Abstract

This paper assesses whether 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 might exist because the short duration of the temporary contract reduces the incentives to invest in specific human capital leading to a higher accident rate. 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 4% to 7%.

JEL Classification: J24, J28
Keywords: work accidents, fixed-term contracts, productivity

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The Hidden Costs of Fixed Term Contracts: the Impact On Work Accidents

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1 Introduction

What are the consequences of allowing for di¤erent contractual arrangements within the labour market on productivity and workers' welfare? Di¤erent arrangements for labour market institutions and the types of contracts allowed in an economy may have di¤erent consequences in terms of labour market e¢ciency and productivity. It is therefore important to take these consequences into account in order to devise the optimal design for a labour market. Di¤erent types of contracts have been shown to di¤er in the wages they o¤er[1], however, little has been said on their e¤ect on other aspects such as productivity and investment in human capital.

In this paper I develop the idea that di¤erent types of employment contracts provide di¤erent incentives to both the worker and the …rm and hence result in di¤erent labour market outcomes. More precisely I focus on the di¤erential impact of the type of contract on work accident rates for …xed term contract (FTC) versus inde…nite or permanent contract (IC) workers. In a market where …rms can choose between …xed term and permanent contracts for their workers, theory predicts that workers on …xed term contracts (characterised by a shorter duration and where rehiring is uncertain) will have a lower investment in speci…c human capital than their colleagues on permanent contracts. The direct consequence of a lower investment in human capital is that FTC workers will have a higher probability of having an accident at the workplace.

In many countries there is no di¤erence between the types of contracts legally allowed, or, these are very similar and it is therefore di¢cult to assess the actual impact of these arrangements (since there is no counterfactual available, only time variation is useful). 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 di¤erent in terms of job protection. Furthermore a substantial part of the Spanish workforce (31% in 2000) is on …xed term contracts, and its accident rate has ‡uctuated substantially in the past 20 years. Spain has the highest work accident rate in the European Union, and while the European Union average in 2000 was 4.09

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

accidents per 100 workers, the Spanish incidence rate was 7.07 accidents per 100 workers. Concerning the di¤erent 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 …xed term contracts (…gures 1 and 2). This paper attempts to explain what part of this very large di¤erence is due to a pure contractual e¤ect.

But there are other elements that create a di¤erential in the accident rates of temporary and permanent contracts that are not strictly a contractual e¤ect. 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 e¤ect. Second, …xed term contract workers may systematically misreport the true accident rate. As a result of moral hazard, workers on FTC may report 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 under-report 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 re‡ect on di¤erential accident rates.

In this paper I analyse two panels of total work accidents between 1988 and 1998 for 32 industrial branches and apply two di¤erent identi…cation strategies to distinguish the pure contractual e¤ect from the selection and reporting biases (and of course of observable controls such as the tenure/age composition of the sector, di¤erent risk across sectors etc.). The …rst identi…cation strategy uses di¤erences in di¤erences while the second exploits accidents on the way to work to identify the pure contractual e¤ect.

In what follows I assess what fraction of the raw di¤erence in accident probabilities between …xed term and permanent workers is due to the pure contractual e¤ect derived from the duality of contracts, and see if after controlling for all the elements that may a¤ect that gap a di¤erential 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. This would be consistent with 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 briefly 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 two different sets of reasons why there may be a systematic difference between the accident rate of fixed term workers and that of permanent workers.

On the one hand 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. The effect comes through 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.

In Spain these rehiring probabilities tend to be low. Güell and Petrongolo (2000) find that the probability of conversion of a fixed term contract into a permanent one went down from almost 20% in 1987 to 7% in 1996[2]. In fact previous studies have shown that fixed term contracts are used as a flexible mechanism to adjust employment to fluctuations in the business cycle rather than using them as a worker screening or testing device (for a theoretical account of this

[2] They explain that in their sample from the Spanish Labour Force survey (covering the period 1987-1994) 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. 20% of the spells they observe are censored.

see Blanchard and Landier (2001)). In that case, the mentioned e¤ect of having a …xed term contract on accident rates is fully at work.

On the other hand a stream of literature has analysed the moral hazard e¤ects 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 bene…t. They argue that if WC is more generous than unemployment bene…t (UB), those workers who are close to being laid o¤ will try to bene…t 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 di¢cult to diagnose. These people will claim WC and exaggerate their state.

In Spain, a 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 six months lead to recovery). To be entitled to bene…t 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 bene…t received is 70% of the previous wage (80% before 1992) for the …rst six months subject to a maximum and a minimum cap.

