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Abstract

We investigate the impact on work absence of a massive reduction in paid sick leave benefits. We exploit a policy change that only affected public sector workers in Spain and compare changes in the number and length of spells they take relative to unaffected private sector workers. Our results highlight a large drop in frequency mostly offset by increases in duration. Overall, the policy did reduce the number of days lost to sick leave. For some however, return to work was premature as we document very large increases in both the proportion of relapses and, especially in the number of working accidents. The displacement towards this latter (unaffected) benefit cancels out almost two-fifths of the estimated gains in terms of days lost to absences from cutting sick leave generosity.

JEL-Codes: I120, I130, I180, J220, J280, J320.

Keywords: sickness insurance, paid sick leave, absenteeism, presenteeism, relapses, contagious diseases, benefit displacement, working accidents, Spain.

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1 - Introduction

How much does the generosity of sickness insurance (SI) affect health related work absences? This is a question almost as old as organized labor with the earliest evidence of sick leave rights uncovered among workmen who built the Egyptian royal tombs over 2,500 years ago (Austin, 2015). The potential distortionary impact on worker behavior of such entitlements has recently regained accrued interest among economists and policy makers. Many European states have cut back on previously high SI provision in response to the financial crisis while local US lawmakers have been expanding minimal SI coverage rights following failure to act at the federal level (Pichler and Ziebarth, 2020). The ongoing Covid-19 pandemic crisis has brought critical urgency to our need to understand how to design optimal benefits which simultaneously guarantee an individual's right to go on sick leave while still incentivizing return to work as early as possible without putting own and others' health at risk[1]. We study these issues by investigating the impact on work absences of Spanish public sector workers from a large reduction in the generosity of their sick leave benefits – much lower replacement rates for shorter spells – that did not affect employees from the private sector.

Theoretically – considering moral hazard issues that arise when asymmetric information is present in insurance markets – the predicted first order effect is simple: the more income one has to lose from taking sick leave, the less one will make use of it. In practice, however, obtaining credible causal estimate of the elasticity of benefit generosity on worker's behavioral adjustment is not straight forward for several reasons. For instance, the presence of adverse selection will result in an upward bias in the estimates of the moral hazard effect as individuals with preferences for more absences will tend to self-select into jobs with more generous SI provision. This latter issue is the more worrisome one in the context of the policy we study as our treated group of workers may have self-selected into the public sector specifically for the better sick leave entitlements it offers. There is indeed evidence of this in Spain as on average 30 percent more days were lost to illness per worker in the public compared to the private sector pre-policy[2]. This level difference should however not be an

[1] Employee paid sick leave was introduced in March 2020 at the federal level in the US as a response to the Covid-19 pandemic among other benefit legislation passed under the Families First Coronavirus Response Act (FFCRA). The American Rescue Plan Act (ARP), introduced by the incoming Biden administration in March 2021, most paid sick leave eligibility for workers from the FFCRA, with some restrictions, until 30 September 2021. These have now expired and there are no longer any federal guarantees in place to insure individuals against income losses resulting from work absences due to illness in the US.

[2] In the two and a half years prior to the policy we study was introduced, an average of 1.31 days per 1,000 worker each quarter were lost due to sick leave compared to 1.31 days in the private sector. Interestingly, this difference is driven by much higher incidence rates (31%) among public sector employees while mean duration of each started spell is somewhat higher (+10%) for private sector employees.

issue for causal identification if it remains relatively constant over time pre-reform, something we will carefully check empirically.

A number of previous studies have attempted to circumvent these issues by using sick leave reforms to obtain causal elasticity estimates of SI generosity on absences. The general consensus suggests a strong positive relationship which would point to an empirical confirmation of the theoretical predictions. However, the preciseness of the estimates produced and the credibility of the method of identification used have suffered from problems linked to: (i) the implementation of the policies used as quasi experiments; and/or (ii) the availability of adequate data to study them. One thorny issue is that the impact on sick leave has been explored in contexts when all workers are affected by a reform, either by design or because of data availability[3]. In such a context, no control group exists and, thus, there is a risk that time specific shocks may bias causal effect estimates if one compares before vs after work absence behavior. There is also the tendency for sick leave policy changes to be implemented by combining modifications in both generosity and monitoring simultaneously[4]. In this case, it is difficult to know which channel is behind a change in absence behavior as monitoring will affect the level of asymmetric information this insurance market suffers from, making it almost impossible to obtain clean elasticity estimates of SI generosity. Another frequent limitation has been the reliance on self-reported absence information in this literature. Many papers have used survey questions which ask respondents how many days of work they have missed due to illness in the past year, or in the reference week, to measure sick leave behavior. For one, this raises the specter of the usual measurement error issues with self-reported recall data. For another, and more importantly, it prevents researchers from distinguishing between policy important extensive (incidence of absences) and intensive (length of absences) margin effects analysis of a sick leave reform (e.g. 20 sick days in a year could come from a single spell, two 10 day spells, and up to 20 single day spells)[5]. Finally, no paper has estimated the causal impact of reducing SI generosity on absences, while also properly considering two important externalities that may reduce the efficiency of such policies: (i) that these returns to work may occur 'too soon' with consequences for the health

[3] Such as, for example, the case for the Swedish sick leave reforms of the 1980s and 1990s studied by Johansson and Palme (2005).

[4] Both the generosity and monitoring intensity of sick leave entitlements for Italian public sector workers were affected simultaneously in several reforms evaluated by both Paolo et al. (2014) and D'Amuri (2017).

[5] The in-depth investigations of the impact of changes in sick leave generosity in Germany carried out by Ziebarth (2013) and Ziebarth and Karlssonn (2010, 2014) must rely on yearly self-reported sickness absence data where incidence and duration cannot be clearly disentangled.

of affected individuals (ii) that certain employees increase the use of unaffected benefits to remain absent from work when unwell.

The policy change we study here and the data we use do not suffer from many of these recurrent problems. As such, we believe that we are able to provide very credible and clean causal estimates of a change in SI generosity on worker's absence behavior. In August 2012, the Spanish government imposed a radical cut on the replacement rate of the benefits public sector workers would receive during sickness absences over time: from providing 100% of regular wage for up to six months to be replaced with 50% in first 3 days, 75% days 4-20, and 100% after that[6]. Crucially, this reform did not affect private sector workers, consequently allowing us to use this as a comparison group in a difference-in-difference setting[7]. All workers in our context are subject to the same very tight monitoring system throughout this period making it possible to estimate a relatively pure income effect (that is, the response to a change in the amount of benefits received free of change of probability of detection).

We make use of social security register data on employer declared sick leave spells (number and length) with exact diagnostic for all individuals working in Spain between 2010 and 2014. Unfortunately, the administrative data we obtained is only available at the spell – but not the individual – level and it does not contain an indicator for the employee being a private or public sector worker. To solve this latter problem, we turn to worker's occupational sector information observed in each spell to assign a probability of treatment and do this discretely (very public sector or not) and continuously (percentage public in each sector). From official statistics, we also obtain the number of workers at the occupational sector level each quarter to generate a denominator, i.e. how many individuals are eligible for sick leave among the treated and control groups throughout this period. The lack of individual identifier in the sick leave data does however mean that we cannot use it directly to control for potential labor force composition changes around the policy period which could impact the propensity

[6] Low replacement rates that increase as a spell becomes longer are the most common way sick leave benefits are designed. Interestingly, this is almost diametrically opposed to how optimal unemployment insurance should be theoretically designed to maximize search effort (Shavell and Weiss, 1979). In the most extreme cases the first day(s) may not be compensated at all – as for private sector workers in Spain – and studies on the impact of such 'waiting days' on sickness absences by Petterson-Lidbom and Thoursie (2013) and Pollak (2017) which have shown that they may actually increase absenteeism. This is linked to the same perverse disincentive effects from re-starting the benefit clock at a lower replacement rate if one returns to work, something employees will also face in the context of the policy reform we study.

[7] The fact that there is essentially only one treated and one control group in our setting does raise the issue of not being able to, as highlighted by Donald and Lang (2007), properly control for unobserved heterogeneous group shock when obtaining difference-in-difference estimates. We will address this concern by implementing the wild bootstrap method recently developed by MacKinnon and Webb (2018) and Roodman et al. (2019) which is especially suited to obtaining valid standard errors in settings with few (treated) clusters such as the one we investigate.

of employees to become ill because of changing characteristics in the treatment or control group (e.g. older, less educated, working more hours, etc.). To address this potential concern, we make use of a large longitudinal dataset with detailed worker and job characteristics – the Labor Force Survey – to test for any significant differences between public and private sector employees pre- and post-policy. This exercise rejects the idea that compositional changes between groups around the period of the reform are driving our findings.

We then estimate how the reform affected both the sick leave incidence rate (extensive margin) and the mean spell duration (intensive margin). The main gauge of the overall policy effect on absence behavior is eventually obtained by the interaction of these two margins to give us the days lost to sick leave per worker each quarter. To get a more complete picture of its efficiency, we also consider potential externalities generated if return to work were premature as measured by the probability of treated individuals falling ill again, or to suffer more (health related) working accidents. To validate our difference-in-difference approach we first visually and statistically confirm that sickness absence rates of workers from different sectors and the length of these spells were following very similar trends before the policy change. We then document a marked drop in the number of spells taken by public sector workers, a reduction of 29% in sick leave rate by our estimates. The picture is almost perfectly reversed for the average length of spells with a visually sharp increase of 28% after the reform, according to our estimates. The latter result is perhaps not surprising as the change in the level of generosity was most severe for shorter spells, thus imposing large costs from returning to work after passing the 21 days threshold. We investigate this by checking where in the spell length distribution spectrum, the intensive margin effects come from, and confirm that it only increases for those longer than three weeks. In terms of total number of days lost, we still find that the reform had a substantial impact in reducing absenteeism that we estimate to be about 10 percent (from a baseline average of 1.3 days lost per public sector worker each quarter). We further study the potential for heterogeneity in policy response with respect to the type of illness causing the work absence. We do this by estimating the same difference-in-difference models separately for the six most common medical conditions declared to social security. The results reveal a similar pattern for all illness categories: large significant reductions – in the range of 20-40% – in the number of spells mirrored by increases in average duration of relatively similar magnitudes. In terms of reducing numbers of days lost to sick leave, the policy effects are revealed to be strongest for three disease types: respiratory (-26%), infectious (-22%), and muscle or joint (-18%) illness categories.

Finally, we investigate whether the incentives to return to work provided by the policy may have led some to do so prematurely with potential negative consequences to their health and that of others. This is an important issue to consider since it might change the assessed effectiveness of the SI benefit cut by increasing its medium to long run costs in various dimensions. We explore this in two ways. First, we look at the effect the reform may have had on the proportion of sick leave spells due to relapses, i.e., being absent from work because of a disease diagnosed during a previous sick leave spell from which the individual had not completely recuperated. We find evidence of a significant increase in the proportion of relapses (+8%) after the policy change which is especially strong when looking solely at short spells (+30%) and for sick leave due to infectious diseases (+20%). This finding of an increased likelihood of falling ill at work again for an infectious disease not properly cured, is especially worrying for the externalities that these premature returns may have on others' health. Second, we check for a potential post policy change in absences due to work accidents of public sector employees, a benefit scheme unaffected by the reform. Here, we uncover a massive 56% increase in the number of days lost each quarter due to accidents at work which, even if this is from a low baseline of 0.086 days per worker, cancels out about two-fifths of the gains in sickness absences from the reform. The vast majority of accidents among public sector employees are due to muscular related issues ('back pain'), reinforcing the likelihood that much of this is the result of displacement from one benefit scheme to the other. Further evidence comes from the fact that muscular illnesses was the only disease category for which we observed a significant drop when looking at sick leave relapses. These findings generally point to important potential spillover effects of SI benefit cuts that may lead to workers returning too soon, and the costs that this may put on own and others' health in the medium run as well as on the Social Security system in the long run.

The rest of the paper is structured as follows. Section 2 gives background information about sick leave provision in Spain and explains the nature of the reform we study. Section 3 describes the administrative data and our methodological approach. Section 4 presents and interprets the main results. Section 5 examines compositional changes in the leave duration and the type of diseases under which such absences are classified. Section 6 explores the issue of potential policy spillovers if workers returned to work too soon. Section 7 concludes.

2 - Sick Leave and The Reform

2.1 - The sick leave program

The temporary sick leave program is an economic benefit with the objective of compensating the loss of income suffered by workers who are temporarily unable to work due to an illness or an accident. An individual suffering from an ordinary illness becomes eligible for sick leave benefits only if the individual is currently employed and he/she has contributed to the Social Security system for at least 180 days of the last 5 years before the onset of the sick leave condition. If the sick leave condition arises from an accident or a professional illness, the individual also needs to be employed but there is no minimum contributive period required. The sick leave benefit is received until the individual has recovered from his/her condition to a maximum of 365 days, with a potential extension of 180 extra days only if it is highly likely that the worker is going to recover during this additional time[8]. After this maximum period of one and a half years, the worker either goes back to work or is transferred to the permanent disability system[9]. This decision depends on how permanent his/her diseases in considered to be, from a medical point of view, and the extent to which it prevents the individual from returning to work.

To give some perspective on the economic importance of sick leave programs, if we focus attention on the evolution of expenditures (as a percentage of GDP) in paid sick leave in selected OECD countries, we can see that these programs were extremely important in Northern European countries at the beginning of the 1990s. For example, The Netherlands was spending 2% of its GDP on these programs in 1990 and Sweden reached 2.3% of its GDP to finance sick leave programs in the same year (OECD database). However, from the early 1990s, there was a strong reduction in sick leave benefits to the point that, in the mid- and late 2000s, Spain had a similar level of expenditure in paid sick leave as countries like Sweden and The Netherlands, spending around 1% of the GDP. This number is above the OECD average, which stands at 0.4% in 2015 and is also well above the expenditure in countries like France and Germany, which spend less than 0.5% of its GDP on sick leave (data extracted from the OECD database).

Our investigation of the impact of reforms in the SI system in the Spanish context will thus have informative policy implications not only for other European countries with similarly

[8] In the case of observation periods for professional illness, the maximum time is set at 6 months with a potential extension of 6 additional months if needed for observation and diagnosis of the disease.

[9] The requirements to enter the permanent disability system are very stringent in Spain with the process including individuals having to show medical proofs of their permanent inability to work to a medical jury who then decides on the outcome. As a consequence, the inflow into the Spanish permanent disability system has been low and stable since the 1990's.

high levels of expenditure, but also for the US where federal paid sick leave rights have recently been rapidly evolving.

2.2 The 2012 sick leave policy reform

Until 2012, public sector employees were subject to a sick leave policy that had been in place for over a decade (Royal Decree 3/2000 of 23rd of June 2000). Under this regime, the individual received a temporary sick leave benefit with a replacement rate equal to 100% of the wage that was applicable in the month before becoming temporarily sick. The 100% rule was in place for the complete duration of the sickness leave and independently of the cause of the sickness—be it a common illness or a working accident.

