The hidden costs of fixed term contracts: the impact on work accidents

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Abstract

This paper assesses whether or not there is a systematic difference between the accident rates of fixed-term and permanent contract workers that is not just the result of a compositional effect. A pure contractual effect leading to a higher accident rate might exist because the short duration of the temporary contract reduces the incentives to invest in specific human capital or because effort is higher to increase rehiring probabilities. I provide two identification strategies to control for selection and reporting biases. The results confirm there is a pure contractual effect that increases the accident probability by 5 percentage points.

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Keywords: Work accidents; Fixed-term contracts; Productivity

1. Introduction

What are the consequences of allowing for different contractual arrangements within the labour market on productivity and workers' welfare? Different arrangements for labour market institutions and the types of contracts allowed in an economy may have different consequences in terms of labour market efficiency and productivity. It is therefore important to take these consequences into account in order to devise the optimal design

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for a labour market. Different types of contracts have been shown to differ in the wages they offer[1] and in the training provided by employers.[2] However, there is little evidence on other consequences of the incentives generated by the different types of contracts such as their impact on productivity and workers welfare.

In this paper, I develop the idea that different types of employment contracts provide different incentives to both the worker and the firm, and hence, result in different labour market outcomes. More precisely, I focus on the differential impact of the type of contract on work accident rates for fixed-term contract (FTC) versus indefinite or permanent contract (IC) workers. In a market where firms can chose between fixed-term and permanent contracts for their workers, theory predicts that workers on fixed-term contracts (characterised by a shorter duration and where rehiring is uncertain) will have a lower investment in specific human capital than their colleagues on permanent contracts. In addition, FTC workers may also exert more effort on the job to raise their rehiring probabilities. The direct consequence of both a lower investment in human capital and higher effort is that FTC workers will have a higher probability of having an accident at the workplace.

In many countries, there is no difference between the types of contracts legally allowed, or these are very similar, and it is therefore difficult to assess the actual impact of those arrangements (since there is no counterfactual available). This is why Spain is an ideal scenario to study these issues since it has a dual system in which temporary and permanent contracts are very different in terms of job protection. Furthermore, a substantial part of the Spanish workforce (31% in 2000) is on fixed-term contracts, and its accident rate has fluctuated substantially in the past 20 years. Spain has the highest work accident rate in the European Union, and while the European Union average in 1998 was 4.09 accidents per 100 workers, the Spanish incidence rate was 7.07 accidents per 100 workers.[3] Concerning the different incidence of accidents between FTC and IC workers, in 1999 the incidence of work accidents for FTC workers was 13% while that of IC was 4.1%. The increase in work accidents has gone parallel to that in fixed-term contracts (Figs. 1 and 2). This paper attempts to explain what part of this very large difference is due to a pure contractual effect.

There are other elements that create a differential in the accident rates of temporary and permanent workers that do not result strictly from a contractual effect. First, there may be some type of selection that results in FTC workers being more or less accident prone independently of the contract type. For instance, if employers systematically hire the low-ability workers under FTC. This would result in a higher accident rate for workers that is not a result of a contractual effect. Second, fixed-term contract workers may systematically misreport the true accident rate. As a result of moral hazard, workers on FTC may report

[1] Jimeno and Toharia (1993) show that Spanish workers on temporary contracts receive a lower pay than their permanent counterparts.

[2] Booth et al. (in press) find that the probability of receiving on-the-job training for workers in some type of FTC with respect to their permanent counterparts is 12% lower for male and 7% lower for female workers.

[3] These are harmonised data from the European Statistics on Accidents at Work (ESAW) study run by the EU Commission and correspond to accidents at work resulting in more than 3 days of absence and fatal accidents at work. For reference see Dupré (2001).

Fig. 1. Evolution of FTC and accident rate 1987–1999.
Source: EAT and EPA.

Fig. 2. Incidence of accidents for FTC and IC workers 1989–1998.
Source: EAT and EPA.

accidents more frequently than IC workers. On the other hand, having had an accident may be a bad signal to your current employer, who is also a potential future employer, and to other potential employers. In that case, FTC workers have an incentive to underreport their accidents in order to have a higher probability of having their contracts renewed. For these reasons, FTC may alter the reporting incentives and this will also reflect in differential accident rates.

In this paper, I analyse two panels of sectoral work accidents between 1988 and 1998 for 32 industrial branches and apply two different identification strategies to distinguish the pure contractual effect from the selection and reporting biases. The first identification strategy is a difference estimator while the second exploits accidents on the way to work to identify the pure contractual effect.

In what follows I assess what fraction of the raw difference in accident probabilities between fixed-term and permanent workers is due to the pure contractual effect derived from the duality of contracts, and see if after controlling for all the elements that may affect that gap a differential between FTC and IC accident rates persists. If this is so, one can conclude that temporary workers not only earn lower wages (Jimeno and Toharia, 1993) but they also have a higher accident risk.[4] This would be consistent with the theory and empirical analysis developed by Hamermesh (1999) where increasing wage inequality is accompanied by increasing inequality in work disamenities including risk of work injury.

The next section describes what determines the different accident rates between contracts. Section 3 outlines the econometric specification. Section 4 describes the data used and the identification strategies. Section 5 presents the results and Section 6 concludes.

2. Reasons for a differential in accident rates between FTC and IC workers

From the existing theory, we can select three different sets of reasons why there may be a systematic difference between the accident rate of fixed-term workers and that of permanent workers.