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 bene…t because they have not been contributing long enough.

Another source of hazard for the temporary workers is that if the probability of being rehired is increasing in e¤ort, then FTC workers will exert more e¤ort on the job. Intensity of work (or faster pace to impress the employer) will increase accident probabilities. Jimeno and Toharia (1996) …nd evidence that this is happening in Spain but do not make the link to the accident rate[3]. At the same time, and following this argument, a systematic under-reporting of accidents

[3] In the empirical analysis they proxy e¤ort with absenteeism and because of the nature of the data needed they merge absenteism with the states of sickness and accident. They run a probit of the probability of being absent

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 under-report accidents. So the reporting e¤ect may go either way and in our estimation the net e¤ect will be captured by the contractual e¤ect.

In addition to the human capital and reporting e¤ects, the di¤erence in accident rates between the two types of contracts may be the result of some type of selection on who holds a …xed term contract. If it is "bad" workers who are systematically hired on temporary contracts, then the gap is just a result of some unobserved di¤erence in the quality/ability of workers. The analysis in this paper provides a way to control for this.

Finally, in the empirical analysis other mechanisms must be controlled for. Workers on FTC will typically have less tenure and be of younger age (FTC are mainly concentrated on young people -see table 1). If experience is acquired with tenure then FTC workers will have more accidents just through this compositional e¤ect. Similarly young workers will possibly have fewer accidents than older workers. The empirical analysis will account for these compositional e¤ects to disentangle what is the proportion of the actual raw di¤erence in accident probabilities that is exclusively due to the type of contract.

3 Econometric Speci…cation

The probability of an accident can be written as a function of a series of covariates as $y^{\alpha}_{ijt} = Pr(y_{ijt} = 1) = f(X_{ijt}; \beta)$

$$y_{ijt} = \begin{cases} 1 \text{ if } f(X_{ijt}; \beta) > z^{\alpha} \\ 0 \text{ otherwise} \end{cases}$$

So we will only observe accidents if the function determining the probability of an accident exceeds some threshold. Aggregating all the individuals in a sector j yields the proportion of

from work controlling for di¤erent measures of sectoral/occupational accident rates to separate absences due to accidents.

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 $¼_{jt}$, which is determined by $F(X_{jt};¯)$: A standard econometric technique to apply to these data is the minimum chi-square logit estimator[4]. This implies estimating:

$$\ln\left(\frac{¼_{jt}}{1 ¡ ¼_{jt}}\right) = ¬^{0} x_{jt} \qquad (1)$$

This is estimated by weighted least squares and produces the minimum chi-squared logit estimates of ¯. Marginal e¤ects are computed as: $Ma:ef fect = ¯ ¤ \overline{P}(1 ¡ \overline{P})$; where $\overline{P}$ is the average sample probability of an accident.

My analysis consists in computing the sample probabilities of having an accident in a year by taking the proportion of people in a branch who have an accident in a year. This is regressed using the minimum chi-squared logit method of a series of covariates that account for the business cycle, sectoral variables and individual characteristics. The results are computed using the White covariance matrix. The purpose is to see whether after controlling for all these elements there is still an e¤ect that is due strictly to the type of contract held. The individual level regression would be a limited dependent variable regression of:

$$y_{ijt} = \begin{array}{l} 1 \text{ if } ® + X^{0}_{ijt}¯_1 + Z^{0}_{jt}¯_2 + °_1 FTC_{ijt} + °_2 dt_{ijt} + °_3 dj_{ijt} + "_{ijt} > 0 \\ 0 \text{ otherwise} \end{array} \qquad (2)$$

Where X_{ijt} are individual characteristics, Z_{jt} are sectoral variables, FTC_{ijt} is a dummy variable of whether the individual is on …xed term contracts, dt_{ijt} is a time dummy, dj_{ijt} is a sectoral dummy. Since I have data for the proportions $¼_{cjt}$ of accidents by industrial branch and type of contract, equation (2) can be naturally speci…ed in the grouped logit framework as:

$$\ln\left(\frac{¼_{cjt}}{1 ¡ ¼_{cjt}}\right) = ® + \overline{x}^{0}_{cjt}¯_1 + Z^{0}_{jt}¯_2 + °_1 FTC_{cjt} + °_2 dt_{cjt} + °_3 dj_{cjt} \qquad (3)$$

Where $\overline{x}_{cjt}$ 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 coe¢cients of equation (3) : The gap between the accident rates of the two types of workers will be captured by the coe¢cient $°_1$:

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

Similarly, if instead using $¼_{cjt}$ (i.e. accident sample probabilities by contract, branch and time) $¼_{jt}$ is used (accident probabilities by branch and time), then the equation to be estimated becomes:

$$\ln(\frac{¼_{jt}}{1 \; i \; ¼_{jt}}) = ®^{0} + \overline{x}^{0}_{jt \; \overline{\ }1} + Z^{0}_{jt \; \overline{\ }2} + °_{1}\overline{FTC}_{jt} + °_{2}dt_{jt} + °_{3}dj_{jt} \qquad (4)$$

Where $\overline{FTC}_{jt}$ is the proportion of workers in sector j at time t that have a …xed term contract.

