})$, will adopt a particular form depending on the availability and the amount of the subsidy, ψ, to which firms are entitled (see Table 3).

Table 3: **Social security functions in PCs and TCs**

	Baseline	STW-No subsidy	STW-ψ subsidy	STW-Prop. subsidy
$\xi^{tc}(w^{tc}_{ft}, w^{tc}_{pt})$	$(\xi_{cc}+\xi_u)w^{tc}_{ft}$	$(\xi_{cc}+\xi_u)w^{tc}_{ft}$	$(\psi*\xi_{cc}+\xi_u)w^{tc}_{ft}$	$\psi\xi_{cc}w^{tc}_{pt}+\xi_u w^{tc}_{ft}$
$\xi^{pc}(w^{pc}_{ft}, w^{pc}_{pt})$	$(\xi_{cc}+\xi_u)w^{pc}_{ft}$	$(\xi_{cc}+\xi_u)w^{pc}_{ft}$	$(\psi*\xi_{cc}+\xi_u)w^{pc}_{ft}$	$\psi\xi_{cc}w^{pc}_{pt}+\xi_u w^{pc}_{ft}$

Workers, on the other hand, are entitled to a wage subsidy, ω, to prevent drastic reductions in net income as a result of being on short-time work or on a temporary layoff. In Spain this subsidy amounts to 70% of the wage and is paid by the Unemployment Benefit System.

4 Main Findings

Section 4.1 shows the predicted steady-state effects of the COVID-19 crisis for different scenarios. Section 4.2 shows the welfare implications and the cost of these policies.

4.1 Steady-state effects

Table 4 shows the steady-state effects of the COVID-19 crisis for the unemployment rate, job destruction and the tenure distribution in several scenarios. In the benchmark scenario the aggregate shock, z, is set such that there is no need to use STW schemes. In the other scenarios examined in

[10]Based on the fact that most firings in the past reached an amount very close to the legal limit, we have set 33 days of wages p.y.o.s, for every firing regardless of whether the dismissal is fair or unfair.

this section the aggregate shock is set to a lower value to represent the fall in aggregate demand due to the COVID-19 crisis.

In scenario A we shut down the possibility of adjusting hours to focus on the effects that would have prevailed if firms could only use the extensive margin. This was the predominant way to adjust labor before the Spanish 2012 labor market reform changed the regulation of furloughs. In scenario B firms can use both, temporary layoffs and temporary reductions in hours worked,[11] and payroll taxes are subsidized by 33%. This STW scheme was introduced in the 2012 labour market reform, but only for the period January 2012- December 2013 as a response to the "Great Recession". Finally, in scenarios C and D payroll taxes are reduced in the same proportion as hours worked, and they are also subsidized.[12] Payroll taxes are heavily subsidized in escenario C to match the degree of subsidization prevailing during the COVID-19 crisis in 2020: an 80% subsidy in the case of reductions in the number of hours worked and a 75% subsidy in the case of temporary layoffs. In scenario D these subsidies are reduced to 65% and 55%, respectively, to illustrate the effects of a lower degree of subsidization, similar to the one that has been proposed for the ongoing months in 2021.

When only the extensive margin is available (scenario A), the unemployment rate increases sharply to 41.9% due to massive firings given the drop in aggregate demand and the impossibility of adjusting hours worked. The temporary job destruction rate doubles and the permanent job destruction rate also grows significantly. As a result the tenure distribution becomes steeper. The most affected workers are those whose temporary contracts expired and are not promoted to a permanent job. In fact, the job destruction rate on these jobs soars from 16.1% to 58.5%, due to the large gap in severance costs between permanent and temporary contracts, which prevents firms from promoting more temporary workers to permanent jobs.

The availability of STW schemes induces smaller increases in the unemployment rate. In scenario B, the rise in both the unemployment and the temporary job destruction rate is not so large. Aggregate job destruction increases hardly two percentage points from the baseline situation. The most striking difference is the change in the job destruction rate once temporary contracts expire. Many of the temporary workers who would have been fired in scenario A, now get promoted to a permanent contract on short-time work or are temporarily laid off. Regarding workers on permanent jobs, those with the lowest level of qualification and tenure are still fired, some of them are only temporarily laid off, and some others are put on short-time work. For the same level of qualification, the higher the tenure the lower the probability of being subject to those schemes and the lower the reduction in working hours. The fact that some workers work less than usual (or even zero hours on temporary layoffs) explains why the unemployment rate in equivalent terms is higher than the standard rate of unemployment.