Firstly, investments in specific human capital depend on the expected return of the investment. For workers with short duration contracts, the incentives of the employer and the worker to invest in specific human capital are lower than for identical workers with longer contract durations. These lower investments create a differential in human capital that may lead to systematically higher accident rates for those with temporary contracts. In this framework, specific human capital would include not only on-the-job training to learn to do the job better, but also investment/training in health and safety (that are typically done by the employer). As far as related evidence on this is concerned, Booth et al. (in press) find on UK data that temporary workers receive less on-the-job training than permanent workers. Furthermore, there is a related literature in the medical and epidemi-

[4] A potential explanation to the difference in accident rates would be that FTC workers are systematically assigned to dangerous tasks. If this were the only explanation, then the incidence for IC workers should have been falling over time (unless risk in the economy had increased dramatically). Fig. 2 shows that it has remained stable while that of FTC workers is much higher and increased over time.

ology fields on the impact of contract precariousness on health. Benavides and Benach (1999) and Benavides et al. (2000) find that job dissatisfaction, fatigue, backache and muscular pains are positively associated with precarious employment. This seems to indicate that investments made by employers in health and safety measures are lower for FTC workers.[5] These differential investments in human capital arise from the difference in contract durations, and hence, a lot will hinge on the probability that a fixed-term worker is rehired on a permanent basis. If the worker is relatively certain that he will be rehired, then there should not be much difference between the two types of contract, but when rehiring probabilities are low, the mentioned effect will be fully at work. Güell and Petrongolo (2000) find that in Spain the probability of conversion of a fixed-term contract into a permanent one went down from almost 20% in 1987 to 7% in 1996.[6] Booth et al. (in press) find for the UK that on-the-job training is lower for FTC workers. In fact, previous studies have shown that fixed-term contracts are used by firms as a flexible mechanism to adjust employment to fluctuations in the business cycle rather than using them as a worker screening or testing device (see Blanchard and Landier, 2001). It is also possible that the fact that FTC workers are less protected by trade unions reduces their bargaining power, enabling employers to reduce their investment in safety measure and training for those workers. This would reinforce the mentioned effect of having a fixed-term contract on accident rates through human capital differences.

Secondly, a stream of literature has analysed the moral hazard effects in relation to work accidents. Fortin et al. (1999) analyse the relationship between workers compensation (WC) and the probability of reporting accidents and incorporate the interaction between WC and unemployment benefit. They argue that if WC is more generous than unemployment benefit (UB), those workers who are close to being laid off will try to benefit from WC as much as they can. This applies straightforwardly to the case of FTC, and workers who know their contract is close to expiry will report more since they are entitled to WC (and maybe not to UB). This is referred to as ex ante moral hazard. There is also a form of ex post moral hazard given by those who have injuries that are difficult to diagnose. These people will claim WC and exaggerate their state.

In Spain, an FTC worker who has an accident is entitled to 75% of his previous wage as worker compensation. This may last for a maximum of 12 months (plus six if those extra 6 months lead to recovery). To be entitled to benefit, the worker must have made social contributions for at least 12 months in the previous 6 years (6 months in the previous 4 years before the 1992 reform). The amount of unemployment benefit received is 70% of the previous wage (80% before 1992) for the first 6 months subject to a maximum and a minimum cap.

[5] Amuedo-Dorantes (2002) finds in a study for Spain in 1997 that workers on FTC have worse working conditions than IC workers. She then studies the impact of the type of contract on the accident probability after controlling for these working conditions and finds a negligible effect. Unfortunately, that study does not attempt to control for the moral hazard, reporting effects and selection on ability biases as I do in this paper. This residual contractual effect is likely to be a combination of all these reasons plus the pure contractual effect.

[6] They explain that in their sample from the Spanish Labour Force survey, a third of fixed-term contracts terminate with a new FTC, a third terminate in unemployment or inactivity and 11% are renewed to a permanent basis. Twenty percent of the spells they observeare censored.

Table 1
Descriptive statistics of contract data

	Fixed-term contract		Permanent contract	
	Mean	S.D.	Mean	S.D.
Accident probability	0.116	0.105	0.0457	0.043
Tenure				
≤ 2 months	0.353	0.127	0.016	0.012
2 to 6 months	0.296	0.057	0.024	0.014
6 months to 1 year	0.251	0.844	0.076	0.032
1 to 3 years	0.075	0.058	0.104	0.036
3 to 10 years	0.0199	0.024	0.283	0.046
More than 10 years	0.0046	0.009	0.498	0.103
Age				
≤ 25	0.415	0.132	0.099	0.062
26 to 35	0.310	0.077	0.282	0.055
36 to 45	0.153	0.055	0.286	0.056
46 to 55	0.088	0.049	0.216	0.056
More than 55	0.034	0.030	0.116	0.044
Overtime	0.115	0.081	0.102	0.077
Male	0.622	0.262	0.675	0.209
Training contract	0.029	0.021	0	0
Seasonal contract	0.111	0.128	0	0
Other FTC contract	0.859	0.121	0	0

Within this system, a moral hazard problem of the ex ante type may appear especially for young workers on FTC who are not entitled to unemployment benefit because they have not been contributing long enough.