The rules governing sick leave benefits for private sector employees had been unchanged for almost two decades (in the Ley General de Seguridad Social of 1994) and they vary according to the duration and the source of the sick leave episode. If the sick leave spell is caused by a common illness during the first 3 days, private sector employees do not receive any amount as sick leave benefits, neither from the Social Security administration nor from the employer. From the 4th to the 20th day they receive 60% of the previous month's wage while from day 21 onwards they get 75%[10]. From the 4th to the 15th day these amounts are paid by the employer whereas from day 16 onwards the Social Security administration is in charge of the payment. However, if the sick leave episode is caused by a working accident or a professional illness, the benefit is 75% of previous wages from the first until the last day and is paid by the mutual insurance company.

Spain was one of the most economically affected countries by the ramifications of 2008 financial crisis and, as a result, the government was looking for ways to limit public expenditures. This led to the legal introduction, on the 13th of July 2012, of a reform package with the explicit aim of reducing public sector wage-related costs while increasing the productivity of public employment. The central and most radical change was the immediate reduction in the generosity of sick leave benefits received by public workers, with the explicit

[10] In Spain, most workers and employers are included in the scope of a collective bargaining agreement. The rules of these agreements are compulsory for them. In some of the collective bargaining agreements affecting private sector workers there are rules that increase the amounts of sick leave benefits, establishing that the employer must complement the Social Security benefits up to certain amounts and for a given period of time. It is not unusual to find collective agreements establishing complements of sick leave benefits up to 100% of worker's wages for up to one year. In any case, there are huge differences among different collective agreements and summarizing them is out of the scope of this paper. Furthermore, those rules are relatively constant over time (as it is very difficult to change the contents of the collective agreements) and are not changing at the same time than the public sector reform studied in this paper.

objective of reducing absenteeism[11]. Public and private sector workers already had differential rules governing sick leave benefits, as explained above, and the change in law implemented in 2012 affected only public sector workers[12]. It is important to note that the reform in the sick leave program for public workers was only implemented for individuals suffering from a common illness. If the sick leave episode emanated from a working accident (or professional illness), the amount received was left unchanged at 100% of previous wages. Also, it is crucial to note that there was no change in the level of monitoring of sick leave absences throughout this period which was similarly very stringent for both private and public sector workers. It was the result of reforms in the mid-2000s, which made Spain an example cited by the OECD as one of the countries with the most elaborate monitoring system in the world[13]. In practice this means that workers that require a sickness absence can only go to their government assigned general practitioner – usually based on nearest distance to place of residence – who will diagnose and grant him an absence for a pre-established period which depends on the type and severity of the diseases. When this has expired, workers who have not returned to work yet and wants to take a longer sick leave period have to visit the same doctor who will either extend this period (if the worker is assessed as not fully recovered) or issue a reincorporation document that ends the sickness absence period that requires the worker to go back to his job.

The reform made the replacement rate of benefits that public workers received contingent on the number of days of sick leave, following a similar structure as that of private sector employees but with different amounts of sick leave benefits. Thus, after the reform, public sector employees received 50% of previous wages during the first three days of the sick leave episode, 75% from the 4th until the 20th day and 100% from the 21st day onwards[14].

[11] Some of the other changes introduced included the incompatibility of the receipt of several compensatory benefits (for some previous high-level public workers), the abolishment of the extra-pay received in December of each year, and a reduction in the number of hours allocated for personal permission. We do not expect any of these other marginal changes to public sector worker statutory rights to have any substantial effect on sick leave absences.

[12] Public sector employees include everybody that works in the public administration, even if the person does not have a contract as a public sector employee.

[13] In the 2010 OECD report on *Sickness, Disability, and Work*, it states that "Several countries … have increased their efforts to reduce sickness absence by making drastic modifications in their sickness *monitoring* policy …in Spain in 2004 when a new department at the National Institute of Social Security was created with the sole purpose of better monitoring and reducing absence rates. A new monitoring tool with daily updated complete individual sickness absence histories allows online selection of cases for reviews on the basis of longer-than-expected recovery phases. In addition, in 2005 a general absence control was put in place when the duration of absence was greater than six months." (pp 83-84)

[14] The law gives room for administrative units in the public sector system to consider exceptional cases than can be assigned a 100% rate of the wage. However, these cases must be duly justified and are always related to hospitalizations or surgical interventions. Furthermore, some public sector administrative units include benefits for dependent children on top of these amounts (like members of the judiciary system).

Interestingly, the sick leave incident was due to a working accident or professional illness the amount was left unchanged at 100% independently of the duration of the sick leave, something we exploit later to check for potential absence behavior cross-benefit displacement. The pre- and post-reform features are summarized in Table 1 for public and private sector employees for cases in which the sick leave arises from a common illness.

Table 1. Sick Leave Benefit Rights – Before/After 2012 Reform – Public/Private Sectors.

Duration of Sick Leave Spell	Public Sector		Private Sector
	Before the Reform	After the Reform	Throughout Period
0-3 days	100%	50%	0%
4-20 days	100%	75%	60%
21 days onwards	100%	100%	75%

Notes: Percentages indicate replacement rates relative to wage in last month prior to sick leave spell start.

The reform that we study in this paper was introduced in July 2012 and affected only the sick leave spells of public sector workers started after this date. It has to be noted that in February 2012 the Spanish government had introduced a more general labor market reform (Real Decreto Ley 3/2012) that affected all employees based in Spain. Summarizing, the February labor market reform included two main elements: the first one is the decentralization of the collective bargaining process at the firm level (instead of at the regional or sector level), in an attempt to promote internal flexibility. The second one is a reduction of the monetary compensation for an unfair dismissal (as ruled by a judge); the aim of this second change was to promote the amount of permanent contracts and to reduce the use of temporary contracts in the Spanish labour market. Some of the evidence on the impacts of this reform shows a small increase in the use of permanent contracts (instead of temporary contracts) but the effect is very small and only materializing in the medium/long-term (OECD, 2013). These results are consistent with the fact that, even with the reduction in severance payments for unfair dismissals Spain still has one of the highest severance costs in a European context (OECD, 2013). At the same time, changes in the collective bargaining process take time to materialize. Those arguments, together with the fact that the February reform affected all workers in Spain, provide reliability that in our analysis we are able to capture the public sector reform independently from the general labor market reform.

3 - Data and Methodology

3.1 Data and descriptive statistics

In order to study the impact of the policy, we obtained restricted access administrative data from the Spanish Social Security for the years 2010 to 2014. It is spell level data that contains information on all sickness absence occurrences reported for any (private or public sector) employee in the country during these five years. For each sickness absence spell we have information on: the month and year of birth, gender, exact date when the sick leave started and of the recovery (allowing us to calculate the duration of each spell); the province and the economic activity of the job (according to the CNAE classification at the 5 digit specification); and the type of diseases that caused the sickness spell (according to the CIE-10 classification which are categorized into 17 main disease types). The data was provided without an individual identifier – that would have enabled us to match workers across spells – but does contain an indicator if any new spell is classified as a 'relapse' (which happens if the current sick leave is for the same previously diagnosed illness that had already required an absence from work and has recurred within six months).

We focus our analysis on prime working age males - i.e. men aged 25-60 with typically high labor market participation rates – for whom we observe 6,837,774 unique sickness absence spells between 2010 until 2014.[15] Table A1 of the Appendix provides information on the number of spells for each of the 21 economic activities as well as the percentage of workers in each activity. As we do not have information in the Social Security data on whether the individual works in the private or public sector, we use the Spanish Labor Force Survey to calculate the percentage of workers that have declared to be public sector workers within each of the 21 activity groups. In the last column of Table A1 we can see that only 0.77% of workers in the manufacturing industry are public sector workers. Conversely, over

[15] Although the impact of the policy on women is of high interest for our analysis, we focus on men for two reasons not to include them. First, there are strong differences in labor force participation and employment rates between men and women in Spain. Women have much lower participation rates than men, more than 15 percentage points lower (52.6% for women at the beginning of our sample period in 2010 and 68.3 for men) and their employment history is much more interrupted because, until recently, paternity leave was very limited. Therefore, sickness absences in the case of women include also pregnancy-related problems, which entail a totally different set of incentives. Second, the policy change that we study includes also some small elements that are only affecting women. For example, before the reform, when women came back from maternity leave during the first year after giving birth they could work 80% of the time while earning 100% of their wage. The reform changes this element of the system and establishes that during this first year women that work 80% of the time would earn 80% of the salary. This change is only affecting mothers and not fathers. Therefore, this additional policy change may also have an impact on sickness absence behavior and, for these two reasons, we have decided to focus on prime age men.

98% of workers in the public administration and defense category are classified as public sector workers.

Based on that percentage, we construct two different treatment indicators used for the rest of our statistical analysis. First, we classify individuals as public sector workers (treated group) if they belong to an activity group in which more than 95% of the workers are public employees. They are categorized as private sector workers (control) if they work in an activity in which less than 5% of the workers are public employees. This treatment dummy variable that we label "highly public" takes a value of 1 for only one group of workers: those in Public Administration and Defense. In this definition, we exclude the six categories for which the percentage of public sector workers ranges from 5% to 95% (water supply, sanitation, waste management & decontamination; transport & storage; professional, scientific & technical activities; education; health & social services; artistic, recreational and entertainment activities). The remaining economic activity sectors are labelled as "very private" and its workers are assigned 0 in the treatment dummy variable[16]. Additionally, we create an alternative treatment variable which is continuous and simply takes the value of the percentage of public sector workers (the last column in Table A1) for each spell. This second definition is less restrictive as it does not exclude any category and thus lets us check for a relative policy effect in all economic activity sector which we will always compare to the dummy treatment approach[17].

Table A2 of the Appendix provides some basic descriptive statistics for the proportion of public sector workers when only using the treatment dummy variable. It shows that employees form the "very public" sector are on average older and take about 11.6% of sick

[16] One could consider including individuals who work in Education (70.5% public) and Health and Social Services (59.6% public) in our 'very' public sector definitions. We are not doing so as this would mis-categorize respectively 30 and 40% of private sector workers in these sectors, too large for statistical comfort. Also, our intensity of treatment approach will more continuously account for the fact that a large proportion of workers in these sectors are impacted to the policy thus revealing if including them is crucial to our findings. Still, we produced results including Education and Health in very public for all three main outcome and found that these were between 20 and 30 percent smaller than when not included these, which is very much in line with including a larger proportion of untreated private sector workers in the treatment group.

[17] A potential worry here that the reform changed the incentives of workers moving from the public to the private sector. To address this, first, it is important to recall that between 2010 and 2014 the unemployment rate in Spain ranged from a minimum of 20% to a maximum of 27%. Thus, finding a new job in these conditions was not easy. Second, most of the jobs in the public sector in Spain are permanent until retirement and very few people lose or leave their jobs in the public sector. Finally, we can look at Figure A1.1 which plots the total number of workers per quarter in the public and private sectors from the first quarter of 2010 to the first quarter of 2015, we can see that there is a continuous and sustained drop for both sectors during our sample period as this was a period of rising unemployment rates in the context of an ongoing economic crisis. However, there is no differential trend after the introduction of the policy between public and private sector workers which, again, suggests no sorting across these two sectors as a response to the sickness absence reform.

leave spells observed. We also note the differences in the mean duration of sick leave spell between public and private sector workers (32.2 days for public sector workers versus 29.5 days for private sector workers) as well as the differences in the distribution of the duration of the spells. The table then reports the top six disease categories for sick leave spells – representing over 80% of the total – which are the same and, mostly, similarly distributed in the private and public sector. Finally, it reveals that about five percent of spells started are due to a relapse within six months of a worker needed to take time off work because of the same disease. The relapse rate is slightly higher in the public (5.1%) than in the private (4.6%) sector.

3.2 Methodology: Standard and Continuous DiD

We are interested in the impact the policy may have on principally two margins of sick leave behavior; the "extensive" margin, or the probability to take sick leave, and the "intensive" margin, or the average length of sick leave spell started. As the cost of beginning a work absence spell increases, we expect to find a reduction in the incidence of work absences. However, the reform increases the cost of returning to work after 20 days since public sector workers are then at a 100% replacement rate but would have to restart at 50% if coming back too soon causes relapse into a new sick leave spell. Therefore, individuals will have incentives to extend longer absence spell to make sure that they are fully recovered and the total effect of the policy on days lost to sick leave is thus ambiguous. We will therefore consider in turn various effects which the reform may have had on sick leave absence behavior. Our dependent variable, Outcome, identifies the sickness spell *s* of an individual working in economic sector *k* in quarter *t* when estimating the following difference-in-difference (DiD) specification:

$$Outcome_{skt} = \alpha + \beta Pub_{sk} * PolicyOn_{st} + \gamma YearQuarter_{st} + \delta EconSector_{sk} + \varepsilon_{skt} \quad (1)$$

Pub in equation (1) is one of the two treatment variables that we have described above for public sector workers (i.e. a treatment dummy for "highly public" activity sector employees or the percentage of public workers in each activity) and *PolicyOn* is an indicator variable that takes a value of 1 from the third quarter of 2012 and onwards, and ε is the error term. Our preferred specification of the model includes *YearQuarter* – 20 unique values for year and

quarter of spell start – and *EconSector* – 21 unique values for the economic sector category of the job – fixed effects. These should help capture most of the across period and across sector variations that might affect sick leave behavior which are not due to the policy change. ε_{skt} is the error term.

An important econometric issue we must carefully address is how to obtain reliable standard errors for our estimates in this DiD setting. We start by clustering all standard errors produced by equation (1) at the economic sector level to account for potential sectoral shocks that might impact sick leave behavior. This may however not be enough when we only have one treatment and one control group – the case when using the very public dummy approach – which can make it difficult to properly control for unobserved group shocks (see for example Donald and Lang, 2007). We thus also report wild bootstrap standard error inferences when presenting the policy impact estimates on the main outcomes of interest since this method is especially well suited for settings where (very) few clusters are present (see MacKinnon and Webb (2018) for the theory and Roodman et al. (2019) for its applications).

The three main dependent variables for which we estimate β, the DiD policy coefficient of interest, are: (i) number of sick leave spell started; (ii) mean duration (total duration for spells starting in that quarter, including days after the quarter for continuing spells); and (iii) mean number days lost to sick leave each quarter[18]. The extensive margin impact is (i) but it should account for how many workers can potentially take sick leave, something we come back to in detail below. The intensive margin impact is (ii) although here one may worry that is also capture compositional changes in the kind of workers who start spells post-reform (e.g. in worse health). We explore such selection effects carefully by looking at changes in duration thresholds and disease type spell composition in a dedicated section. Finally, to obtain an economically relevant estimate of the overall policy impact, we use (iii), the mean number of days that are lost to sick leave each quarter per worker. Otherwise, when extending our analysis to indirect policy effects – on how often spells were now due to health relapses and into potential displacement towards working accident absences – we also use the same basic DiD model specified in equation (1) with some extra explanation when needed.

Before estimating this model, we may want to think especially carefully about changes in the number of individuals potentially affected by treatment in the context of a protracted economic crisis in the period we study. As can be seen in Figure A1.1, there was a sustained

[18] The number of days lost per quarter includes days related to spells that started in previous quarters and excludes days of of absences from any subsequent quarters: i.e. it only includes the number of days lost within a given quarter.

decrease in the number of men employed in the quarters pre-reform which then plateaued. Reassuringly for our DiD approach, this downward trend is extremely similar in both the (very) public and private sectors[19]. This is important because, since paid sick leave can only be taken by employed individuals, a divergence across sectors would have made private employees poor controls for treated public employees. Still, in order for our model to properly take into account this change in the number of workers able to take sick leave over this period, we weight all regressions by the male labor force size of the economic activity sector an individual works in each quarter[20].