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

4 Data and Identi…cation Strategies

I use the work accidents data published by the Spanish Ministry of Labour and Social A¤airs in the Estadistica de Accidentes Laborales (EAT). 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). In the event that an accident occurs there is an obligation to declare it, …ll in a report and pass it to the insurance company and the Public Administration. From those reports (partes de accidentes laborales) aggregate statistics on the number of accidents according to di¤erent classi…cations are published in the EAT.

I use two di¤erent classi…cations from the EAT, and for each of them I have a di¤erent identi…cation strategy. The aim is to have a measure for the pure contractual e¤ect net of all compositional e¤ects including the accident proneness and reporting biases.

Firstly I use the number of work accidents by year, industrial branch and type of contract occurred in the period 1989-1998 to estimate equation (3). I identify the e¤ect of temporary contracts using a di¤erences in di¤erences method on the e¤ect of holding a temporary contract. Provided the selection into either type of contract is constant across sectors, i.e. if there is a selection bias as a function of ability, accident proneness or systematic misreporting, then the di¤erencing ensures that what is captured in the contract coe¢cient is the pure contractual e¤ect I am interested in. The problem would arise if the selection was not constant across industrial branches.

To assess to what extent this coe¢cient captures the e¤ect of ability or other types of systematic di¤erences - like under or over-reporting - between workers in either type of contract I use another dataset, namely the total number of accidents by industrial branch and seriousness (light, serious, deadly). These data are split into two groups: accidents that occurred at the workplace and accidents on the way to work. The identi…cation 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 equation (4) will capture the accident proneness and the contract coe¢cient will then be net of this the ability/selection biased related to accident proneness. On the other hand, if there is a systematic reporting di¤erence between the two groups (temporary and permanent), this should be captured by the variation in light accidents on the way to work. But light accidents also capture the accident proneness di¤erential mentioned before (assume that one can misreport light accidents but not serious fatal accidents). So total accidents on the way to work (light, serious and deadly) in the regression will capture both the selection bias due to di¤erences in accident proneness and due to systematic misreporting di¤erences of workers on either type of contract and allow us to identify the pure contractual e¤ect.

Figure 2 presents evidence for the validity of the identi…cation strategy. If accidents on the way to work 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, and changes in that ratio should only be due to factors that a¤ect di¤erentially both magnitudes, like the changes in the proportion of people holding …xed term contracts. The main characteristic of the1984 reform - a major reform of the Spanish employment legislation - was that it introduced …xed 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 speci…c cases). So we should expect that before the reform this accident type ratio is stable

and that if …xed term contracts are indeed relevant the ratio will fall as the proportion of FTC in the economy increases. This is indeed what happens in …gure 2. After the introduction of …xed term contracts in 1984 the rise in the proportion of workers under FTC is accompanied by a fall in the ratio of accidents. Figure 3 shows the evolution of the total number of accidents at work and on the way to work. Both series are smooth and con…rm 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 …xed term contracts and is not a measurement problem.

This con…rms the validity of the use of accidents on the way to work as a way to identify the pure contractual e¤ect, since the variation in compositional changes will be captured by the accidents on the way to work, and hence the coe¢cient on the contract variable will capture the pure contract e¤ect.

Thus I estimate equations 3 and 4 using two di¤erent panels of work accidents by branch. The following section describes the covariates used.

4.1 Determinants of the injury probability

To determine the probability of a person having a work accident a number of elements are relevant. The di¤erence in accident rates of FTC and IC workers could arise from other di¤erences that have nothing to do with the contract. The most immediate one is that workers on …xed 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 sectoral or aggregate data, i.e. how sectoral conditions or the structure of the labour market a¤ect injury probabilities, and then the individual characteristics of the worker. In the former category I will include the following variables:

- Unemployment rates as an indicator of the business cycle. I use the unemployment rate in the sector as the number of people that have worked previously in the sector and are unemployed.