A third source of hazard for the temporary workers is that if the probability of being rehired is increasing in effort, then FTC workers will exert more effort on the job. Intensity of work (or faster pace to impress the employer) will increase accident probabilities. Jimeno and Toharia (1996) find evidence that this is happening in Spain but do not make the link to the accident rate.[7] Descriptive studies on health at the workplace also find that FTC workers are less absent from work than permanent workers (Benavides et al., 2000; see also Paoli and Merlié, 2001). At the same time, and following this argument, a systematic underreporting of accidents might appear since if having had an accident is a negative signal for the employer and reduces (re)employment probabilities, FTC workers will tend to underreport accidents. So the reporting effect may go either way. In our estimation, the net reporting effect will be dealt with using accidents on the way to work as a proxy for accident proneness.

In addition to the human capital and reporting effects, the difference in accident rates between the two types of contracts may be the result of some type of selection on who holds a fixed-term contract. If it is "bad" workers who are systematically hired

[7] In the empirical analysis they proxy effort with absenteeism but the data are such that one cannot distinguish absences due to illness and those due to accidents. They run a probit of the probability of being absent form work controlling for different measures of sectoral/occupational accident rates to separate absences due to accidents from the absenteeism effect.

on temporary contracts, then the gap is just a result of some unobserved difference in the quality/ability of workers. The analysis in this paper provides a way to control for this.

It must also be noted that there are no systematic institutional differences in the treatment of FTC and IC workers. Health and safety regulations treat both types of workers equally.[8] Furthermore, the reporting procedure of work accidents, the fact that firms are not penalised for housing a lot of accidents (no experience rating) and that it is insurance companies who pay the workers compensation implies that there is close to 100% notification and that there are no differences in the behaviour of workers due to different incentives provided by the legislation.

Finally, in the empirical analysis, other mechanisms must be controlled for. Workers on FTC will typically have less tenure and if experience is acquired with tenure then FTC workers will have more accidents just through this compositional effect. The empirical analysis will account for these and other observable differences (see Table 1) to disentangle what is the proportion of the actual raw difference in accident probabilities that is exclusively due to the type of contract.

3. Econometric specification

The probability of an accident can be written as a function a of a series of covariates as $y^*_{ijt} = Pr(y_{ijt} = 1) = F(X_{ijt}, \beta)$. At the individual level we would observe $y_{ijt} = 1$ if $F(X_{ijt}, \beta) > z^*$ and $y_{ijt} = 0$ otherwise. Aggregating all the individuals in a sector j yields the proportion of the n_{jt} individuals in sector j who had an accident in time t. This observed proportion P_{jt} is an estimate of the population quantity π_{jt}, which is determined by $F(X_{jt}, \beta)$. A standard econometric technique to apply to these data is the minimum chi-square logit estimator.[9] Assuming a logistic distribution for F allows us to work with the transformation:

$$\ln\left(\frac{\pi_{jt}}{1-\pi_{jt}}\right) = \beta' X_{jt} \tag{1}$$

This is estimated by weighted least squares and produces the minimum chi-squared logit estimates of β. Marginal effects are computed as: Ma.effect $= \hat{\beta}^* \bar{P}(1-\bar{P})$, where $\bar{P}$ is the average sample probability of an accident.

My analysis is based on computing the sample probabilities of having an accident in a given sector and year. This is regressed using the minimum chi-squared logit method on a series of covariates that account for the business cycle, sectoral variables and individual characteristics. The standard errors are computed using the White covariance

[8] The adoption of the EC 91/383 directive on health and safety for FTC workers in the Spanish legislation (in the Ley de Prevencion de Riesgos Laborales in 1995, article 28) has established equal treatment for both types of workers. Nevertheless, the ban on dangerous jobs for FTC workers has only been adopted for workers hired through temporary work agencies since 1999 (RD 216/1999).

[9] See Amemiya (1981) for a complete analysis.

matrix. The individual level regression would be a limited dependent variable regression of:

$$y_{ijt} = 1 \text{ if } \alpha + X_{ijt}'\beta_1 + Z_{jt}'\beta_2 + \gamma_1 \text{FTC}_{ijt} + \gamma_2 dt_t + \gamma_3 dj_j + \varepsilon_{ijt} > 0 \quad (2)$$

$$y_{ijt} = 0 \text{ otherwise}$$

where X_{ijt} are individual characteristics, Z_{jt} are sectoral variables, FTC_{ijt} is a dummy variable of whether the individual is on fixed term contracts, dt_t and dj_j are a set of time and sector dummies. Since I have data for the proportions P_{cjt} of accidents by industrial branch and type of contract, Eq. (2) can be naturally specified in the grouped logit framework as:

$$\ln\left(\frac{P_{cjt}}{1-P_{cjt}}\right) = \alpha + \bar{x}'_{cjt}\beta_1 + Z'_{jt}\beta_2 + \gamma_1 \text{FTC}_{cjt} + \gamma_2 dt_t + \gamma_3 dj_j + \bar{\varepsilon}_{cjt} \quad (3)$$

where $\bar{x}_{cjt}$ are the mean values of individual characteristics by type of contract, sector and time. Note that it is possible in this framework to identify the coefficients of Eq. (3). The gap between the accident rates of the two types of workers will be captured by the coefficient γ_1.