Scenario C shows the effects of heavily subsidizing STW schemes. The unemployment rate increases substantially less, from 13.7% in the benchmark to 19.4%. Regarding the job destruction rates, the generous subsidies provided makes firms more prone to continue with the matches, albeit at a reduced number of hours worked (or even at zero hours) in some instances. Note that in scenario B the reduction in payroll taxes is independent of the reduction in hours worked, whereas in scenarios C and D the reduction in payroll taxes is proportional to the reduction in hours worked, thereby creating an incentive to preserve more short-time jobs. In fact, job destruction rates are much lower in scenarios C and D but at the expense of significantly reducing working hours and keeping workers

[11]In the model firms have the option of reducing hours worked by 30% or 60% depending on the magnitude of the adverse shock, or even to zero by using temporary layoffs.

[12]This type of STW scheme was introduced in a number of countries during the "Great Recession" to provide more incentives to adopt these type measures (see Arpaia et al. (2010)).

Table 4: **Steady-state effects**

Scenarios / Statistics	Baseline	(A) No STW	(B) STW 33% subsidy	(C) STW 80% prop.subs.	(D) STW 65% prop.subs.
u	13.7	41.9	29.0	19.4	25.4
u_{equiv}	13.7	41.9	32.2	30.5	30.1
JD	10.8	17.5	12.2	2.6	8.6
JDt	16.8	33.3	22.1	8.9	13.6
JDp	8.2	10.7	8.0	0.0	5.8
$JD_{d=2}$	22.3	22.4	22.5	6.4	22.4
$JD_{d=3}$	10.4	29.6	29.5	14.8	10.2
$JD_{d=4}$	16.1	58.5	10.8	5.2	4.7
$n_{d=1}$	15.9	27.6	18.1	10.5	14.5
$n_{d=2}$	12.4	21.4	14.0	9.8	11.3
$n_{d=3}$	11.1	15.1	9.9	8.4	10.1
$n_{d=4}$	9.3	6.3	8.8	7.9	9.7
$n_{d=5}$	8.8	5.9	7.4	7.9	8.9
$n_{d=6}$	8.1	5.0	7.7	7.9	8.1
$n_{d=7}$	7.3	4.1	7.0	7.9	7.3
$n_{d=8}$	6.6	3.4	6.4	7.9	6.6
$n_{d=9}$	6.0	3.2	5.7	7.9	5.9
$n_{d=10}$	5.4	2.9	5.2	7.9	5.9
$n_{d>10}$	9.2	5.1	8.8	15.8	11.8
$n_{d>3}$	60.6	35.9	58.0	71.3	64.1

u_{equiv} stands for unemployment measured in full-time equivalents.
$JD_{d=i}$ stands for job destruction at the beginning of period i.
$n_{d=i}$ stands for the proportion of workers in period i.

on payroll who would not be otherwise employed. This effect is more prevalent in scenario C than in scenario D due to the greater degree of subsidization. In scenario C, almost one third of the adjustment is made using temporary layoffs while they barely represent one fourth in scenario D, and only 17% in scenario B. This explains why the difference between the unemployment rate in equivalent terms and the standard rate of unemployment is much higher in scenario C.

With regard to the effects on job destruction rates in the early durations, $JD_{d=2}$, $JD_{d=3}$ and $JD_{d=4}$, they decrease dramatically to 6.4%, 14.8% and 5.2% in scenario C. Consequently, the tenure distribution changes drastically becoming much smoother. The proportion of workers with more than ten years of tenure increases from 9.2% in the benchmark scenario to 15.8%, and the proportion of workers with more than three years of tenure increases from 60.6% to 71.3% in this case. In contrast to what Hijzen and Venn (2011) find, STW schemes reduce labour market segmentation.