A final methodological issue we must address to validate the use of a DiD approach concerns potential compositional change in the worker pool of private and public sector workers around the policy introduction. The fact that change in number of workers in each sector is the same – what we have just shown – does not guarantee that their characteristics also evolve similarly, which is crucial since this could have (in)direct effects on sick leave behavior unrelated to the policy (e.g. more less educated older workers on overtime?). Given the lack of individual identifier in our administrative data, which in any case is limited to those taking sick leave, we turn to the Spanish Labor Force Survey that collects detailed individual and job information for a large sample of the population each quarter to investigate this issue. The simple exercise we propose to test for changes in worker composition generates estimates on a large number of characteristics from a simple DiD model akin to equation (1) where treated individuals are public sector workers, and the policy is switched on in the third quarter of 2012. The resulting coefficients, presented in Table A3 of the Appendix, are all small and statistically insignificant reassuring us that any policy impact we uncovered will not be driven by changes in worker characteristics[21].

4- Direct Policy Impact Estimates

[19] This is confirmed by running equation (1) with *log(number of workers)* as the dependent which yields a very small and non-significant estimate of β: coefficient of -.018 with standard error of .089. We can thus also crucially conclude from this that the policy did not appear to affect the probability of employment across sectors.

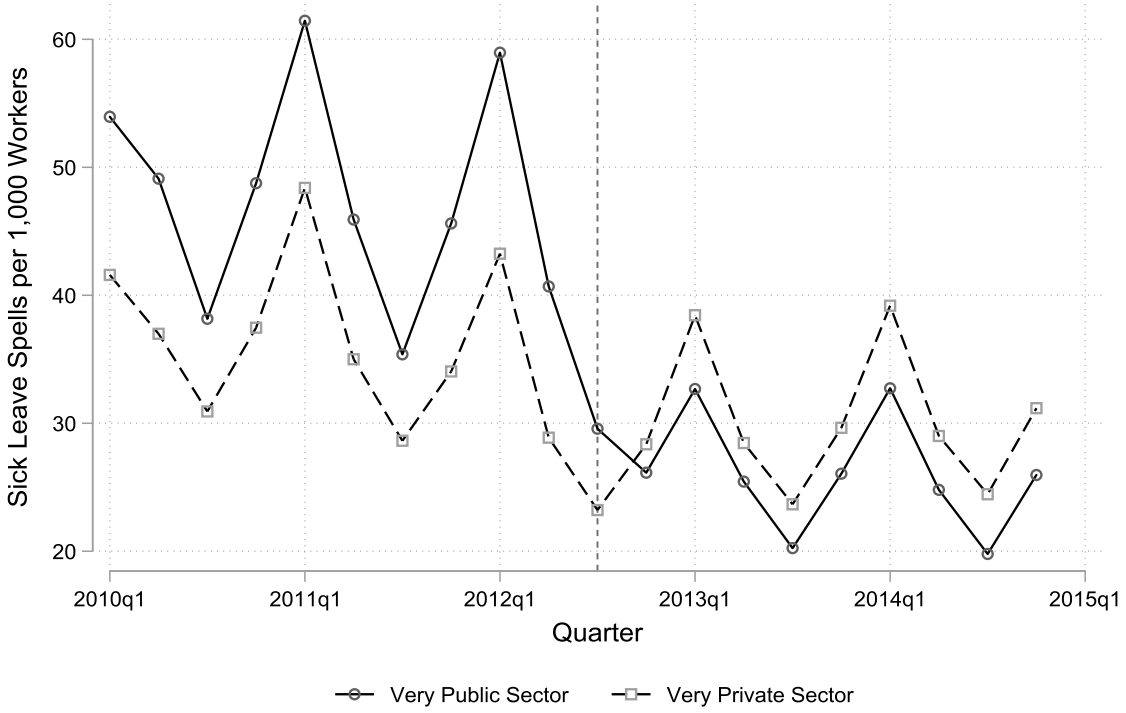
[20] Two things to note here about how this choice of weighted specification affects our findings. First, none of our regression results are different if we exclude these weights, confirming that our control and treatment groups are equally affected by changes in employment probability in this period. Second, we obtain exactly similar results throughout when collapsing the sick leave data at the activity sector-quarter level and matching it to male employment data to run the same model at the quarter-sector cell level. We use this collapsed version of the data to produce most of the graphs in the paper but present the result using the individual level data weighted by economic sector size each quarter.

[21] Table A3 also reports pre-policy means in worker and job characteristics in the private and public sector separately to further inform the interested reader on differences in type of individuals and employment that are most common in Spain around the time of the reform.

4.1 Extensive margin results: number of spells

Figure 1 plots the absence rate for men calculated by dividing the total number of sick leave spells started by the number of employed individuals in the public and private sector categories for each quarter[22].

Figure 1. Sick Leave Incidence: Number of Spells per 1,000 Workers.



Notes: Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector for the same period. The vertical dashed line indicates the quarter of policy introduction. Very public sector includes workers in an activity group in which more than 95% of the workers are public employees (treated group). Very private sector includes workers in an activity in which less than 5% of the workers are public employees (control group). See Table A1 for more details. Statistical estimates of parallel pre-trends confirm that these are similar in all quarters up to policy introduction.

The dashed line is for private sector men while the solid line is for public sector men. At first glance, we see a strong seasonal pattern of the absence rate during our sample period, with a higher absence rate in the winter months and a lower one in the summer months. We also see that before the reform, public sector men have higher absence rates and that there is a

[22] The underlying statistics for the number of workers in each sectors (denominator) and of sick leave spells taken (numerator) each quarter are presented respectively in Figures A1.1 and A1.2 of the Appendix. Note that we only include absences from work due to common illness in all our analysis of the direct policy impact, and not absences due to working accidents. As already mentioned, this is because the compensation received for the latter was not affected by the reform but we will closely study the possibility of an indirect policy effect of displacement from sick leave towards working accidents of absences from work in Section 6.2 of the paper.

decreasing trend for both groups over this period (probably because of the ongoing economic crisis). Importantly, the evolution of the absence rate is remarkably parallel across groups before the reform. In the third quarter of 2012, once the reform kicks in and benefits are cut for public sector workers, we observe a strong drop in the absence taken by these workers and not those from the private sector. This simple graphical evidence is suggestive of a strong impact of the reform.

Table 2. Extensive Margin Policy Impact: Changes in Sick Leave Frequency

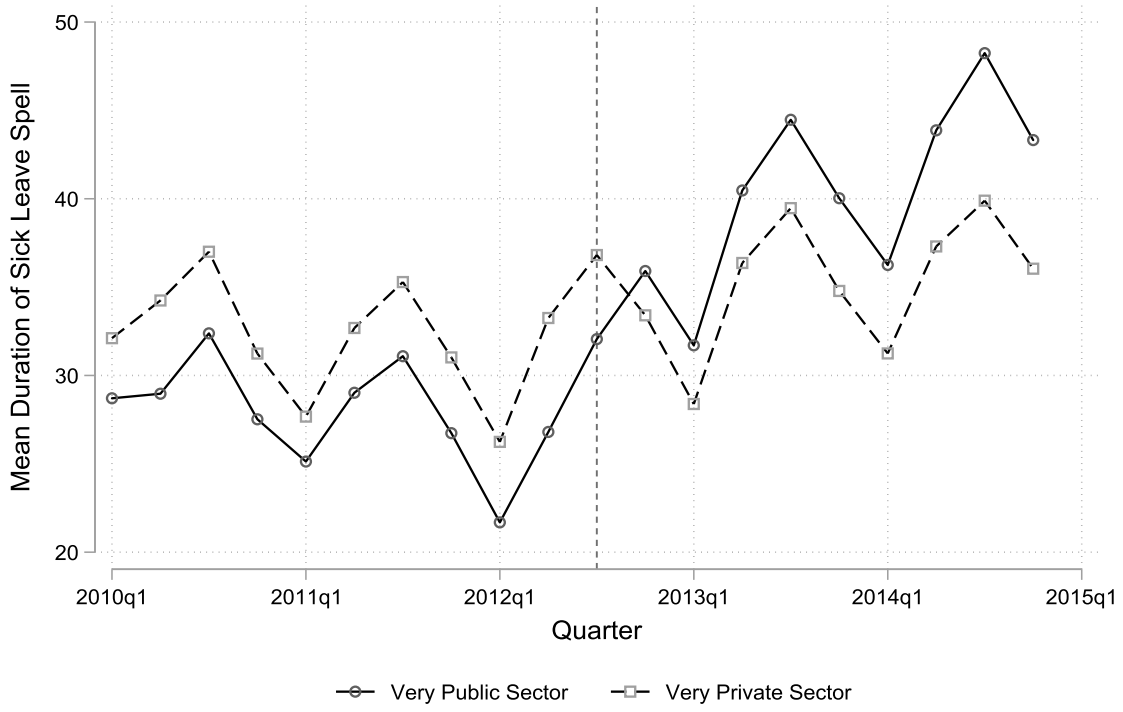
	Sick Leave Spells Started by 1,000 Workers			
	Spell Level		Sector Level	
	(1)	(2)	(3)	(4)
Standard DiD Estimates: Very public sector definition	-14.9*** (1.06)		-14.4*** (1.38)	
Continuous DiD Estimates: Proportion public sector definition		-15.6*** (1.19)		-13.4*** (1.52)
Wild bootstrap p-value	.000	.000	.000	.000
Wild bootstrap [confidence interval]	[-17.5, -12.6]	[-18.1, -13.1]	[-17.1, -11.7]	[-16.3, -10.3]
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Economic Sector Fixed Effects	Yes	Yes	Yes	Yes
Age Controls and Province FEs	Yes	Yes	No	No
Mean of Outcome	47.8	48.8	47.8	45.0
Size of Estimated Effect (%)	-31.3	-31.9	-30.1	-29.8
Observations	5,120,458	6,760,117	300	420

Notes: Columns (1) and (3) present standard differences-in-differences estimates where the treated belong to economic sectors where a large majority are public sector workers and the control group as sectors where a large majority of employees are private sector workers (i.e. in both cases they represent > 95% of employees). Columns (2) and (4) present continuous differences-in-differences estimates where the intensity of treatment in each sector is assigned relative to the proportion of public sector workers they employ before policy introduction. Table A1 of the appendix reports these proportions for all 21 economic sectors. In columns (1) and (2) we use the spell level data and in columns (3) and (4) the aggregated sector level data. When using the spell level data we assign to each spell the probability of observing a sick leave incident per sector-quarter. Data source is register data from the Spanish Social Security Administration, which includes the entire population of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector (ages 25-60). Robust standard errors clustered at the sector-quarter level in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Post-estimation wild bootstrap p-values, and 95% confidence intervals in square parenthesis, are also presented to account for the small number of treated clusters.

This is corroborated by the statistical results presented in Table 2 where we estimate equation (1) above using the two treatment variables defined in section 3.1 using either spell

level or economic sector level data[23]. Columns (1) and (3) report the estimates of the effect of the reform on the absence rate for public sector men using the "highly public" dummy variable and columns (2) and (4) the coefficients from the continuous intensity treatment approach. In all cases interaction term of the treatment variable and post-reform return large and statistically significant negative coefficients. Associated wild bootstrap standard errors clearly confirm this finding. Using our most conservative estimate, we find that 13.4 fewer spells were started per 1,000 public sector workers after policy introduction. As the mean sick leave rate for these employees before the reform was 45 spells started per 1,000 workers which implies that the policy reduced the probability of treated workers starting a spell by almost 30%, a large extensive margin effect.

Figure 2. Sick Leave Duration: Mean Length of Spells in Days.



Source: Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014. The vertical dashed line indicates the quarter of policy introduction. Very public sector includes workers in an activity group in which more than 95% of the workers are public employees (treated group). Very private sector includes workers in an activity in which less than 5% of the workers are public employees (control group). See Table A1 for more details. Statistical estimates of parallel pre-trends confirm that these are similar in all quarters up to policy introduction.

[23] Since we do not have the universe of eligible workers, when using the spell level data to evaluate the policy impact on the extensive margin, we assign to each spell the probability of observing a sick leave incident per sector-quarter the concerned worker belongs to. We do this for two reasons. First, they enable us to control individually for some basic spell characteristics (age of claimant and region it stems from) at the spell level to account for potential compositional changes pre-post policy that could impact on the outcome. Second, these are of interest to compare with estimates produced from data collapsed at the sector-quarter level. We throughout put more weight on the interpretation of the latter which are statistically sounder as more demanding in terms of returning significant coefficients as it will generate larger standard errors.

4.2 Intensive margin results: mean duration of spells

We now turn to estimating the effect of the policy on the intensive margin – duration given a spell was started – of sick leave absences. Figure 2 plots the average duration of started spell in days for men working in the public sector (solid line) and private sector (dashed line). Here we see an interesting seasonal pattern with longer durations for absences in summer months and shorter ones the winter months which is in fact inverse to that of number of spells started observed previously. Crucially, this pattern is almost perfectly parallel for workers from both sectors up to the quarter of policy introduction with the only difference being that private sector employees take on average a few more days (2 to 3) of sick leave per spell started. However, right after the reform, mean duration increases substantially for public sector workers while it remains stable in the private sector resulting in the former now taking on average more days per spell than the latter.