Similarly, if instead using P_{cjt}, P_{jt} is used (accident probabilities by branch j and time t), then the equation to be estimated becomes:

$$\ln\left(\frac{P_{jt}}{1-P_{jt}}\right) = \alpha + \bar{x}'_{jt}\beta_1 + Z'_{jt}\beta_2 + \gamma_1 \overline{\text{FTC}}_{jt} + \gamma_2 dt_t + \gamma_3 dj_j + \bar{\varepsilon}_{jt} \quad (4)$$

where $\overline{\text{FTC}}_{jt}$ is the proportion of workers in sector j at time t that have a fixed-term contract.

Eqs. (3) and (4) are the basis of the empirical analysis.

4. Data and identification strategies

I use the work accidents data published by the Spanish Ministry of Labour and Social Affairs in the Estadística de Accidentes de Trabajo. In Spain all salaried workers must be insured against work accidents by law. The employer can choose whether to use public insurance with the national social security or to use a private insurance company (Mutuas de Accidentes laborales) and the premium paid depends on the wage of the worker regardless of the type of contract. In the event that an accident occurs, there is an obligation to declare it, fill in a report and pass it to the insurance company and the Public Administration. From those reports[10] aggregate statistics on the number of accidents according to different classifications are published in the E.A.T.

[10] Partes de accidentes laborales.

I use two different classifications from the E.A.T., and for each of them I have a different identification strategy. The aim is to have a measure for the pure contractual effect net of all compositional effects including the accident proneness and reporting biases.

Firstly, I use the number of work accidents by year, industrial branch and type of contract occurring in the period 1989–1998 to estimate Eq. (3). I identify the effect of temporary contracts using a difference estimator on the effect of holding a temporary contract. The problem with this estimator is that if there is a selection bias into FTC as a function of ability, accident proneness or any other unobserved variable, then the contract coefficient will be capturing this. The problem arises only if the selection is done through the unobserved characteristics.

To assess to what extent this coefficient captures the effect of ability or other types of systematic differences—like under- or overreporting—between workers in either type of contract, I use another data set, namely, the total number of accidents by industrial branch. These data are split into two groups: accidents occurred at the workplace and accidents on the way to work (Fig. 3). The identification strategy here relies on the assumption that the individual probability of having an accident on the way to work is independent of the type of contract held, but will depend on the accident proneness of workers. On the one hand, both the probability of having a serious or a fatal accident on the way to work and the probability of having an accident at work will depend on the accident proneness of the individual. Hence, introducing the probability of having a serious or a fatal accident in the estimation of Eq. (4) will capture the accident proneness and the contract coefficient will then be net of the ability/selection bias related to accident proneness. On the other hand, if there is a systematic reporting difference between the two groups (temporary and

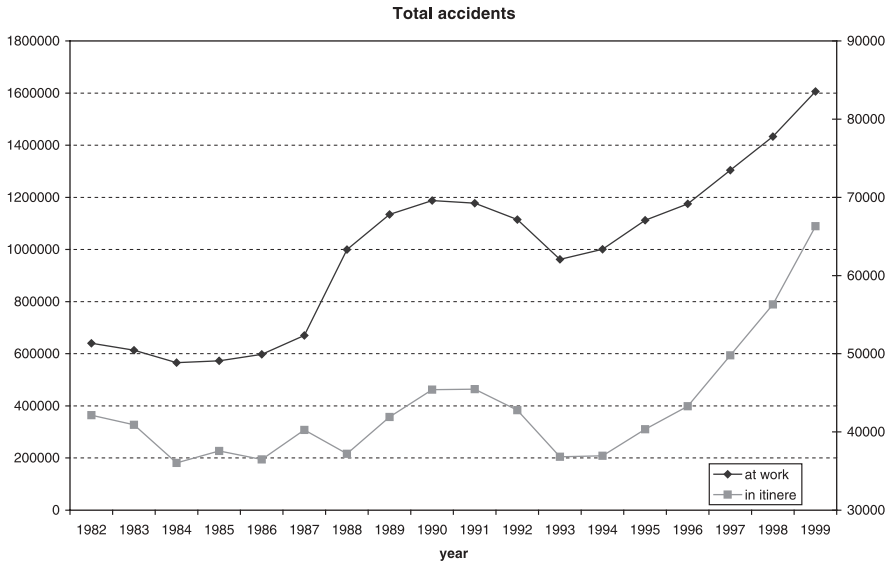

Fig. 3. Total number of accidents at work and on the way to work.
Source: EAT.

permanent), this should be captured by the variation in light accidents on the way to work. But light accidents also capture the accident proneness differential mentioned before (since one can misreport light accidents but not serious or fatal accidents). So including total accidents on the way to work (light, serious and deadly) in the regression will capture both the selection bias due to differences in accident proneness and due to systematic misreporting differences of workers on either type of contract.