To summarize, the possibility of putting workers on short-time and/or using furloughs help prevent firings when firms are hit by negative shocks. Adding this internal flexibility mechanism implies lower unemployment, lower aggregate and temporary job destruction rates and a smoother tenure distribution. This exercise also shows that external and internal flexibility, when combined, do not necessarily prevent a larger increase in the unemployment rate than when only the external flexibility is available, at least in full-time equivalents. Moreover, in some scenarios the generous subsidies generate deadweight losses because they induce firms to keep some workers on payroll, either through temporary layoffs or working very few hours, that would not be otherwise working in the benchmark case. This is inefficient from a fiscal point of view.

4.2 Welfare effects and fiscal costs

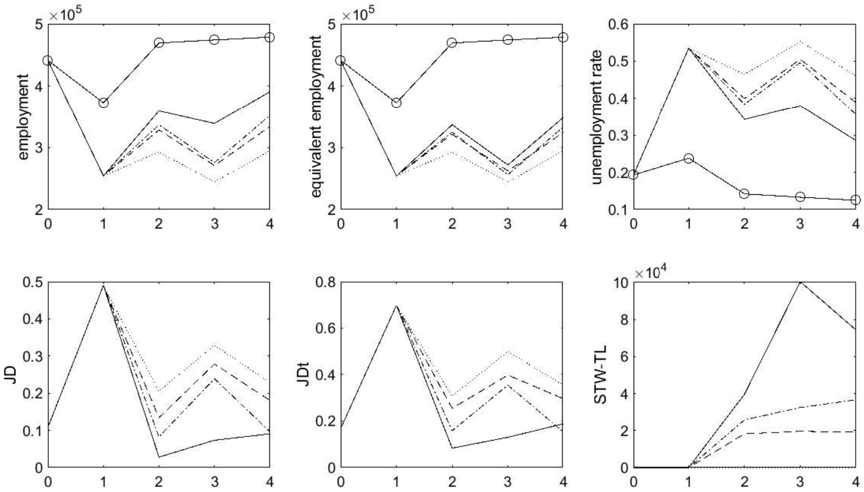
As it is well known, an assessment of a policy cannot be conducted based on steady-state comparisons. To assess the welfare consequences of these policies a transition exercise is performed. For this purpose, we take a sub-sample of workers from the MCVL data set previously described in the year 2019, who differ in several dimensions, such as whether they are employed or unemployed, the type of contract, tenure on the contract and productivity level (proxied by qualification), and we impose the fall in aggregate demand to compute the changes they experience in terms of employment, hours worked and income in the scenarios previously described. We assume that in the first period of the transition no STW policy is available[13], and from that period on a particular STW scheme is implemented (B, C or D) until the end of 2020 during three quarters. We also run the transition under the assumptions that no STW scheme is available to compare with the other exercises. In every scenario, workers are subject to the same shocks, but their employment histories are different because the policy rules are different.

Figure 1 shows the evolution of several labour market variables related to level of employment, unemployment, job destruction, short-time work and temporary layoffs according to the different scenarios. The huge rise in the unemployment rate experienced in all scenarios except in the baseline illustrates the severity of the crisis. Among the STW scenarios, the heavily subsidized one seems to deliver the highest level of employment. However, in equivalent terms the difference is not really that high. The reason is quite simple. In the heavily subsidized STW scenario the number of jobs are larger, but average hours worked are in comparison to the other two STW scenarios lower. Regarding job destruction rates, again the scenario that shows the lowest ones is the heavily subsidized STW scenario, followed by the other two. In sum, the higher the subsidy the less negatively affected is the

[13]This is actually what happened from the beginning of the crisis till mid March 2020, when the Decree "Real Decreto-ley 8/2020, March 17, on Urgent measures to tackle the socio-economic Impact of COVID-19 crisis" was passed.

economy according to these variables. Of course, when no STW is available, unemployment and job destruction rates are the highest because there is no other way to adjust to the adverse shock.

Figure 1: The transition



Note: Baseline (circles), STW80 (solid line), STW65 (dashed dot line), STW33 (dashed line), No STW (dotted line).