Table 3. Intensive Margin Policy Impact: Changes in Sick Leave Duration

	Mean Duration of Sick Leave Spell in Days			
	Spell Level		Sector Level	
	(1)	(2)	(3)	(4)
Standard DiD Estimates:	9.09 ***		8.79***	
Very public sector definition	(.671)		(1.15)	
Continuous DiD Estimates:		9.10***		7.89***
Proportion public sector definition		(.613)		(1.09)
Wild bootstrap p-value	.000	.000	.000	.000
Wild bootstrap [confidence interval]	[7.6, 10.9]	[7.7, 10.6]	[5.9, 11.2]	[5.5, 10.2]
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Economic Sector Fixed Effects	Yes	Yes	Yes	Yes
Age Controls and Province FEs	Yes	Yes	No	No
Mean of Outcome	27.7	27.6	27.8	28.2
Size of Estimated Effect (%)	32.8	32.9	31.6	28.0
Observations	5,120,458	6,760,117	300	420

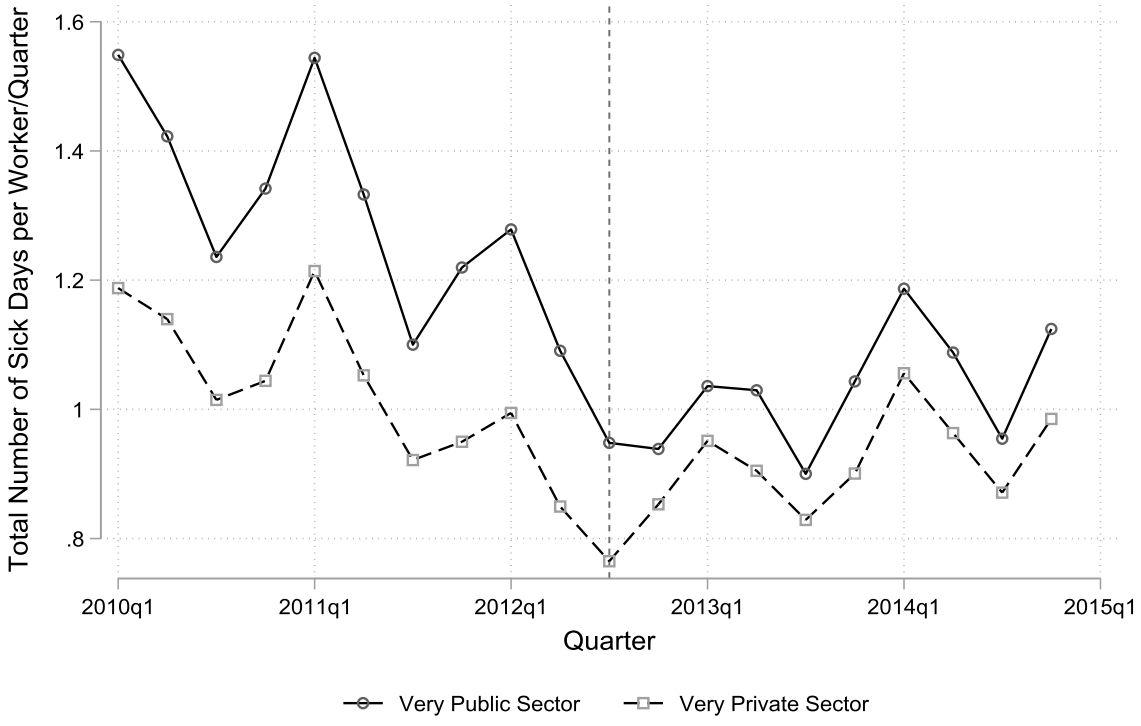
Notes: Columns (1) and (3) present standard differences-in-differences estimates where the treated belong to economic sectors where a large majority are public sector workers and the control group as sectors where a large majority of employees are private sector workers (i.e. in both cases they represent > 95% of employees). Columns (2) and (4) present continuous differences-in-differences estimates where the intensity of treatment in each sector is assigned relative to the proportion of public sector workers they employ before policy introduction. Table A1 of the appendix reports these proportions for all 21 economic sectors. In columns (1) and (2) we use the spell level data and in columns (3) and (4) the aggregated sector level data. Actual length observed for each started spell is used for the former and mean length by sector quarter for the latter. Data source is register data from the Spanish Social Security Administration, which includes the entire population of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector (ages 25-60). Robust standard errors clustered at the sector-quarter level in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Post-estimation wild bootstrap p-values, and 95% confidence intervals in square parenthesis, are also presented to account for the small number of treated clusters.

We statistically quantify this impact in Table 3 (set up in exactly the same way as Table 2) and find that the policy increased the mean duration of the sickness absence spells by 7.9 days when using our most conservative estimate. As average spell duration for public sector workers pre- reform was 28.2 days, we conclude that the benefit cut as it was implemented – with reduced generosity during the first days of a spell – increased average time spent on sick leave by 28%. This is therefore almost symmetrically inverse to the reduction in number of spells started observed earlier which means that the total impact of the policy on days lost to sick leave is uncertain, something we test for more directly in the next section.

4.3. Total policy impact: days lost to sick leave

So far, we have reported two main results of the change in sickness absence benefits for public sector workers: a reduction in the number of sickness absences for affected workers by 30% (extensive margin) as well as an increase in the duration of sickness absences of public sector workers by 28% (intensive margin).

Figure 3. Days Lost to Sick Leave: Absences per 1,000 Workers each Quarter.



Source: Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector for the same period. The vertical dashed line indicates the quarter of policy introduction. Very public sector includes workers in an activity group in which more than 95% of the workers are public employees (treated group). Very private sector includes workers in an activity in which less than 5% of the workers are public employees (control group). See Table A1 for more details. Statistical estimates of parallel pre-trends confirm that these are similar in all quarters up to policy introduction.

We now turn to estimating the total effect of the policy by calculating the average number of absent days per worker in each economic activity sector[24]. Figure 3 plots the evolution of this variable for individuals in the (very) private and public sector respectively. We see that there are again strong but identical seasonal patterns between both groups but that the mean number of absent days per worker is consistently much larger for public sector workers before the reform. We then clearly observe that this difference becomes much smaller once the policy is introduced suggesting that it overall reduced number of days lost to sick leave in the public sector.

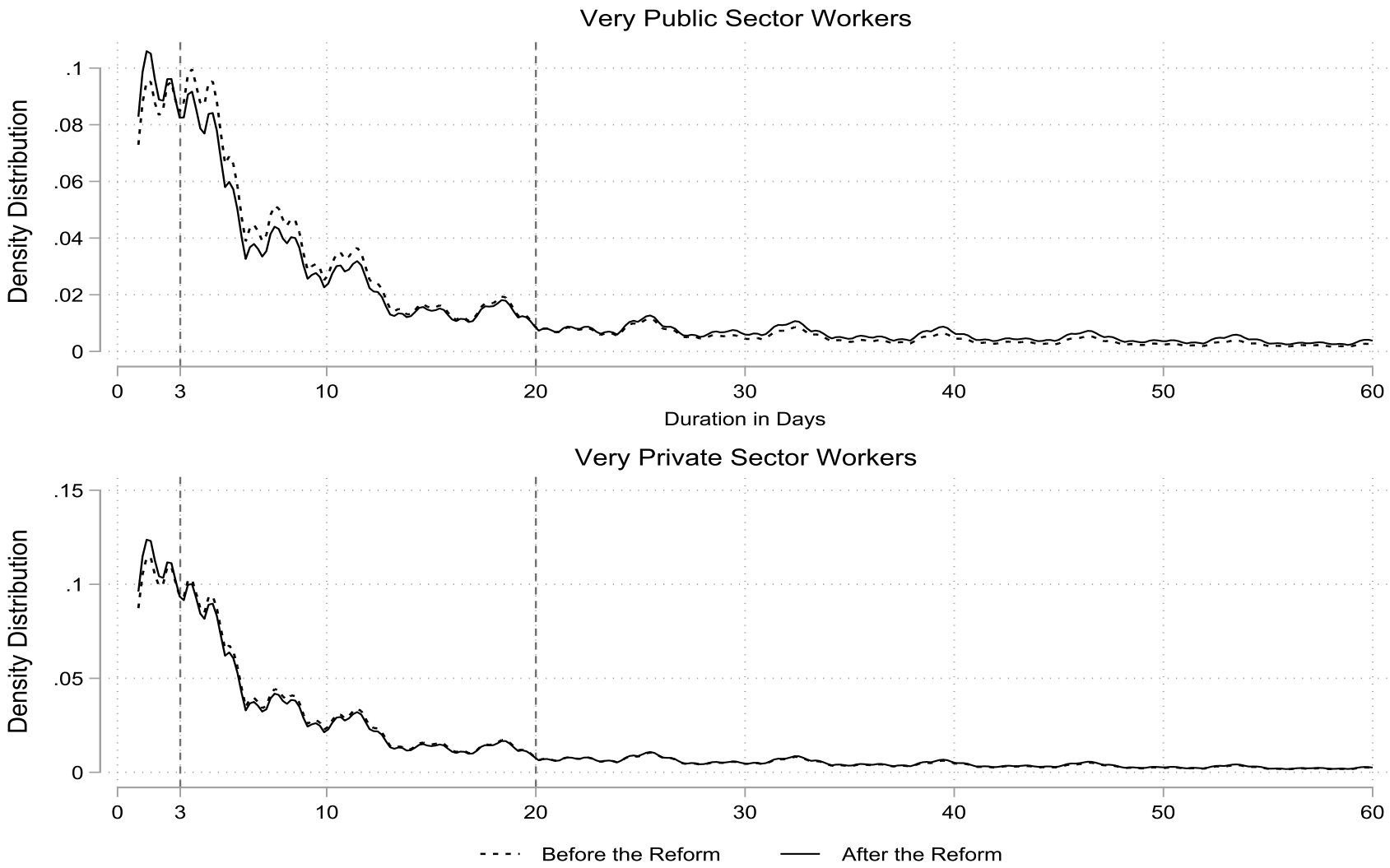
Table 4. Overall Policy Impact: Changes in Days Lost to Sick Leave

		Total # Days Lost per Worker/Quarter			
		Spell Level		Sector Level	
		(1)	(2)	(3)	(4)
Standard DiD Estimates:		-.157***		-.160***	
Very public sector definition		(.016)		(.020)	
Continuous DiD Estimates:			-.150***		-.127***
Proportion public sector definition			(.019)		(.024)
Wild bootstrap	p-value	.000	.000	.000	.000
	[confidence interval]	[-.191, -.123]	[-.191, -.110]	[-.201, -.118]	[-.176, -.077]
Year and Quarter Fixed Effects		Yes	Yes	Yes	Yes
Economic Sector Fixed Effects		Yes	Yes	Yes	Yes
Age Controls and Province FEs		Yes	Yes	No	No
Mean of Outcome		1.30	1.38	1.31	1.26
Size of Estimated Effect (%)		-12.1	-10.9	-12.2	-10.1
Observations		5,120,458	5,120,458	300	420

Notes: Columns (1) and (3) present standard differences-in-differences estimates where the treated belong to economic sectors where a large majority are public sector workers and the control group as sectors where a large majority of employees are private sector workers (i.e. in both cases they represent > 95% of employees). Columns (2) and (4) present continuous differences-in-differences estimates where the intensity of treatment in each sector is assigned relative to the proportion of public sector workers they employ before policy introduction. Table A1 of the appendix reports these proportions for all 21 economic sectors. In columns (1) and (2) we use the spell level data and in columns (3) and (4) the aggregated sector level data. When using spell level data, we assign to each spell the probability of observing a sick leave incident per sector-quarter and then use the actual duration of each spell to calculate total number of days lost in each given quarter. Data source is register data from the Spanish Social Security Administration, which includes the entire population of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector (ages 25-60). Robust standard errors clustered at the sector-quarter level in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Post-estimation wild bootstrap p-values, with 95% confidence intervals in square parenthesis, are also presented to account for the small number of treated clusters.

[24] It is worth noting here that a rough estimate of the size of the total impact on days lost of the policy can be inferred by multiplying these two effects: i.e. (1+extensive margin) x (1+intensive margin) = (1-0.298) x (1+.280) = .899. It is however only an approximation without a level of statistical significance attached to it and also because it includes total duration of each spell, not duration in a given quarter, the measure we use to estimate the overall policy effect on days lost to sick leave in what follows..

Figure 4. Density Distribution of Duration of Sick Leave Spells Before and After the Reform



Source: Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014. The vertical dashed lines indicates the sick leave duration in days when the replacement rate for paid sick leave changed discontinuously for public sector workers (see Table 1). Very public sector includes workers in an activity group in which more than 95% of the workers are public employees (treated group). Very private sector includes workers in an activity in which less than 5% of the workers are public employees (control group). See Table A1 for more details.

Table 4 reports estimates of regression equation (1) when the dependent variable is the number of absent days per workers per quarter and is set up as the previous two result tables[25]. All estimates confirm that there was indeed a significant drop in the probability of public sector employees being absent from work in any given quarter after the generosity of their sick leave benefits was cut. On average, using again our most conservative estimate, there were 10% fewer days lost to illness post reform from a baseline of 1.26 days per 1,000 public sector employees each quarter. This is however probably an over-simplistic picture that omits many of the other indirect consequence this cut in sick leave benefit may have had, something we now turn our attention to by first considering potential compositional changes in the type of spells taken post reform.

5. Compositional Changes: Duration Thresholds and Disease Types

In this section, we provide evidence on potential changes in the composition of the pool of sickness absences taken post reforms in terms of duration thresholds and disease types.

5.1. Duration thresholds composition

We begin by taking a closer look at the distribution of the sickness absence duration in order to understand what part of the distribution around policy relevant duration threshold (i.e. 1-3, 4-20, and 21+ days) is driving the reported increase in the average length of sick leave spells. We first explore the effects by graphically plotting the distribution density of sick leave duration in days before and after the reform for public and private sector workers. Figure 4 shows, in its top panel, the graph of the density distribution for public sector workers respectively before (dashed line) and after (solid line) the reform. The vertical lines correspond to the new replacement rate thresholds introduced by the policy change which were previously of 100% for all durations. The graph appears to reveal a drop in sick leave spells lasting from 3 to 20 days after the reform and an increase in those with durations longer than 20 days. The bottom panel graph of Figure 4 plots the same distribution for private sector workers and seems to indicate that there was very little change in the distribution of sick leave duration before and after the reform for our control group. These graphs using high frequency

[25] We again here, as was the case for the extensive margin, assign to each spell the probability of observing a sick leave incident per sector-quarter the concerned worker belongs to. We then use the actual duration of each spell to calculate total number of days lost in a specific quarter to calculate the total policy effect.

daily data are however hard to clearly interpret and we turn to our statistical model to obtain estimates that better capture these potential changes.

To quantify these effects, we create three dummy variables that capture the three thresholds introduced by the reform relating to the duration of the sickness absences. The first dummy captures whether the sickness absence lasted for 1 to 3 days, the second captures that for 4 to 20 days and the last one captures durations of 21 or more days. We can see in Table 5 that the probability of having short duration spells (1-3 days) slightly decreased for public sector workers after the reform (a drop of around 2%). For durations between 4 and 20 days the drop was significantly higher around 13%. In counter to this, the probability of having the longest duration spell (21 days or more) significantly increased by 25% as a result of the reform. This is exactly what we expected as the cost of returning to work too soon increases post-reform, and as a result longer duration sick leave now represent a much larger proportion of all spells[26].