Fig. 4 presents evidence for the validity of the identification strategy. If accidents on the way to work (in itinere) capture the changes in the accident proneness composition of both groups, then the ratio of accidents on the way to work to accidents at the workplace should be stable over time, everything else equal. Changes in that ratio should only be due to factors that affect differentially both magnitudes, like the changes in the proportion of people holding fixed-term contracts. The main characteristic of the 1984 reform—a major reform of the Spanish employment legislation—was that it introduced fixed-term contracts as a standard contract that could be used under a large number of circumstances (before that date they were seldom used and restricted to specific cases). So we should expect that before the reform this accident type ratio is stable and that if fixed-term contracts are

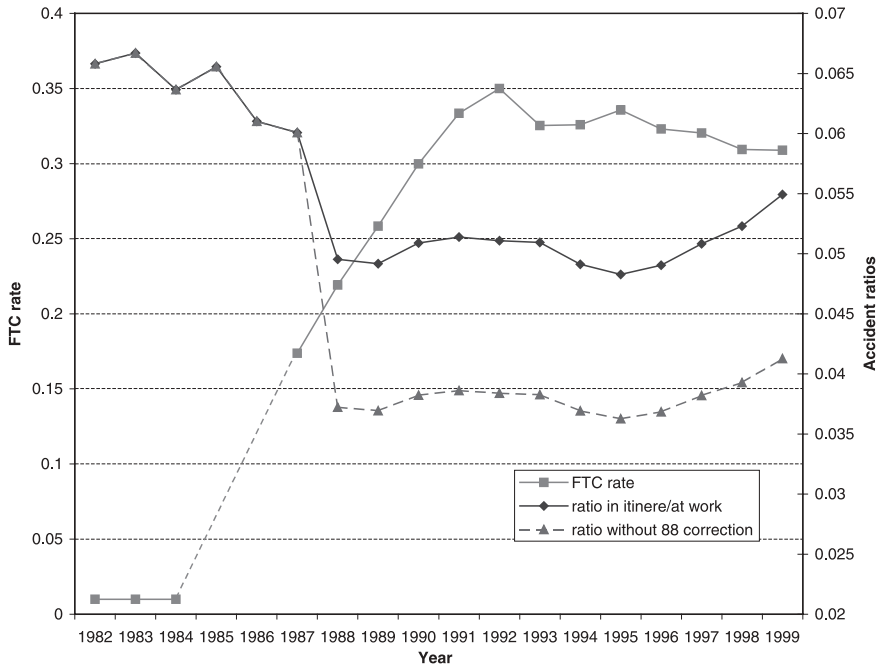

Fig. 4. Validity of the identification strategy.
Source: EAT and EPA. In 1987 the competency to record work accidents is assigned to a different entity in the Ministry and the rules to declare accidents are made more explicit (Orden 16 Dic. 1987). To minimise the risk of the large fall in the ratio being due to a statistical break, the solid line assumes that the increase in work accidents in 1988 is the same as that in 1987 and plots the ratio after this based on that figure. Also note that the FTC rate data before 1987 are an extrapolation: before 1984 FTCs were restricted to seasonal contracts and I assume they grow linearly after that (no data are available from EPA on FTC before 1987).

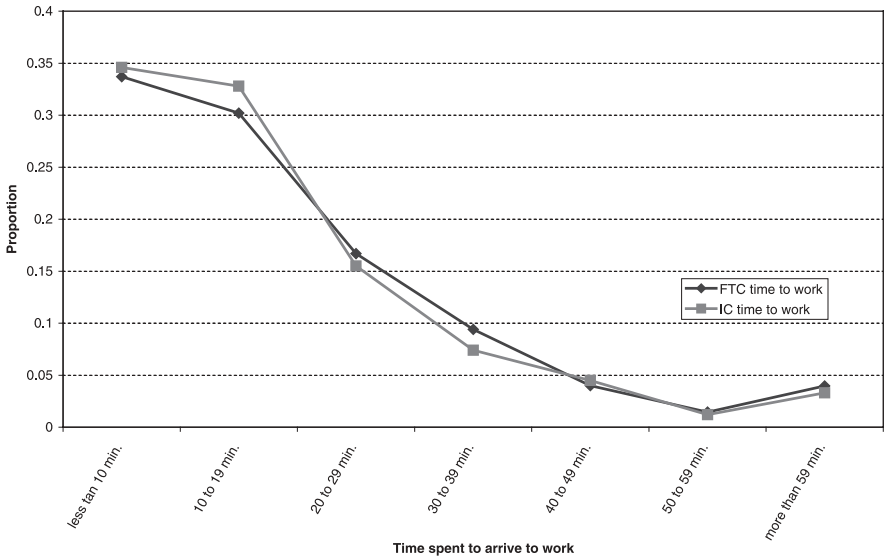

Fig. 5. Distribution of travel times to work by type of contract.
Source: Encuesta Nacional de Condiciones de Trabajo, 1997, C.I.S. Based on 3804 observations.

indeed relevant, the ratio will fall as the proportion of FTC in the economy increases. This is indeed what happens in Fig. 4. After the introduction of fixed-term contracts in 1984, the rise in the proportion of workers under FTC is accompanied by a fall in the ratio of accidents.[11] Further, Fig. 5 shows the distribution of travel time to work for both types of workers.[12] These are virtually identical supporting the idea that accidents on the way to work and type of contract are independent. This confirms the validity of the use of accidents on the way to work as a way to identify the pure contractual effect, since the variation in compositional changes will be captured by the accidents on the way to work. Thus, I estimate Eqs. (3) and (4) using two different panels of work accidents by branch. The following section describes the covariates used.

4.1. Determinants of the injury probability

The difference in accident rates of FTC and IC workers could arise from other differences that have nothing to do with the contract. The most immediate one is that workers on fixed-term contracts have shorter tenure and since the probability of an accident is decreasing in tenure and experience, FTC contracts will show a higher incidence just from this fact. But many other elements have an impact on injury probabilities. The determinants of injury probabilities fall into two categories: that of

[11] Fig. 3 shows the evolution of the total number of accidents at work and on the way to work. Both series are smooth and confirm that the big fall in the accident type ratio is capturing a progressive change in the risk of work accidents that is due to the widespread use of fixed-term contracts and is not a measurement problem.