Table 5: **Welfare effects and fiscal costs**

Scenarios Statistics	Baseline	(A) No STW	(B) STW 33% subsidy	(C) STW 80% prop.subs.	(D) STW 65% prop.subs.
Equivalent variation	–	–	-498	-174	-184
$SS-cc_{firm}$	3199	1897	2068	2056	2027
$SS-u_{firm}$	840	497	548	629	562
$SS-cc_{State}$	572	1874	1704	1716	1744
Unemploy. benefits	658	2154	1914	1543	1840
Wage subsidies	–	–	153	808	305
Total Fiscal Costs	1231	4029	3770	4067	3878
Fiscal Revenue	4039	2394	2616	2685	2589
Fiscal balance	2809	-1635	-1154	-1383	-1289
STW take up rate	–	–	4.1	5.9	5.0

Note: $SS-cc_{State}$, $SS-cc_{firm}$ and $SS-u_{firm}$ stand for social security contributions paid by the State and by firms.

To gauge the welfare changes induced by these reforms, we compute the equivalent variation expressed as an income annuity. We measure the "welfare change" as the difference in the individual annuity values in two institutional settings. A positive value implies a larger utility in the benchmark situation. For this exercise, scenario A will be considered the benchmark scenario. The reason is that we want to understand the differences in welfare experienced by similar individuals in a economy where no STW schemes are available (scenario A) compared to that of an economy where STW schemes are implemented (scenarios B, C, and D). Furthermore, the change in welfare is expressed in euros, which allows for an easy comparison to the financial calculations discussed below. We obtain an aggregate welfare figure by computing the average of the individual welfare changes across all the individuals in the sample.

To obtain a complete picture, we also compute the net cost that each individual represents for the public system in the different scenarios as a constant annuity to facilitate comparison with the welfare measurement defined above. This cost is assessed by computing the value of the payments that the worker will receive along the transition, net of all contributions to be made in the same period. Our calculation reflects the fact that workers can change their labor state as a result of the exogenous sources of uncertainty in the model and takes also into account that individuals will react optimally according to the institutional environment.

In scenario A welfare decreases sharply due to the substantial drop in average income (9.6%). Regarding the fiscal balance, the enormous deficit generated is attributable to the huge growth in fiscal costs and the substantial drop in fiscal revenue. This changes are due to the large decrease in the level of employment because of massive firings stemming from the COVID-19 crisis and from the impossibility of adjusting the labor force using the intensive margin. As a result, unemployment benefits and social security contributions paid by the State rise quite significantly and payroll taxes on behalf of firms drop accordingly.

In scenario B the drop in average income is substantially lower than in scenario A (5.8)%. This is in part due to fewer firings and to the wage subsidies provided by the State for those workers on short-time work. Moreover, unlike in the other short-time work scenarios (C and D), workers on short-time tend to work longer hours affecting income in a positive way. The reason is that the subsidy on payroll taxes is independent of the reduction in hours worked. The fact that workers work on average a larger number of hours has also a positive impact on fiscal revenue. In fact, among the four scenarios experiencing the drop in demand, this is the one with the largest amount of social security contributions paid by firms.

Concerning the fiscal balance, the deterioration in scenario B is the least harmful among the four scenarios studied. It is true that the amount of unemployment benefits is larger than in scenarios C and D, but wage subsidies are substantially lower in this case because the State does not need to compensate workers so much for the lost hours worked. Comparing the situation with and without STW schemes (scenarios A and B), people would be willing to pay almost five hundred euros to transition to scenario B, an scenario with short-time work schemes in place and where subsidies on payroll taxes amount to 33%.

With regard to scenarios C and D, the drop in average income (8.2%) is higher than in scenario B (5.8%) and the fiscal balance deterioration is more harmful. Unlike in scenario B, wage subsidies account for a substantial part of the rise in fiscal costs, particulary in scenario C. In this scenario, the generous subsidies on payroll taxes and the fact that they are proportional to hours worked induce firms to keep workers on bill working very few hours (or even zero hours on furloughs). This also explains that fiscal revenue does not fall as much as in the other scenarios and that the amount of unemployment benefits and social security contributions paid by the State do not comparatively account equally to the upsurge in total fiscal costs.