Table 5. Impact on Duration Distribution around Replacement Rate Threshold Days

Continuous DID Estimates	Duration of Spells - Compositional Change			
	Mean (in days)	1-3 Days (probability)	4-20 Days (probability)	21+ Days (probability)
Proportion Public*After Policy	9.10***	-.006	-.061***	.067***
	(0.18)	(.006)	(.004)	(.001)
Year and Quarter Fixed Effects	Yes	Yes	Yes	Yes
Economic Sector Fixed Effects	Yes	Yes	Yes	Yes
Mean of Outcome	27.6	.260	.469	.271
Size of Estimated Effect	+32.9%	-	-13.0%	+24.7
Observations	6,760,117	6,760,117	6,760,117	6,760,117

Notes: Coefficients reported stem from continuous differences-in-differences estimates where the intensity of treatment in each sector is assigned relative to the proportion of public sector workers they employ before policy introduction. Table A1 of the appendix reports these proportions for all 21 economic sectors. Robust standard errors clustered at the sector-quarter level in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

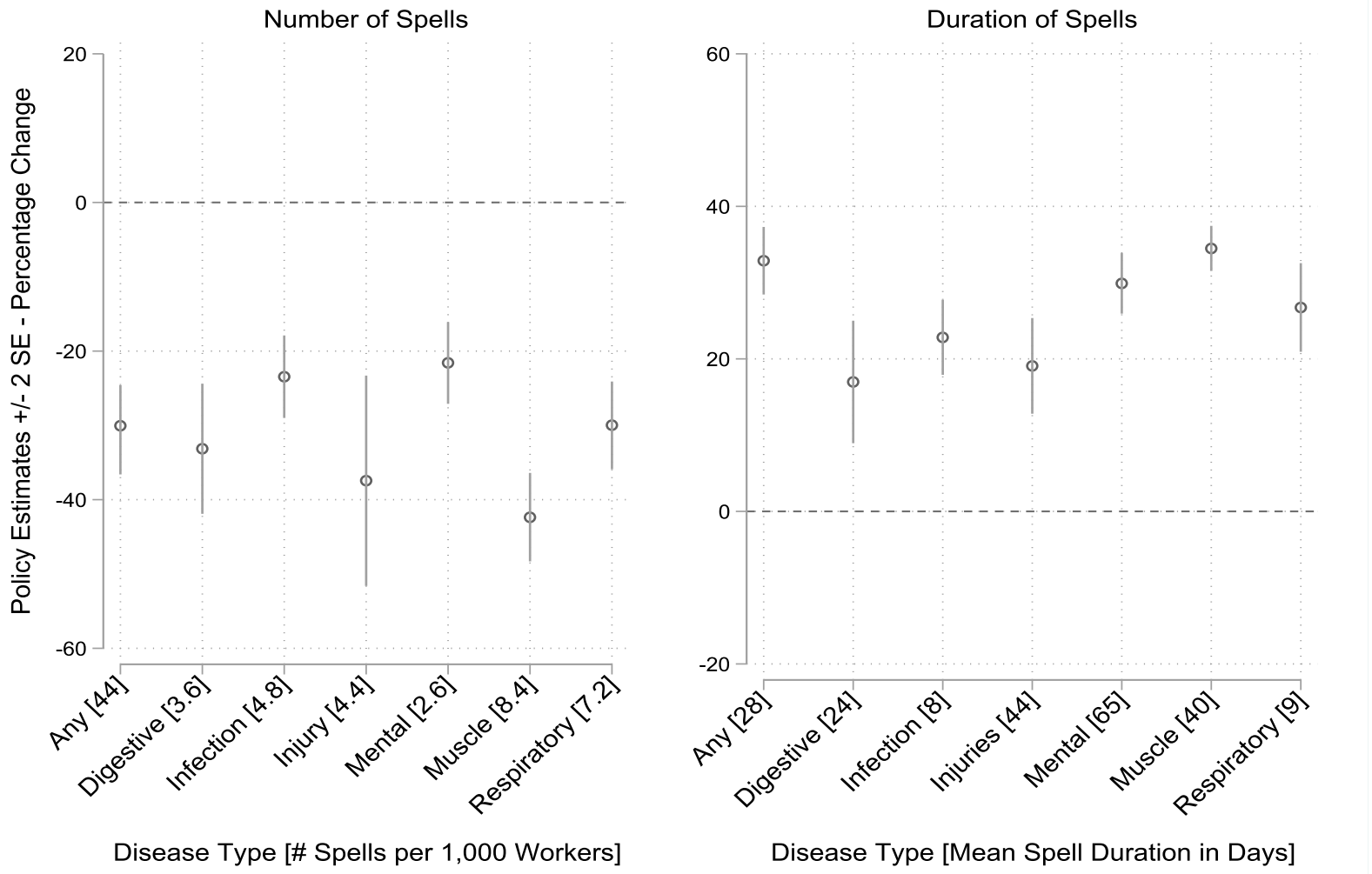
[26] Another way to look at how spell duration has changed around these replacement rate threshold days is to estimate the policy impact on incidence rates for each of them separately. This will give us an idea of how spell duration has changed unconditional on the number of spells started, which on average has dropped by about 30% (see Table 2). We present these estimates in the first three rows of Table A4 of the Online Appendix (the final row is for relapses, something we come back to when discussing this outcome). What they show is that the incidence of all spell types – short (1-3 days), mid-duration (4-20 days), and long (21+ days) – strongly and significantly decreased among public sector workers after the policy was introduced. This change was however not evenly distributed with short spells reducing by as much as all spells on average (-30%), mid-duration spells by more (-40%), and long ones by much less (-15%). This approach confirms that the policy did reduce sick leave days taken on average, our finding from the previous section, and that this was unevenly distributed across spell length, our findings from Table 5.

5.2 Disease type composition

Next, we explore another margin of the composition of sickness absences: policy impact by disease type. The administrative data we obtained includes a detailed classification of the type of diseases that caused the sickness absence spell, as diagnosed by a doctor (according to the CIE-10 classification). We use this information to explore which types of diseases reported as the cause of the leave spell were most affected as a result of the cut in sick leave benefit generosity. To do this, we start by classifying the diseases into fifteen categories that include all CIE-10 groups: muscles and joints, respiratory system, infectious diseases, injuries, digestive system, mental disorders, senses and nervous system, circulatory system, skin diseases, genitourinary system, neoplasms, endocrine diseases, congenital anomalies, blood diseases, and, finally, diseases not well defined. Table A5 in the Appendix shows the main sub-categories of diseases included in each of the fifteen groups as well as information on the percentage that they represent within each category, the number of spells, the percentage of spells and the mean duration in days. It presents this information for (very) public and private sector spells separately, both before and after the policy is introduced, to give a complete picture of evolution of sick leave reasons around this period. In order to explore which types of diseases are more responsive to the policy, we estimate the same baseline difference-in-difference model for each of the disease categories that represent, at least, 5% of the total number of spells in our sample. Together, these account for over three quarters of all spells (muscles and joints, respiratory system, infectious diseases, injuries, digestive system, mental disorders, and diseases not well defined).

We first present the regression coefficient results for incidence and duration of sick leave spells in Figure 5, where we plot the estimated policy impact in percentage changes (i.e. estimated coefficient/baseline) together with the 95% confidence intervals. The left-hand side graph reveals a strong reduction in the number of spells per worker in all illness categories. These extensive margin effects range between 21% and 42%, with the strongest reductions observed for the case of diseases related to muscles and joints (of which more than two-fifth belong to the back pain sub-category), followed by respiratory and infectious diseases with a reduction of 39% and 33% respectively. The right-hand side of Figure 5 summarizes the effect of the policy on the mean duration of sick leave spells. It shows large increases in average spell length of between 19% and 35% across all disease categories as a result of the policy change.

Figure 5. Policy Impact on Sick Leave Incidence and Duration, by Type of Diseases.

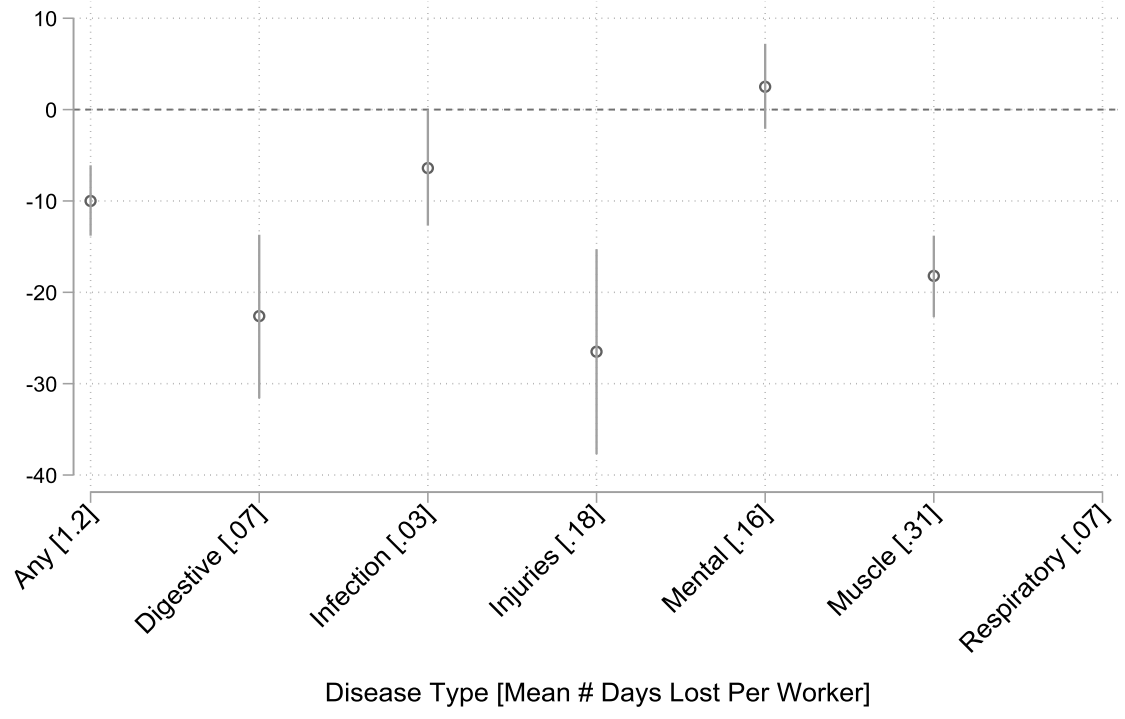


Notes: We report here the size of the policy impacts (i.e. coefficient estimates/mean pre-policy level) and the 95% confidence intervals of regressions following equation (1) where the dependent variable is either the number of sick leave spells per 1,000 workers (left graph) or the length in days of each spell (right graph). We estimate these regressions separately for each type of diseases. Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector for the same period.

In a mirror image to the impact on the number of spells results, the strongest increase in duration is reported for the case of muscle and joints. Most relevant in order to gauge where the policy was most efficient in reducing absences is to look at changes in days lost per worker each quarter as the outcome for each disease type.

This is what we report in Figure 6, again in terms of the estimated percentage change effect and a +/-2 standard error confidence interval. The average policy impact, as already discussed, is estimated to be a 10% reduction in days lost to sick leave. What comes out of our heterogeneity analysis is that this appears to be driven by very large drops in days taken off due to three disease categories: muscle and joint pains (-18%), infectious (-23%), and respiratory (-26%) illnesses. The first in the list may not be surprising as it consists of a majority of 'back pain' sufferers, a notoriously difficult ailment to objectively diagnose and for which the prevalence has already been shown to be very sensitive to change in benefit entitlement in other contexts (e.g. when looking at disability insurance claimant in both the US – Deshpande and Li, 2019 – and in the Netherlands – Godard et al, 2019).

Figure 6. Policy Impact of Days Lost to Sick Leave, by Disease Type.



Notes: We report here the size of the policy impacts (i.e. coefficient estimates/mean pre-policy level) and the 95% confidence intervals of regressions following equation (1) where the dependent variable is the number. Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector for the same period.

The other categories include the two most common types of viral diseases, gastroenteritis and influenza (see Table A5), both of which are highly contagious. The concern here is that not taking (enough) sick leave not only puts one's own health at risk, but also that of others as close physical contact would increase the virus' potential to spread, especially if one returned to work while still a carrier, with substantial cost-consequences (Adda, 2016). These two observations lead us to take a closer look at the potential negative consequences of "too early" returns to work with the reduction in sick leave generosity, resulting in falling ill again, or possibly displacing absences towards another type of benefit.

6. Policy Spillovers: Unhealthy Returns to Work?

In order to assess if the policy created incentives for workers to have potentially went back to work too early (i.e. before they had properly recovered from the disease they were suffering from), we look at two potential externality channels. First, we focus on relapses, that is, the probability that the work absence is a result of a previous diseases that already required a sick leave spell and has recurred. Second, we analyze the extent to which the policy displaced sickness absences to another social security program that covers individuals experiencing a work-related accident. This should provide us with a clearer picture of the net effect of the policy and also accounts for its potential spillover effects.

6.1. Relapses

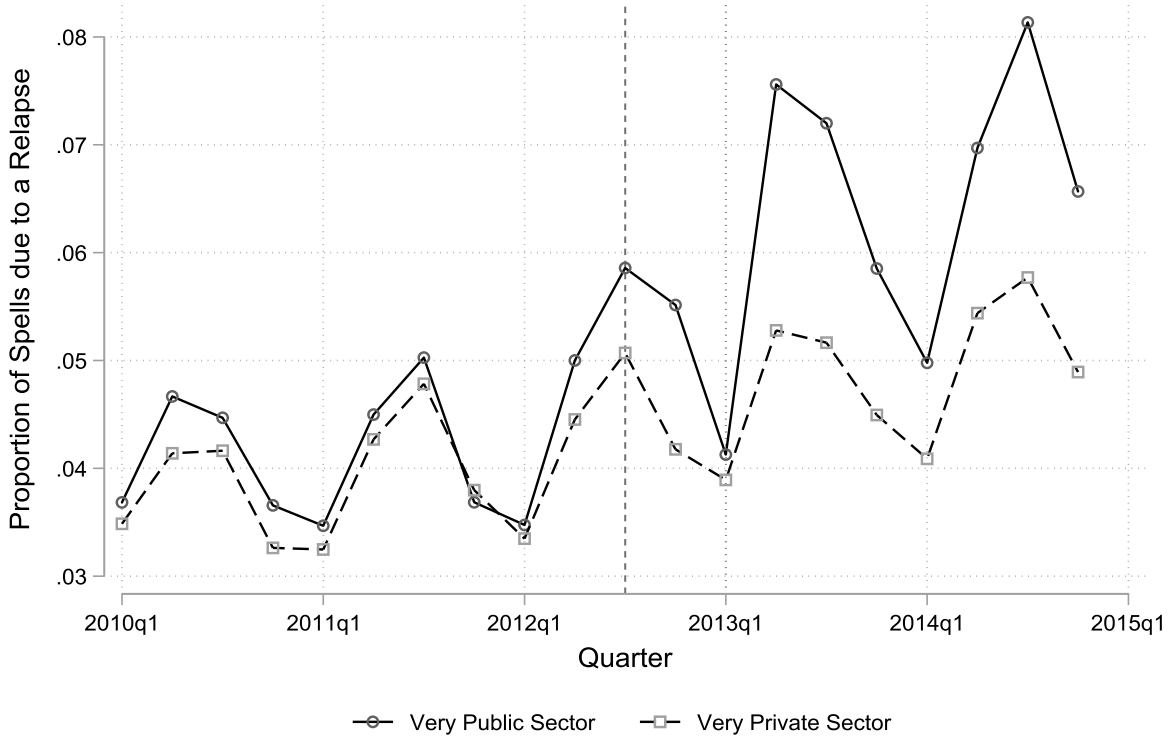
The Spanish Social Security administration defines a relapse as a sick leave spell that is due to the same diagnosed illness that previously required an employee to be absent from work, and within 180 days of the antecedent spell. If these conditions are fulfilled, the system will automatically categorize the new spell as a relapse in the administrative data to keep track of such events, otherwise, the individual is subject to all the same benefit conditions as for any regular sick leave occurrence.

6.1.1 Relapse probability and duration

Figure 7 depicts the evolution in the proportion of spells in each quarter due to relapses for public and private sector workers around the time of policy introduction. We first note that the pre-trends are extremely parallel with about 4-5% of all sickness absences due to relapse up until the reform was implemented. Once sick leave becomes more costly for public sector

employees, we then observe a large divergence with the increase in relapse probability only occurring for the public sector group. The difference becomes especially marked two quarters after the policy is in place, which can be read as further evidence of its impact, as this is the time when all relapses will relate to a previous spell that had been filed post-reform (i.e. 180 days).

Figure 7. Probability that Sick Leave Spell is due to a Relapse.



Source: Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector for the same period. The first vertical dashed line in 2012Q3 indicates the quarter of policy introduction. The second vertical dashed line is two quarters starts two quarters later and indicates the time from which all relapses would have been linked to a previous spell taken post policy. Very public sector includes workers in an activity group in which more than 95% of the workers are public employees (treated group). Very private sector includes workers in an activity in which less than 5% of the workers are public employees (control group). See Table A1 for more details.