[12] In the Canaries between 1996 and 2000, 61% of accidents on the way to work were caused by vehicles, the next category being falls (13%) (data provided by the Labour Agency).

Table 2
Descriptive statistics of accidents by seriousness (at the workplace/on the way to work)

	Mean	S.D.
Accident probability (yearly)		
Light, at the workplace	0.0509	0.0460
Serious, at the workplace	0.00096	0.00073
Deadly, at the workplace	0.000097	0.0011
Total at the workplace	0.052	0.0467
Light, on the way to work	0.00313	0.00199
Serious, on the way to work	0.00020	0.00011
Deadly, on the way to work	0.00003	0.000026
Covariates		
Tenure (proportion)		
≤ 2 months	0.097	0.045
2 to 6 months	0.089	0.034
6 months to 1 year	0.121	0.042
1 to 3 years	0.101	0.036
3 to 10 years	0.217	0.042
More than 10 years	0.377	0.110
Age (proportion)		
≤ 25	0.169	0.061
26 to 35	0.342	0.062
36 to 45	0.247	0.044
46 to 55	0.195	0.039
More than 55	0.122	0.065
Overtime (>40 h per week)	0.198	0.141
Male	0.666	0.208
Training contract	0.007	0.005
Seasonal contract	0.029	0.030
Other FTC contract	0.198	0.0.096

sectoral or aggregate data, i.e. how sectoral economic conditions affect injury probabilities, and then the individual characteristics of the worker. In the former category, I will include the following variables: sectoral unemployment rates and the growth rate of sectoral valued added as indicators of the business cycle; the sector to which the worker belongs; the sectoral vacancy rate as a proxy for the degree of expertise of those entering the labour force (when the vacancy rate is high it should mean that all the experts in the workforce have been employed and hence that the new recruits will have less expertise); year dummies to account for other macroeconomic effects that may not be captured in the previous variables and a sectoral trend in the first set of regressions.

Table 3
Sectoral variables

	Mean	S.D.
Proportion of FTC	0.232	0.092
Prop. first time unemployed	0.251	0.047
Sector unemployment rate	0.136	0.055
Gross value added growth rate	0.029	0.039
Vacancies	30,399	28,886

The other relevant set of factors are individual characteristics. Among these I include: the type of contract; the age, gender and tenure distributions; and the proportion of people that work overtime hours in the sector as a proxy for work intensity computed from the EPA. Finally, in the second set of results, I include the probability of having an accident on the way to work. Tables 1, 2 and 3 contain the descriptive statistics of the variables used and the detail of how these are built can be found in Appendix A.

5. Results

To analyse the effect of FTC on the probability of work accidents, I run the minimum chi-squared logit method on two sets of data. First, I use the data of work accidents at the workplace by branch and type of contract from 1989 to 1998. The covariates used in the estimation are as described in the previous section. The contract effect is captured by a dummy variable that indicates if the workers were on FTC.

The results are presented in Table 4. The sample raw differential in accident probabilities is of about 7 percentage points. FTC workers have an accident probability of 11.6% while for IC workers it is 4.5%.

Table 4
Probability of accidents at the workplace by type of contract

	Coefficient	Coefficient	Coefficient
Constant	− 4.879** (0.084)	− 137.665** (28.89)	− 159.46** (29.32)
FTC dummy	1.032**(1) (0.114)	0.838**(2) (0.0256)	1.464**(3) (0.270)
U rate	x	− 0.669 (0.709)	− 0.307 (0.615)
GVA growth rate	x	0.189 (0.496)	0.210 (0.365)
Vacancies	x	− 5.59e − 07 (1.58e − 06)	6.23e − 08 (1.21e − 06)
Male	x	x	0.355* (0.210)
Tenure distribution			
2–6 months	x	x	0.485 (0.350)
6 months to 1 year	x	x	1.568** (0.231)
1 to 3 years	x	x	1.125** (0.432)
3 to 10 years	x	x	0.651 (0.495)
More than 10 years	x	x	1.191** (0.385)
Age distribution			
26 to 35	x	x	1.330** (0.304)
36 to 45	x	x	0.139 (0.279)
46 to 55	x	x	0.054 (0.388)
More than 55	x	x	2.852** (0.604)
Overtime	x	x	− 1.189** (0.393)
Year dummies	x	yes	yes
Sector dummies	x	yes	yes
Sector trend	x	yes	yes
Observations	640	640	640
R^2	0.212	0.944	0.957

Marginal effects: (1) 0.058, (2) 0.041, (3) 0.072.
Standard errors in parenthesis.
* 10% significance.
** 5% significance.