The main difference between scenarios C and D lies on the number of jobs preserved. This is due to the lower degree of subsidization in scenario D, which induces less short time take up rate in the latter case. Regarding the fiscal balance, the deterioration in scenario D is also substantial. The rise in fiscal costs is accounted for by wage subsidies, unemployment benefits and also by the rise in social security contributions paid by the State. In comparison to the other two short-time work scenarios the rise in fiscal costs is half way. On the other hand, fiscal revenue is lower because the number of jobs preserved is lower than in scenario C, and the number of hours worked in the jobs preserved is lower than in scenario B. These two factors generate lower social security contributions on behalf of firms. Concerning welfare, there are no significant differences between scenarios C and D: individuals are willing to pay 174 to transition to scenario C and 184 to transition to scenario D.

To summarize, considering welfare changes and fiscal deterioration, scenario B seems to be the least harmful. It is true that more workers get unemployment benefits and that the State needs to satisfy their social security contributions, but the lower amount of wage subsidies more than compensates and fiscal revenue does not fall comparatively so much because average hours worked are relatively high. However, if the aim is to maximize the number of jobs preserved and minimize unemployment, scenario C, which is a good approximation of the scenario implemented in the first year of the pandemic, would be preferable. The problem with this scenario, apart from the deadweight costs effects already referred to, is sustainability from a fiscal point of view. This may be the reason why the Spanish government has decided to cut down the degree of subsidization as the economic situation has improved in 2021. The main effect of this downsizing is the reduction in the amount of temporary layoffs. STW take up rate is also a bit lower. This implies less fiscal revenue because the level of employment is lower, but also lower fiscal costs.

To study the distributional consequences of the COVID-19 crisis according to these scenarios we finish our evaluation by providing additional information on the average increase/decrease in annual income with respect to the baseline, before the COVID-19 crisis started. We perform this exercise for every worker in the sample and group them according to their employment status at the beginning of the transition (permanent, temporary or unemployed worker).

Table 6 shows that more than 50% of the workers are hit negatively by the crisis in terms of average income. Very few workers are better off, 8% and 6% in scenarios A and B, respectively, and less than 3% in scenarios C and D, the rest of the sample being unaffected. This might be surprising but it is, in fact, the result of the generous work sharing strategy in scenarios C and D. For the winners, the average increase in annual income is the greatest in scenario B (817 euros) because those that have a job tend to work longer hours. For the losers, the average decrease in annual income is substantial, especially in scenario A, where no STW scheme is available.

According to their employment status at the beginning of the transition, the unemployed experience the strongest distributional changes across all the scenarios studied. In scenario A, almost three quarters of the unemployed suffer a loss of income of 2788 euros on average. Permanent and temporary workers also suffer a substantial decrease in average income, but the proportion affected is not that large, 43.6% and 63.8%, respectively.

In scenario B, the winners are concentrated among temporary workers and the unemployed with similar proportions, 9.0% and 8.0% respectively. Among the winners, temporary workers experience the highest increase in income due to their better prospects in terms of preserving a temporary job and promoting to a permanent one compared to other scenarios. On the contrary, in the heavily subsidized STW scenarios (C and D) the unemployed are the ones who improve more in terms of the proportion of workers and also in terms of the average increase in annual income. This is due to the higher probability of getting a job (although on short-time) and of, subsequently, promoting to a permanent job where, on average, income is higher than on unemployment. Among the losers, the unemployed are also the ones who lose more in both respects. The unlucky ones, those that do not find a job, have less chances of getting one because of the huge labour hoarding induced by this generous STW scheme compared to the baseline situation.