Statistically, we formally estimate the size of this effect by running the same baseline model as in equation (1) with the probability of relapse as our dependent variable using the un-collapsed micro data. The first column in Table 6 reports that the proportion of absences due to a previously diagnosed disease is estimated to have increased by 8.3% on average[27]. As

[27] The unconditional incidence of spells due to relapses itself significantly decreased as a result of the reform. As the last column of Table A4 of the Appendix reports, an average 2.16 sick leave spells per thousand public sector employees were due to relapsing from a previously diagnosed disease (within six months) before the policy

this mean effect may hide heterogeneity in policy response, we consider how relapse probability changed depending on duration of the new spell in columns (2) to (4) of Table 6. What is most striking here is the very large increase (35%) estimated in the proportion of short spells (1-3 days) due to relapse. Longer spells (over 21 days), however, did appear to see a smaller but significant decrease in relapse cases. This is actually very much in line with the design of the benefit change we study which puts more financial pressure to return to work for short spells, and not for longer ones, and, in so doing, may have inadvertently increased the likelihood to fall ill again for this category of sickness absences.

Table 6. Changes in the Probability of Sick Leave due to a Relapse, by Spell Duration.

Spells due to Relapse by Duration in Days	All Spells	1-3 days	4-20 days	21+ days
	(1)	(2)	(3)	(4)
Proportion Public *After	.004***	.015***	.003***	-.007***
	(.001)	(.002)	(.001)	(.001)
Year and Quarter Fixed Effects	Yes	Yes	Yes	Yes
Economic Sector Fixed Effects	Yes	Yes	Yes	Yes
Mean of Outcome	.048	.042	.041	.067
Policy Effect at Mean (%)	+8.3	+35.3	+7.4	-10.4
Observations	6,760,115	1,871,520	2,972,169	1,916,424

Notes: We report here continuous differences-in-differences estimates coefficients where the treatment in each sector is assigned relative to the proportion of public sector workers they employ before policy introduction. Table A1 of the appendix reports these proportions for all 21 economic sectors. Own elaboration with register data from the Spanish Social Security Administration, which includes the entire population of sickness absences in Spain from 2010 until 2014. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

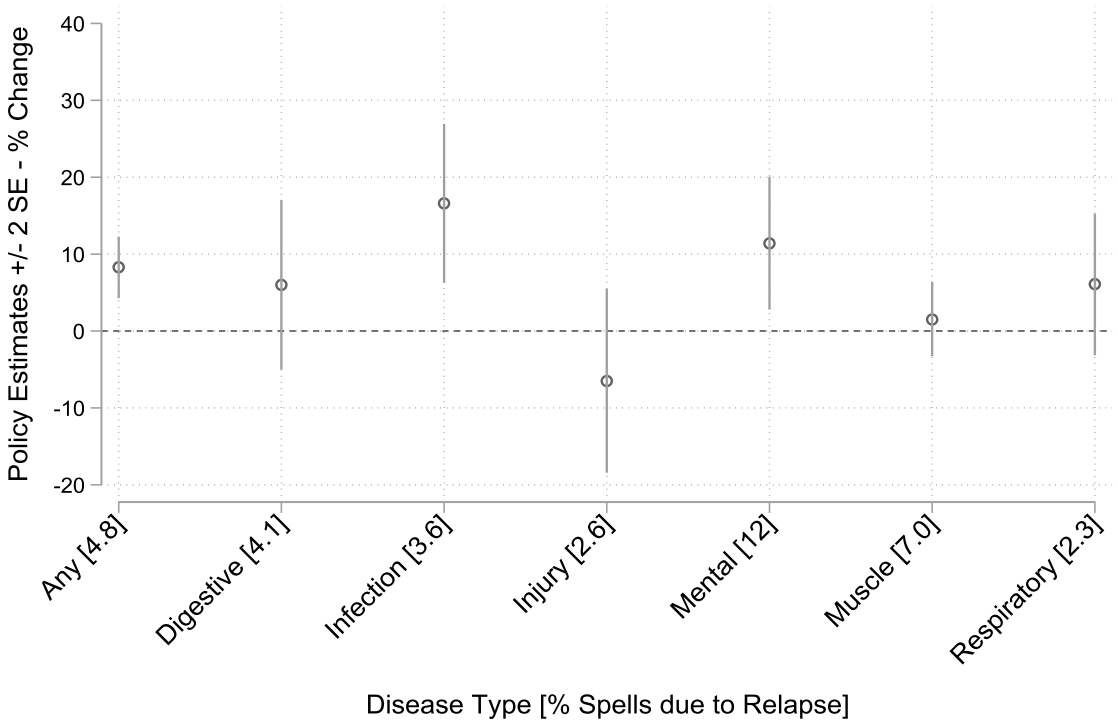
6.1.2 Relapses by disease type

We can further explore this mechanism by looking at relapses by disease type. Since certain categories are much more associated by shorter durations (e.g. infectious diseases with a mean of about 6.4 days pre-policy, see Table A5) and workers with such illnesses could thus also be more prone to relapse once the first days of sick leave are the most costly. We do this graphically in Figure 8 which presents these effects for the six more common illness

introduced. It then decreased by 28.5 percent for public sector employees, a large drop which is however still smaller than the one in incidence we have estimated to be of 29.8 percent. This difference explains the increase we undercover here when looking at the proportion of spells that are due to relapses, conditional on spell start.

categories in terms of percentage change (i.e. estimated coefficient/baseline) with a 95 percent confidence interval.

Figure 8. Policy Impact on Sick Leave Spells due to a Relapse, by Disease Type.



Notes: We report here the size of the policy impacts (i.e. coefficient estimates/mean pre-policy level) and the 95% confidence intervals of regressions following equation (1) where the dependent variable is the probability that the sickness absence is due to a relapse from a previous illness. We estimate the regression separately for each type of diseases. Own elaboration with administrative Spanish Social Security data, which includes the universe of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector for the same period.

Clearly, the largest increase is observed for infectious diseases where relapses increase by over one-fifth. This category mostly includes gastroenteritis cases, the most common type of any viral diseases and highly contagious. The large increase in the probability that workers would relapse from such infectious illnesses also increases the likelihood that these workers would have returned as carriers and infecting other individuals at their respective places of work[28]. This would be in line — even symmetric — with the positive effects on reducing the spread of another viral disease, influenza, using Google Flu data reported by Pichler and Ziebarth (2017) in the US after the introduction of sick pay mandates.

[28] We would ideally want to test this contagion spill-over mechanism more directly (à la Adda, 2016), but unfortunately, we do not have granular data enough about where each employee works (e.g. firm) to do this properly.

We further explore relapse probability changes by disease type by plotting the policy effect separately, depending on the duration of the spell and present the coefficients in Figure A2 of the Appendix. The large increase in short term spell relapses (top right-hand graph) noted earlier is due to four out of the six categories of digestive diseases, infections, mental disorders, and muscle and joints pains. The top right-hand graph of Figure A2 shows that the increase in relapses that last between 4 and 20 days is primarily driven by mental disorders. Finally, the reduction in relapses among spells with the longest duration (bottom left-hand graph) is revealed to be entirely due to illnesses linked to muscle and joint ailments. Before we conclude that this is indicative of some positive policy externality as it would seem that fewer individuals suffered recurrently from 'back pain' – the most common reason for taking sick leave – we need to consider if displacement onto another benefit scheme may have been simultaneously occurring for this disease category.

6.2. Displacement Effect: Working Accidents

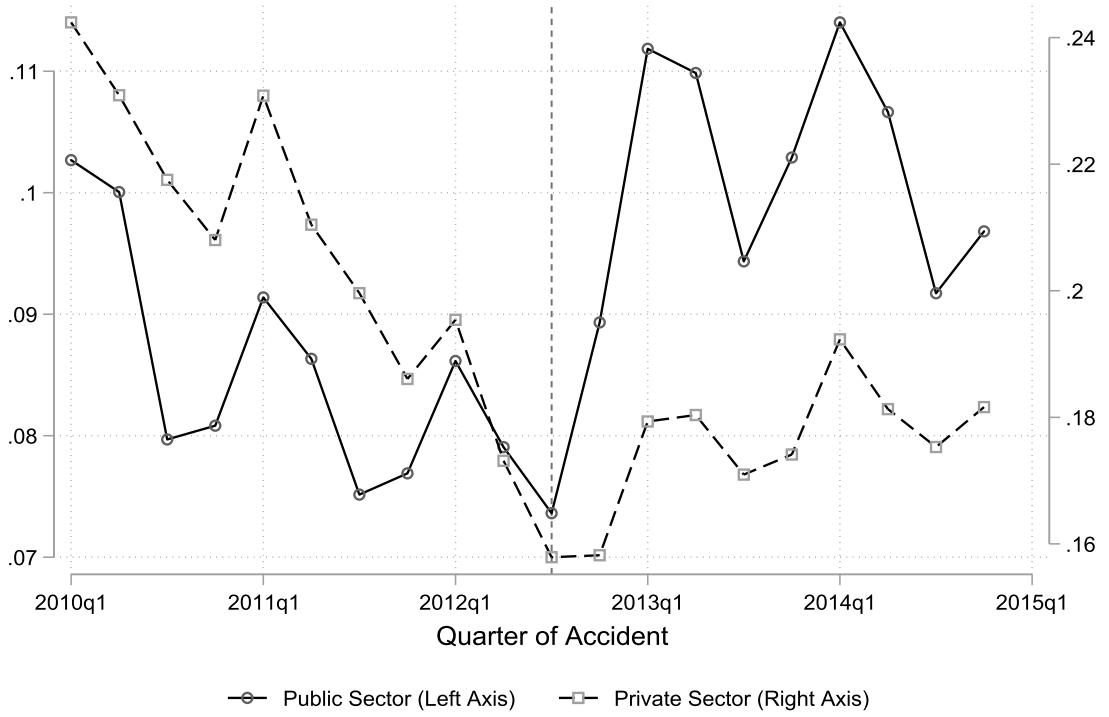
While sick leave generosity for public sector workers was severely reduced by the reform, there was no change in the replacement rate received for suffering a working accident: 100% of previous wage throughout a spell of any duration[29]. It appears thus very relevant to ask if public sector worker absences became more frequent on this unaffected benefit scheme as an indirect result of the sick leave policy. It would also be a prime candidate for displacement for those suffering from illnesses linked to the 'muscles and joints' category since almost three-fifths of working accident cases among public sector employees are the result 'back pain' problems. This displacement could occur for two reasons: (i) because public sector employees chose to switch since it lowers costs of work absence or, (ii) because they took fewer required sick leave days and consequently became more prone to injuring themselves at work. While we cannot distinguish between these two mechanisms but, if we note an immediate effect, one could argue that rational cost-based switch is behind the displacement (at least at first).

There is some evidence in the literature of displacement effects across benefit schemes after policies that tightened access were introduced in other contexts, examples include

[29] As for sick leave benefit, working accident insurance is guaranteed until the individual has recovered from his/her condition for up to a maximum of 365 days, with a potential extension of 180 extra days if it is highly likely that the worker is going to recover from the accident during this period. They are granted by insurance companies that all firms need to have contracted to cover the risk of a working accident. It is the employee that addresses either the general GP to ask for a sickness absence (due to common illness) or addresses the insurance company to apply for a working accident absence. Of course, in the case of working accidents, the employee has to prove that the injury/disease is caused by the job that he/she is developing.

shifting from unemployment benefit to disability insurance in the UK (Petrongolo, 2009) and from disability insurance to social assistance in the Netherlands (Borghans et al., 2014). We however know of no previous study exploring the possibility of displacement to other benefits emanating from changes in paid sick leave rights. This is surprising as checking for benefit spillover seems essential to check in order to properly assess the overall effectiveness of such a policy.

Figure 9. Days Lost to Working Accident Absences per Worker each Quarter.



Source: Own elaboration with administrative Spanish Social Security data, which includes the universe of working accidents in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of public and private sector workers employed each quarter. The vertical dashed line indicates the quarter of the sick leave policy introduction.

To test if working accident absences might have been indirectly affected by the sick leave reform, we obtained administrative data on the universe of working accident spells in Spain between 2010 to 2014. As before, we distinguish between public and private sector workers[30] and once again focus exclusively on male employees. We then proceed as in the main analysis by first graphically checking the evolution of working accident absences around a 'placebo' policy change in July 2012.

[30] The working accident data, however, does contain the actual public or private status of each employee, so we can use this information directly and do not need to rely on economic sector level classifications to categorize each worker, as was the case with the sickness absences administrative data.

Figure 9 plots the evolution of the average number of days lost per employee in each quarter attributable to a work-related accident, separately for the public and private sector. While the levels are quite different between the two, as accidents are much more common in the private than in the public sector (for this reason, we use two y-axes), we note that the trends were, however, very similar up to the time when the sick leave reform was introduced. After this, the number of days lost to working accidents jumps massively for public sector employees, while remaining flat for private sector employees, which, already visually, is strongly indicative of displacement across benefit schemes. It is also worth noting that the immediate and large divergence Figure 9 reveals suggest that cost induced benefit switch – rather than worsening health – is a driver behind this displacement, at least in the quarter just after the reform. To complete our visual investigation Figure A3 plots the incidence and duration of working accidents to uncover where – the extensive or intensive margins - the change in absence behavior is coming from. We see that the change is primarily due to an increase in the number of spells taken by public sector employees (Figure A3.1) since their average length, at around 30 days, evolves in a very similar way pre- and post-policy across both sectors (Figure A3.2).

Table 7. Changes in the Incidence and Duration of Working Accident Absences.

	Incidence	Duration	Days Lost
Public Sector Worker * After	1.97***	-.894***	.049***
	(.002)	(.220)	(.001)
Year-Quarter Fixed Effects	Yes	Yes	Yes
Public Sector Fixed Effects	Yes	Yes	Yes
Mean of Outcome	2.84	30.4	.087
Policy Impact at Mean (%)	69.4	-2.94	56.3
Observations	1,731,941	1,731,941	1,731,941

Source: Table presents standard differences-in-differences estimates where the treatment is assigned individually using information of employee being a public sector or not, information that is available in the working accident data. Own elaboration with register data from the Spanish Social Security Administration, which includes the entire population of working accidents absences in Spain from 2010 until 2014. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

We formerly estimate the size of this potential displacement effect by running a slightly modified version of our difference-in-difference specification in equation (1) which now uses working accidents as the dependent variable and where individuals are classified as private or public sector employees, with the data collapsed accordingly for each quarter. Table 7 reports

the coefficients and the associated percentage change this represents for three outcomes: the incidence rate of working accident, the average duration of each spell, and the total number of days lost due to working accidents per employee each quarter. These estimates confirm the information suggested in the earlier graphs with a huge increase in work-related accident incidence (+69%) combined with very little change in absences (-2.9%) resulting in days lost due to such events jumping by over a half (56%)[31].