Without introducing any other covariates, the effect of FTC is to increase by 5.8 percentage points the probability of having an accident. After introducing the set of controls, sectoral and time dummies the contract effect still survives and indicates that having an FTC increases the probability of accident by 7.2 percentage points. One might think that the coefficient may be biased if temporary workers are systematically of a different quality than permanent workers. In that case, this coefficient will be capturing that selection.[13]

The behaviour of the rest of covariates is as follows. The coefficients on the tenure distribution confirm that the accident probability is higher for people with short tenure and reaches a maximum for those between 6 months and 1 year of tenure. The results for the age distribution show that the age groups with more accidents are old workers (above 55) and those between 25 and 35. This may capture a number of effects like how careful these groups are at the workplace. Concerning gender differences, male workers have more accidents. Finally, the coefficient on the proportion of workers who did overtime hours, which was used as a measure of work intensity, is negative and significant. This is probably because the probability of having an accident for a low tenure worker is higher than that of an experienced worker even when the latter works overtime. In sectors that prefer to make their workers work extra hours instead of hiring new workers, the accident rate will be lower. Finally, branch and year dummies as well as a sector trend were included.[14]

The results confirm the idea that there is a contractual effect at work and it appears to be very large. But as mentioned above, if FTC workers are systematically selected according to some unobserved elements (such as ability), then the reported coefficient may be capturing that systematic difference and hence biased. To check that there is no underlying characteristic of fixed-term contract workers biasing the results, I exploit the second data set.

The second set of data records total accidents at the workplace by branch between 1988 and 1998. A grouped logit regression is run on the same set of industry variables as before. Now the contract effect is captured by the proportion of FTC workers in the branch. Note that most of the accidents are light (the probability of having a light accident at the workplace is 5%, that of a serious accident is 0.1% an that of a deadly accident is 0.001%), and hence, the probabilities of serious and fatal accidents are too small to run the analysis for the different types of accidents.

[13] Observed differences in the selection are controlled for in the regressors. If there are any unobserved differences determining whether the worker holds an FTC, then this would result in omitted variable bias. The second specification in Table 4 excludes as covariates the individual characteristics. The FTC coefficient changes considerably when one omits these variables indicating that selection into either type of contract is correlated with the observable characteristics.

[14] Sector dummies were highly significant confirming the idea that the risk differential between sectors is important and must be accounted for in the analysis. When these dummies were included, the sectoral variables lost significance although they kept the correct sign. The unemployment rate has a negative impact on accidents, indicating that when unemployment is high, there are fewer accidents because activity is low. Vacancies and the growth rate of value added have a positive effect on accidents.

Table 5 shows the results for accidents occurred at the workplace. After controlling for all covariates, the marginal effect of an increase in the proportion of temporary contracts of 1% is 0.038 (though with a *t* value of only 1.3).

At this point and as mentioned above, a potential problem with the estimation of the FTC effect must be dealt with. If there is some type of selection process by which FTC workers are of lower ability and hence have more accidents—and the selection is not constant across sectors—then the FTC coefficient will be capturing this. The other problem is that FTC workers may consistently overreport accidents (because of the moral hazard reasons mentioned before) or underreport them, if they want to make sure they are reemployed and want to avoid the stigma of looking like a "bad worker."

The identification strategy used for these data exploits accidents on the way to work and is based on the assumption that the true probability of having an accident on the way to work is independent of the contract held. Hence, using the proportion of serious and fatal accidents on the way to work as a regressor should control for the variation of accidents at the workplace that are due to variations in the quality of workers hired and hence the FTC coefficient will be free from the quality composition problem.

I also assume that the tendency to over/underreport an accident for an individual should be the same whether the accident occurs at work or on the way to work since

Table 5
Probability of accidents at the workplace

	Coefficient	Coefficient
Constant	− 5.094** (0.417)	− 5.813** (1.113)
Proportion of FTC	1.847**(1) (0.679)	0.762(2) (0.587)
U rate	x	− 0.357 (0.666)
GVA growth rate	x	− 0.051 (0.3324)
Vacancies	x	1.75e − 06* (9.06e − 07)
Male	x	− 0.222 (0.243)
Tenure distribution		
2–6 months	x	1.361 (1.408)
6 months to 1 year	x	3.307** (0.917)
1 to 3 years	x	2.849** (0.956)
3 to 10 years	x	0.512 (1.00)
More than 10 years	x	2.120** (0.838)
Age distribution		
26 to 35	x	− 0.702 (0.758)
36 to 45	x	1.130 (0.801)
46 to 55	x	0.165 (1.058)
More than 55	x	− 0.443 (1.325)
Overtime	x	− 1.708** (0.511)
Year dummies	x	yes
Sector dummies	x	yes
Observations	352	352
R^2	0.033	0.970

Marginal effects: (1) 0.091, (2) 0.038.
Standard errors in parenthesis.
* 10% significance.
** 5% significance.

Table 6
Probability of accidents at the workplace, control for quality

	Coefficient	Coefficient
Constant	− 5.495** (0.118)	− 7.369** (0.877)
Proportion of FTC	1.872**(1) (0.495)	1.501**(2) (0.482)
Proportion of serious + fatal acccident to work	1795.01** (110.0)	814.33** (72.7)
Set of controls	x	yes
Year dummies	x	yes
Sector dummies	x	yes
Observations	352	352
R^2	0.386	0.979

Marginal effects: (1) 0.092, (2) 0.074.
Standard errors in parenthesis.
* 10% significance.
** 5% significance.

the compensation received in either case is the same (in Spain accidents on the way to work are considered by law as work accidents). Hence, variations in the reporting bias because of changes in the composition of the workforce will be captured by variations in accidents on the way to work. In this case, it is light accidents on the way to work that enable the identification since only for this type of accidents workers can misreport the true state. Serious and fatal accidents are harder or impossible to misreport, so serious and fatal accidents will capture the ''ability'' or accident proneness element of the bias while light accidents will capture both the accident proneness and the reporting effects.