Table 6: **Winners and losers**

	all		Permanent		Temporary		Unemployed	
Scenario A	%	Mean	%	Mean	%	Mean	%	Mean
↑ income	8.0	679	8.8	402	7.9	1113	6.4	918
↓ income	55.0	2563	43.6	2418	63.8	2570	73.0	2788
Scenario B								
↑ income	6.0	817	3.7	454	9.0	1083	8.0	830
↓ income	54.9	2256	46.5	2068	59.2	2283	71.5	2555
Scenario C								
↑ income	2.4	331	1.2	306	2.6	274	5.7	382
↓ income	62.6	2084	56.3	1867	65.8	2054	75.3	2563
Scenario D								
↑ income	2.7	335	1.6	335	2.8	270	5.4	383
↓ income	57.2	2279	50.2	2083	61.8	2268	69.3	2679

The columns with the percentage change sign indicate the percentage change of workers experiencing the change indicated with the arrows on the left with respect to the baseline. The numbers below "Mean" indicate the average increase/decrease in income (in euros).

5 Conclusion

In this paper, we have studied the type of furlough schemes that have been implemented in Spain to prevent jobs and labor incomes from falling too much during to COVID-19 crisis. These policies have typically involved some degree of subsidization of payroll taxes for firms, and also subsidies to workers (paid from the Unemployment Benefit System) so that their wages did not fall proportionally with the fall in hours. The objective has been twofold. First, we have shown the steady-state effects of the COVID-19 crisis during the first year of the pandemic on labor market outcomes. We have simulated different scenarios depending on the type of short-time work scheme used to illustrate their differences. And second, we have performed a transition exercise to evaluate the changes in welfare, the costs of these policies and the distributional effects.

The steady-state results have shown that the COVID-19 crisis would have generated a 42% unemployment rate in the absence of STW schemes. Thanks to the labor market policies introduced in March 2020, in particular to the possibility of putting workers on short-time and/or furloughs, coupled with generous subsidies on payroll taxes, unemployment and job destruction rates have only increased moderately. These heavily subsidized STW schemes have provided incentives to preserve workers on payroll working very few hours (or even zero hours) that would not have been employed in the benchmark situation, generating deadweight costs and inefficiencies.

According to our analysis, a scenario with a moderate degree of subsidization of payroll taxes, and where the subsidy is independent of the reduction in hours worked, would have been better from a welfare point of view than the one introduced during the COVID-19 crisis. Also from a fiscal point of view this scenario, which by the way, is similar to the STW scheme introduced in the "Great Recession", would have generated a lower increase in the fiscal deficit. However, the unemployment rate would have been higher.

Regarding the distributional consequences, in all the scenarios studied more than 50% of the workers are hit negatively by the crisis in terms of average income and very few workers improve: less than 3% in the scenarios which heavily subsidizes STW as a result of this generous work sharing strategy. The category that experiences the strongest distributional changes is that of the unemployed. In the heavily subsidized STW scenarios the unemployed are the ones who improve more in terms of the proportion of workers and also in terms of the average increase in annual income. But, among the losers, they are also the ones who lose more in both respects.

In the light of this analysis, one may be wondering why the Spanish government decided to implement a STW scheme considerably more generous than the one implemented in the midst of the "Great Recession", which according to our analysis is less harmful from a fiscal and a welfare point of view. It is very likely that the government has given priority to preserving jobs instead of income to prevent the unemployment rate from escalating to frightening figures, which could have generated political instability. Or it may be the case that the government has received pressures from social actors, such us unions or business associations, or even from institutional organizations. In any case, the particular reasons behind this choice are out of the scope of this paper because that kind of analysis would require a political economic model.

Be that as it may, keeping the unemployment rate under control in the context of a generous STW scheme is just an illusion. The unemployment rate is not really a good indicator of the severity of the crisis. It does not include the 2.9 million workers officially on furlough/STW schemes and those that transitioned to out of the labor force because were unable to find a job in midst of the crisis. Maintaining a doped economy for a long time is also a problem for fiscal sustainability. This is probably why, as the pandemic situation has recently improved, the Spanish government has decided to progressively cut down the degree of subsidization of payroll taxes on these schemes and has introduced incentives for firms that recall their workers. This is probably the right direction once the economy shows signs of recovery.

We think the main lesson from this analysis is that, in the face of a crisis like the one we have encountered this year, STW schemes coupled with moderate subsidies on payroll taxes may be a suitable instrument to cushion the impact of unforseen transitory demand shocks, as long as they do not require occupational or sectoral job reallocation.

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