To understand the magnitude in benefit displacement this could correspond to, we must first point out that public sector employees were absent far less often for accidents at work than for being sick, at 0.087 and 1.38 days per quarter before the reform, respectively. Still, since we estimated that each public sector employee was taking on average 0.049 more working accident days after the reform, and the gains from the reduced sick leave we estimated stood at 0.127 days per worker (taking our more conservative estimate in column (4) of Table 4), we find that about 38.6% (0.049/0.127) of absences are potentially displaced across benefits. This means that the overall 10% policy effect we estimated on absences should probably be scaled down by almost two-fifths of its value after considering possible switching behavior to the working accidents benefit scheme. This negative spillover effect is a phenomenon never before observed in the sick leave literature and its large size suggests that it should always be considered when evaluating the effectiveness of any policy restricting access to benefits in any context.

7 – Concluding Remarks

Understanding the impact of sick leave entitlement on worker's absence behavior has been an important policy issue in the last two decades, gaining new urgency with the Covid-19 crisis and our need to incentivize people back to work while still protecting their health and that of others. While many European countries had been reducing their very generous schemes as they implemented budgetary restrictions in the years following the financial crisis, some US cities were in the process of introducing the first tentative rights to paid sick leave. The pandemic has completely changed this configuration, with many countries implementing emergency measures for people's wage to be paid while they stay at home if sick, or to just

[31] Note that these large displacement effects we document here may actually be a lower bound estimate as they are occurring in the middle of an economic recession which Boone et al. (2011) have shown to be times that lead to workers underreporting of moderate workplace accidents.

not become sick while at work. This situation will not last and these measures will have to be scaled down, but the question remains as to the right, or appropriate, level of sick leave benefits that could simultaneously provide insurance for health shocks while reducing the scope for moral hazard.

In this paper, we contribute to knowledge needed for this debate by obtaining clean estimates of the impact of a large reduction in sickness insurance benefits on absences from work on the extensive (number of spells) and intensive (duration of the spells) margins, and total effect (days lost). Exploiting the introduction of a policy that only affected the benefits of certain workers in Spain and making use of very rich administrative data, we report our four main evaluation findings: first, the reform did lead to a large reduction in the number of sickness absences spells filed but the mean duration of those spells increased by almost as much; second, taking these opposite effects together, the total policy effect amounted to a significant reduction in the number of days absent due to sick leave taken by each employee; third, the change in duration was driven by large increases in the proportion of financially less costly long spells, while the probability of taking costly short and medium length spells decreased; and fourth, incidence (negatively) and duration (positively) of spells for all disease types were strongly affected, but in terms of reduction in days lost, the standout categories were respiratory, infectious, and muscle related illnesses.

Next, we explored for potential spillover effects if the increased incentive not to be absent from work may have resulted in some complying workers doing so while still not properly recovered from an illness (i.e., presenteeism). For this, we first looked at proportion of sick leave spells that were due to employees relapsing for the same disease that recently caused them to be absent from work. We found that this increased significantly after the policy was introduced and that this was especially strong for shorter spells and for infectious diseases. This last finding is especially worrisome given the strong likelihood of further spreading such diseases to others in the workplace. Second, we investigated the possibility that workers affected by the policy may have ended up being absent more often under another benefit scheme, that of working accidents. We are the first to be able to soberly test this possibility and, indeed, we found that absences related to work-related accidents significantly increased after sick leave generosity was curtailed. As most accidents experienced by the treated public sector employees are due to ‘back pain’, a category that experienced large drops in both sick leave absences and relapses, we interpreted this as being a further indication that cross-benefit displacement is at play here. Taking this into account slashed our main estimated effect on

sick leave on absences by almost two-fifths, showing how crucial it is to take such spillovers into account when evaluating any benefit reform policy in the future.

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ONLINE APPENDIX

Supplementary Figures and Table

Figure A1. Sick Leave: Number of Workers and Number of Spells

Figure A1.1. Total number of workers per quarter.

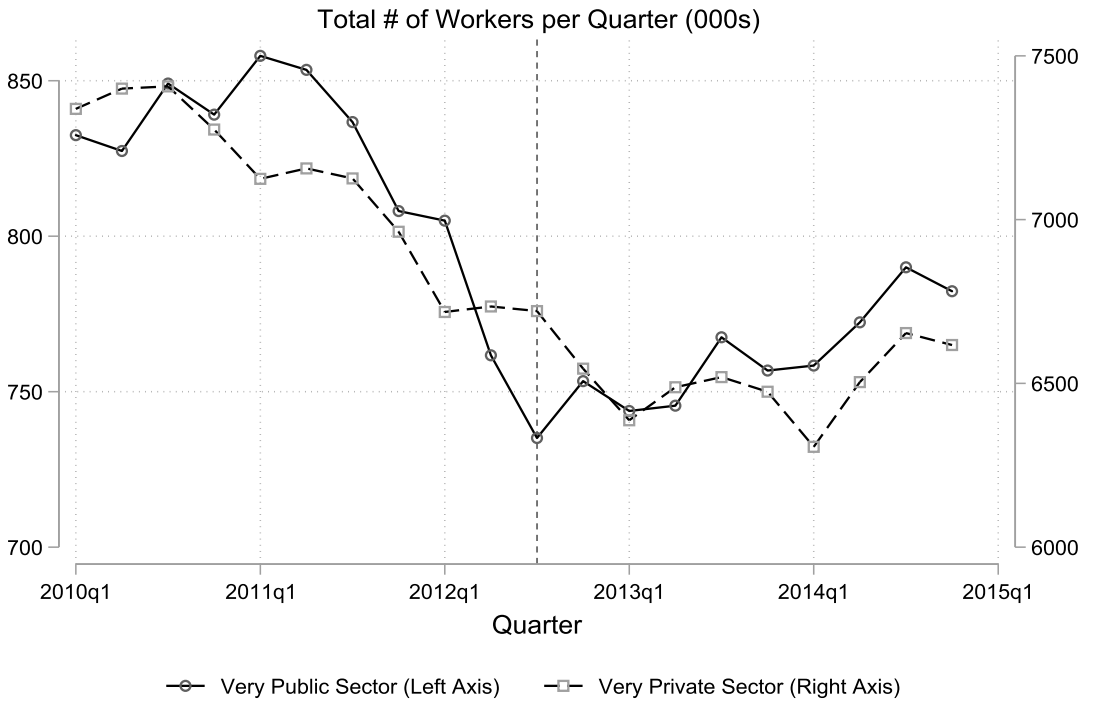
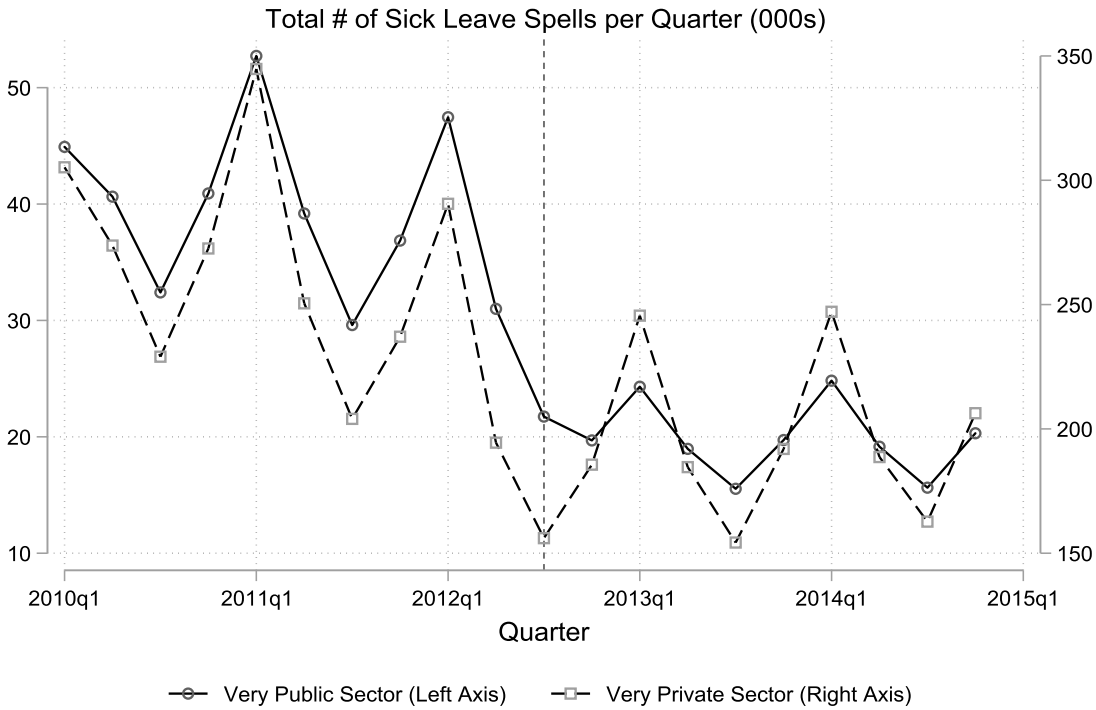
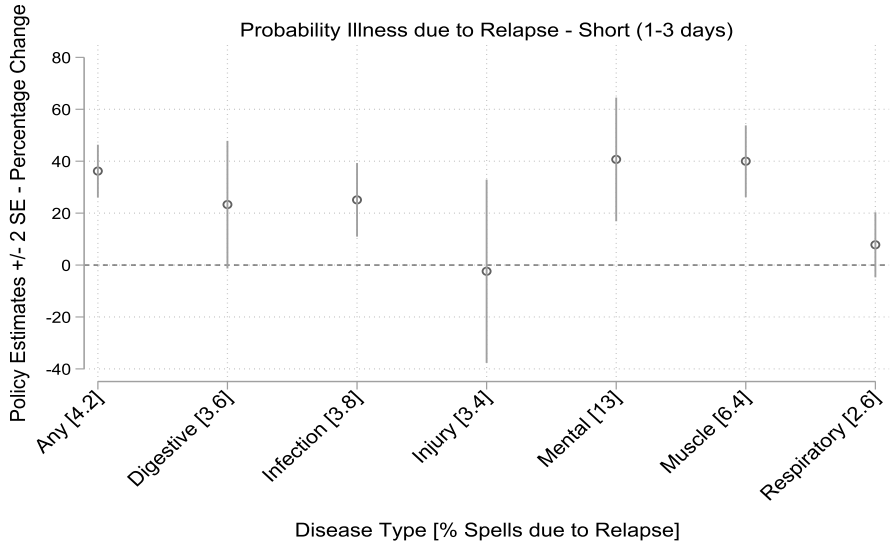


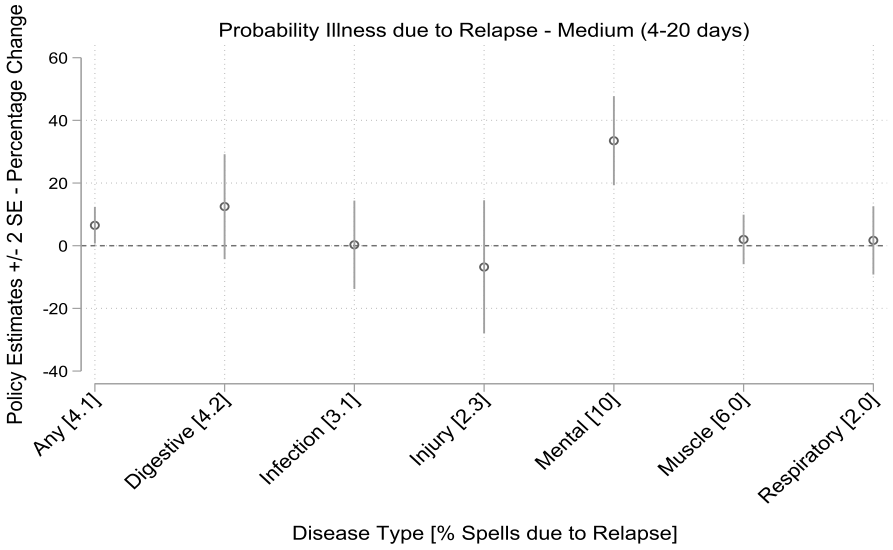
Figure A1.2. Total number of sick leave spells per quarter.

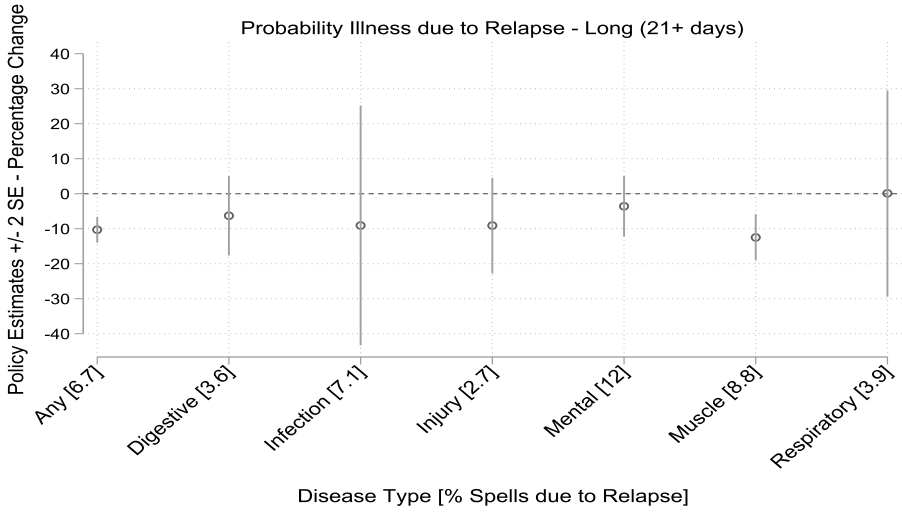


Source: Own elaboration with data from the Spanish Labor Force Survey on the number of employed workers in each quarter and sector for the 2010-2015 period. The vertical dashed line indicates the quarter of policy introduction. Very public sector includes workers in an activity group in which more than 95% of the workers are public employees (treated group). Very private sector includes workers in an activity in which less than 5% of the workers are public employees (control group). See Table A1 for more details.

Figure A2. Percent Change in Sick Leave Spell due to a Relapse, by Disease Type and Spell Duration.







Notes: We report here the size of the policy impacts (i.e. coefficient estimates/mean pre-policy level) and the 95% confidence intervals of regressions following equation (1) where the dependent variable is the probability that the sickness absence is due to a relapse from a previous illness. We estimate the regression separately for each type of diseases and for three different spell durations: 1-3 days (top left graph), 4-20 days (top right graph), and 21+ days (bottom left graph).

Figure A3. Incidence and duration of working accidents.