Thus, including the proportion of serious and fatal accidents occurring on the way to work as a regressor in the workplace accidents regression should eliminate the systematic differences between the two groups and we are left with a pure contractual effect that includes the human capital, increased effort and reporting effects. Then using the proportion of all types of accidents on the way to work also captures the variation in systematic reporting differences or other aspects that can be manipulated by the worker.

Table 7
Probability of accidents at the workplace, control for all unobservable hazard

	Coefficient	Coefficient
Constant	− 5.366** (0.122)	− 7.718** (− 0.640)
Proportion of FTC	1.533**(1) (0.555)	1.043**(2) (0.396)
Proportion of total accidents to work	115.03** (7.540)	78.714** (5.387)
Set of controls	x	yes
Year dummies	x	yes
Sector dummies	x	yes
Observations	352	352
R^2	0.454	0.984

Marginal effects: (1) 0.075, (2) 0.051.
Standard errors in parenthesis.
* 10% significance.
** 5% significance.

After introducing the proportion of serious and fatal accidents on the way to work and hence controlling for systematic differences in accident proneness, the contractual effect survives and is about 7.4 percentage points (Table 6). Further, controlling for all types of systematic differences including reporting biases preserves the positive effect of fixed-term contracts on the probability of accidents and yields a marginal effect of 0.051 (Table 7).[15] That is, after cleaning the contract coefficient of the selection and reporting biases, the contractual effect results in an increase of 5 points in the accident probability, i.e. it roughly doubles that probability.

6. Conclusion

This paper assesses whether there is a systematic difference between the accident rates of fixed-term and permanent contracts workers that is not just the result of a compositional effect. A pure contractual differential may arise because the nature of the temporary contract, namely, its short duration, reduces the incentives to invest in specific human capital and hence reduces the expertise of the worker leading to a higher accident rate. It may also increase effort exerted thus resulting in more accidents. On the other hand, there may be a systematic selection of workers into either type of contract due to ability or systematic reporting differences that might explain why fixed-term contract workers have more accidents. I try to separate the different effects and see if after controlling for all relevant elements, a contractual effect subsists.

I use a sectoral panel with 32 industrial branches over 11 years. The results indicate that there is a contractual effect at work that explains a very large part of the raw differential (around 70%). This effect subsists after I control for all observables plus the ability and reporting biases using accidents on the way to work. I claim that the resulting difference of 5 percentage points in accident probabilities is due to different investments in human capital (including safety training/measures) and different effort levels exerted on the job.

The consequences of these results in terms of social cost and productivity are evident. Workers on temporary contracts suffer from higher job insecurity both in terms of lower wages and higher accident risk. On the labour demand side, there are negative effects of allowing employers to use FTC to adjust employment to the business cycle at low cost: temporary contracts imply lower human capital accumulation and potentially lower productivity. A policy implication of these results would be to try to limit the use of FTC to cases where it is really necessary and bring in labour market flexibility using another type of institution that does not have this negative feature. Or set up the conditions so that more FTCs are transformed into permanent contracts and the mechanisms through which the pure contractual effect appears are no longer present.

[15] In any case note the increase in the R^2 in the first specification from Table 5 to Tables 6 and 7 indicates that accidents on the way to work are capturing a variation that explains a lot of the changes in workplace accidents. Also, the associated coefficients are positive and highly significant.

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Appendix A. Construction of the variables

(A) Sectors: I had to homogenise the industrial classifications CNAE74, CNAE 92 and the sectors as defined in the EAT (which groups the CNAE subsectors—2 digits—into 44 industrial groups). This forced me to group further some categories and I ended up with 32 ''branches'' or ''sectors'' that represent all areas of activity.

(B) Work accidents: three different panels of sectoral accidents were used. These were obtained from the Estadistica de Accidentes de Trabajo provided by the Ministerio de Trabajo y Asuntos sociales (M.T.A.S.). These are public data that are provided in paper format. The series are constructed from the aggregation of individual records. The series used here were: (1) Total number of accidents at the workplace per industrial branch, year and type of contract (fixed term or permanent); (2) Total number of accidents at the workplace per industrial branch, year and seriousness of the accident; (3) Total number of accidents occurred on the way to work (in itinere) per industrial branch, year and seriousness of the accident. This is divided into light, serious and fatal accidents. All accidents refer to accidents leading to at least one day of absence from work.

(C) Employment by sector and other covariates: To obtain the risk of having an accident, I built the series of the population at risk (employment) per sector (and type of contract where relevant) from the second quarter of the Spanish labour force survey (E.P.A., I.N.E.). The covariates on individual characteristics were also obtained from the E.P.A. These are constructed as the proportions per sector, year (and contract were relevant) of individuals with the relevant characteristic. These were:

- Age, job tenure and gender distributions
- Overtime hours worked: proportion of employed who worked more than forty hours in the reference week.

(D) Sectoral variables

- Proportion of fixed-term contracts in the sector. Source: Second quarter 1987–1998, EPA INE
- Unemployment: The unemployment rate in the sector is the number unemployed workers who previously held a job in the sector over the number of active workers in the sector. Source: Second quarter 1987–1998, EPA INE
- Vacancies: number of vacancies in the sector posted in the national employment institute (INEM). Source: INEM vacancies publication.

- Gross value added (sector): I had quarterly GVA for agriculture, industry, construction, services (market and non-market). The series were transformed to constant prices using the corresponding sector price indices.

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