Figure A3.1. Incidence of working accidents per 1000 workers

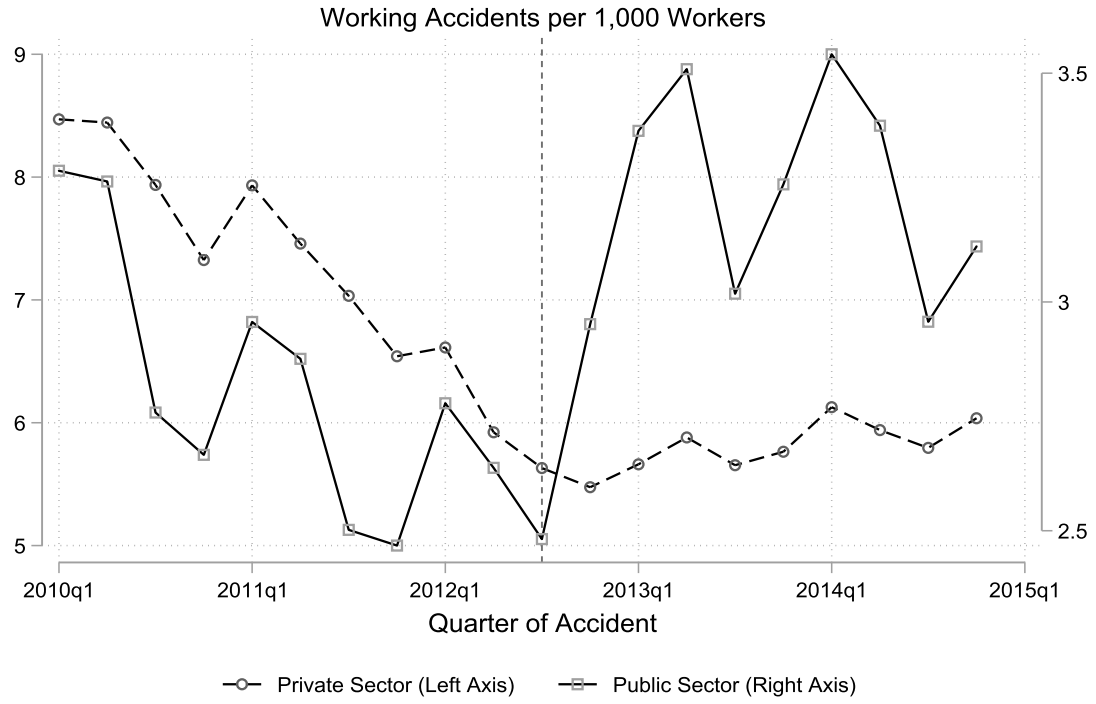
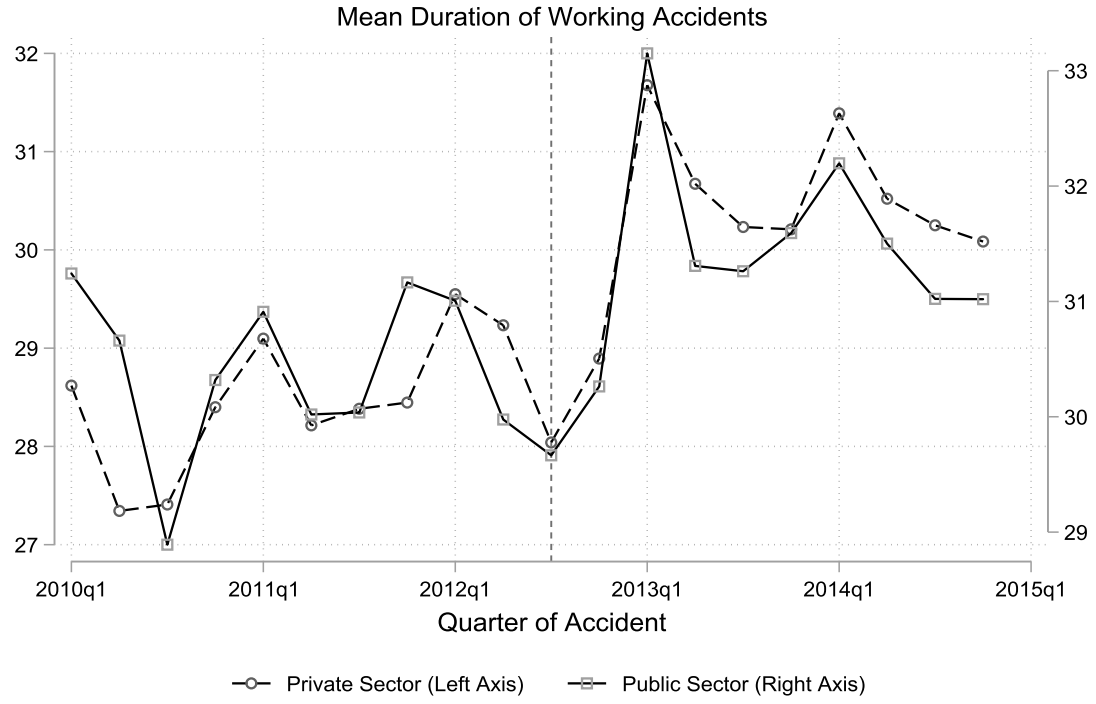


Figure A3.2. Mean duration of working accidents.



Notes: Own elaboration with administrative Spanish Social Security data, which includes the universe of working accidents in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey on the number of public and private sector workers each quarter. The vertical dashed line indicates the quarter of the sick leave policy introduction.

Table A1. Sector Level Descriptive Statistics of Number of Sick Leave spells, Percentage of Total Workforce and Percentage in Public Sector.

Economic Activity Sectors		# Sick	% Total	% Public
Code	Description	Leave	Workforce	Sector
A	Agriculture, forestry and fishing	125,303	1.83	2.12
B	Extractive Industries	23,783	0.35	3.54
C	Manufacturing	1,519,611	22.22	0.77
D	Electricity, gas, steam and air conditioning supply	20,443	0.30	0.47
E	Water supply, sanitation, waste management & decontamination	166,369	2.43	13.48
F	Construction	621,778	9.09	0.76
G	Wholesale and retail; Motor vehicles and motorcycles repair	909,929	13.31	0.11
H	Transport and storage	540,237	7.90	12.97
I	Hostelry	351,417	5.14	0.67
J	Information and communications	204,901	3.00	4.16
K	Financial and insurance activities	120,855	1.77	0.92
L	Real state agencies	15,044	0.22	0.71
M	Professional, scientific and technical activities	333,609	4.88	8.03
N	Administrative activities and ancillary services	555,764	8.13	4.42
O	Public Administration and Defense	601,343	8.79	98.07
P	Education	134,562	1.97	70.45
Q	Health and social services	405,630	5.93	59.60
R	Artistic, recreational and entertainment activities	78,023	1.14	13.00
S	Other Services	87,363	1.28	2.61
T	Domestic staff hired for household activities	19,569	0.29	0.00
U	Extraterritorial organizations	2,241	0.03	0.93
Total		6,837,774	100.00	16.31

Notes: Own elaboration with register data from the Spanish Social Security Administration, which includes the entire population of sickness absences in Spain from 2010 until 2014, and data from the Spanish Labor Force Survey (EPA: https://www.ine.es/uc/OYWlVdpH) on the percentage of workers (ages 25-60) employed in the public sector in each quarter and sector over the same period.

Table A2. Sick Leave Spells Descriptive Statistics by Very Public/Private Sector.

	Sick Leave Spells for Men Aged 25-60, 2010-2014		
	All Spells	Very Public	Very Private
Public sector workers (%)	.163	.981	.013
Mean duration (# days)	30.2	31.3	29.5
Duration 1-3 days (%)	.277	.229	.275
Duration 4-20 days (%)	.440	.237	.444
Duration 21+ days (%)	.283	.309	.280
Disease categories (top 6)			
Muscles and joints (%)	.204	.226	.204
Respiratory system (%)	.175	.172	.177
Infectious diseases (%)	.117	.118	.119
Injuries (%)	.115	.104	.115
Digestive system (%)	.092	.084	.092
Mental disorders (%)	.055	.064	.055
Relapses (%)	.048	.051	.046
Mean Age (years)	40.6	42.7	39.9
Sample Size	6,760,117	593,904	4,509,467

Source: Own elaboration from data of the Spanish Social Security Administration, which includes the universe of sickness absences in Spain from 2010 until 2014. Very public and private sectors are defined using sector level data from the Spanish Labor Force Survey for the same period (see Table A1 for more information). There are 17 possible disease categorizations for a sick leave spell and the table reports the six most common which together represent over 80% of the total (see Table A5 for details on this). Relapse is an indicator that a sick leave spell is for the same previously diagnosed illness that already required an absence from work within 6 months

Table A3: Testing for Changes in Worker Composition around Policy Introduction – Private Vs Public Sector

Workforce Characteristics (Individual, Jobs, Household)	Age (years)	Older (> 50)	Foreign	Low Education	Tenure (months)	Part Time (< 40 hrs)	Work Overtime	Currently Married	Child at Home
Public Sector *After Policy	-0.235	0.009	0.009	0.011	0.547	0.001	0.003	-0.002	0.004
	(0.275)	(0.012)	(0.014)	(0.021)	(0.334)	(0.008)	(0.002)	(0.008)	(0.006)
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Sector & Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean in Public Sector Pre-Policy	44.8	.346	.008	.155	13.2	.397	.022	.662	.393
Mean in Private Sector Pre-Policy	41.7	.240	.078	.439	8.1	.265	.052	.632	.428
Observations	520,599	520,599	520,599	520,599	405,400	389,193	405,541	520,599	520,599

Notes: Table presents differences-in-differences estimates where the outcome of interest are individual, job, and household characteristics of each worker regressed against a treatment indicator that the individual is employed in the public sector. It also include year-quarter, economic, and province, fixed effects and is thus similar to the specification presented in equation (1) to measure the main policy effect – except that it is at the individual not spell level – but now aims to detect any change in worker composition in the public sector between the pre- and post-policy period. Own elaboration using data from twenty quarterly waves of the Spanish Labor Force Survey (EPA: https://www.ine.es/uc/OYWlVdpH) between 2010Q1 and 2014Q4. Robust standard errors clustered at the sector-quarter in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table A4. Unconditional Impact on Sick Leave Spells Started: Duration Thresholds and Relapses

Type of Sick Spell Started per 1,000 Workers	1-3 days	4-20 days	21+ days	Relapses
	(1)	(2)	(3)	(4)
Proportion Public *After Policy	-3.64***	-8.11***	-1.83***	-.615***
	(.496)	(.758)	(.232)	(.056)
Year and Quarter Fixed Effects	Yes	Yes	Yes	Yes
Economic Sector Fixed Effects	Yes	Yes	Yes	Yes
Mean of Outcome	12.1	20.5	12.0	2.16
Policy Effect at Mean (%)	-30.1	-39.6	-15.2	-28.5
Observations	420	420	420	420

Notes: Coefficients reported stem from continuous differences-in-differences estimates where the treatment in each sector is assigned relative to the proportion of public sector workers they employ before policy introduction. Table A1 of the appendix reports these proportions for all 21 economic sectors. These are unconditional policy impacts estimates as they measure the number of spells started of a certain type – categorized around replacement rate days thresholds or as being due to illness relapse or not – started per 1,000 workers and are thus not conditional on incidence change. Robust standard errors in clustered at the sector-quarter level in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table A5. Disease Categorization and Descriptive Statistics: Number of Sick leave Spells, Percentage of Spells, and Mean Duration. (Before and After Policy Introduction for Public and Private Sector Workers).

Main Disease Category	Main Disease Sub-Categories (%)	Number of Spells	% Spells		Mean Duration	
			Before Pub. | Priv.	After Pub. | Priv.	Before Pub. | Priv.	After Pub. | Priv.
Muscles and joints	Back pain (43%) Joint paint (18%)	1,284,471	20.5 20.4 | 23.4	20.1 20.4 | 20.9	40.8 41.2 | 35.0	45.6 44.3 | 53.0
Respiratory system	Influenza (22%) Pharyngitis (15%)	1,101,492	17.3 17.5 | 17.6	17.6 18.0 | 16.3	8.9 8.7 | 8.9	8.6 8.3 | 10.5
Infectious diseases	Gastro infections (53%) Throat infections (17%)	738,261	11.9 12.1 | 10.9	11.5 11.8 | 9.2	6.4 6.3 | 6.7	6.1 5.9 | 8.0
Injuries	Sprained ankle (46%) Main symptom: fever (11%)	725,022	11.5 11.5 | 11.7	11.5 11.5 | 12.1	42.8 41.3 | 39.8	46.6 44.3 | 54.6
Digestive system	Non-infectious gastro (24%) Hernias (13%)	577,405	9.0 9.2 | 8.0	9.4 9.3 | 9.4	22.4 22.4 | 21.5	25.5 24.8 | 32.3
Mental disorders	Anxiety (57%) Depression (17%)	347,810	5.5 5.1 | 6.2	5.5 5.1 | 7.0	64.2 64.9 | 61.1	68.2 66.7 | 78.2
Nervous system	Vertigo (12%) Conjunctivitis (12%)	285,364	4.4 4.4 | 4.2	4.7 4.5 | 5.0	28.7 28.1 | 28.6	31.4 29.9 | 37.1
Circulatory system	Hemorrhoids (18%) Varicose veins (12%)	183,813	2.8 2.8 | 2.4	3.1 3.0 | 3.5	64.3 63.5 | 60.4	68.1 65.9 | 76.2
Skin diseases	Cellulite and abscess (23%) Pilonidal cyst (18%)	123,553	1.9 2.0 | 1.6	2.0 2.1 | 2.0	25.6 25.2 | 24.7	27.4 26.5 | 32.5

Table A5 (Continued) Disease Categorization and Descriptive Statistics: Number of Sick leave Spells, Percentage of Spells, and Mean Duration (Before and After Policy Introduction for Public and Private Sector Workers).

Main Disease Category	**Main Disease Sub-Categories (%)**	**Number of Spells**	**% Spells**		**Mean Duration**	
			Before Pub. | Priv.	After Pub. | Priv.	Before Pub. | Priv.	After Pub. | Priv.
Genitourinary system	Urinary tract infection (15%) Orchitis & epididymitis (12%)	118,589	1.8 1.7 | 1.6	2.1 2.0 | 2.4	26.5 26.0 | 27.3	26.6 25.6 | 29.7
Neoplasms	Benign tumors (41%) Malignant tumors (14%)	88,199	1.3 1.2 | 1.2	1.6 1.5 | 2.3	76.8 75.8 | 66.0	81.6 78.9 | 82.6
Endocrine diseases	Gout (51%) Diabetes (18%)	50,378	0.8 0.8 | 0.9	0.8 0.7 | 0.9	29.9 29.2 | 29.0	32.2 30.2 | 35.5
Congenital anomalies	Musculoskeletal (17%) Eyes (9%)	10,309	0.2 0.2 | 0.1	0.2 0.2 | 0.2	54.9 54.6 | 46.1	56.8 55.0 | 53.0
Blood diseases	Anemias – not specified (20%) Anemias – iron deficiency (13%)	5,653	0.1 0.1 | 0.1	0.1 0.1 | 0.1	71.6 72.7 | 67.6	75.7 74.2 | 82.2
Disease not well defined	Symptom: renal colic (11%) Symptom: fever (11%)	666,394	11.0 11.1 | 10.1	9.8 9.9 | 8.7	20.7 20.4 | 20.8	22.1 21.0 | 27.6
All types of disease	Back pain (9%) Gastro infections (6%) Flu (4%)	6,331,743	61.2 60.2 | 69.6	38.8 39.5 | 30.4	28.8 28.3 | 27.4	31.6 30.0 | 39.4

Notes: The table reports for all sick leave spells taken in Spain from 2010 to 2014: the main disease category classification; the two main sub-classification and the relative percentage they represent in each category; the total number of spells per main disease category; the percentage of spells each disease category represents and the mean duration of each spell per disease category, separately for public (Pub.) and private (Priv.) sector workers both before and after the policy introduction. Author's own calculation from administrative data using classifications from Ministry of Health, Consumption and Wellbeing (Ministerio de Sanidad Consumo y Bienestar Social) with details available at: https://eciemaps.mscbs.gob.es/ecieMaps/browser/index_9_mc.html.