- The sector to which the worker belongs. This will be important since di¤erent sectors have very di¤erent risks. I use 32 branches where all economic activities are represented.

- The sectoral vacancy rate. This is 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.

- Growth rate of sectoral growth valued added as a indicator of the business cycle.

- Year dummies are also included to account for other macroeconomic e¤ects that may not be captured in the previous variables as well as a sectoral trend.

The other relevant set of factors are individual characteristics. Among these I include: the type of contract that captures the di¤erence in accident rates between FTC and IC workers; the age 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 of di¤erent degrees of seriousness on the way to work. A precise description of how the covariates are built can be found in the Appendix.

5 Results

To analyse the e¤ect of FTC on the probability of work accidents I run the minimum chi-squared logit method on two sets of data. This provides a quite complete description of the determinants of work accidents.

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 include the full set of industry variables (industry gross value added growth rate, vacancies in the industry and sector unemployment rate) as well as sector and year dummies, and a sector trend. I also include the distribution of tenure and age in the branch by type of contract. The contract e¤ect is captured by a dummy variable that indicates if the workers were on FTC. I identify the contract e¤ect as the di¤erences in di¤erences in accident rates between temporary and permanent workers. Table 5 presents an analysis of these data.

The sample raw di¤erential 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%.

Without introducing any other covariates, the e¤ect 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 e¤ect still survives and explains 7:4 percentage points, i.e. it is larger than the raw di¤erence. Thus the contract e¤ect estimated by this di¤erences in di¤erences method is signi…cant and positive and having a FTC increases the probability of accident by around seven percentage points. One might think that the coe¢cient may be systematically biased if temporary workers are systematically of a di¤erent quality than permanent workers. Nevertheless, provided the selection into either type of contract of individuals of di¤erent quality is constant across sectors (which is a sensible assumption), then the di¤erences in di¤erences method also gets rid of that systematic "quality" di¤erence and the contract coe¢cient captures a pure contractual e¤ect.

The behaviour of the rest of the covariates is as follows. The unemployment rate has a negative impact on accidents, so that when unemployment is high there are fewer accidents because activity is low. Vacancies and the growth rate of value added increase accidents. The coe¢cients on the tenure distribution con…rm that the accident probability is higher for people with short tenure and reaches a maximum for those between 6 months to 1 year of tenure. The results for the age distribution con…rm that old workers have a higher probability of accident, but I also …nd that the age group between 25 and 35 have more accidents. This may capture a number of e¤ects like how careful these groups are at the workplace. Finally, the coe¢cient on the proportion of workers who did overtime hours, that was used as a measure of work intensity, is negative and signi…cant. 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[5].

[5] Branch dummies were highly signi…cant con…rming the idea that the risk di¤erential between sectors is important and must be accounted for in the analysis.

The results con…rm the idea that there is a contractual e¤ect 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), and this selection is not constant across sectors, then the reported coe¢cient may be capturing that systematic di¤erence and hence biased. To ensure that there is no underlying characteristic of …xed term contract workers biasing the results, I exploit the second dataset.

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 (there are again 32 branches), on industry and year dummies and on the age and tenure distributions of the branch. The contract e¤ect 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% and that of a deadly accident is 0.01%), and hence the probabilities of serious and fatal accidents are too small to run the analysis for the di¤erent types of accidents. Also note that the results of both regressions are not comparable one to one but should yield estimates in the same range.

Table 6 shows the results for accidents occurred at the workplace. After controlling for all covariates, the marginal e¤ect of an increase in the proportion of temporary contracts of one percent is 0:04:

At this point and as mentioned above, a potential problem with the estimation of the …xed term contract e¤ect must be dealt with. If there is some type of selection process by which FTC people are "worse" (or "better") and hence have more (less) accidents - and the selection is not constant across sectors - then the FTC coe¢cient will be capturing this. The other problem is that FTC workers may consistently over-report accidents (because of the moral hazard reasons mentioned before) or under-report them, if they want to make sure they are reemployed at the same …rm (or in a di¤erent one) and want to avoid the stigma of looking like a "bad worker".

The identi…cation strategy used for these data uses 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 people hired and hence the FTC coe¢cient will be free from the quality composition problem.

I also assume that the tendency to over/under report an accident for an individual should be the same whether the accident occurs at work or on the way to work since 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 the accidents on the way to work. In this case it is light accidents on the way to work that enable the identi…cation since only for this type of accident can workers misreport the true state. Serious and deadly 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 e¤ects.

So, including the proportion of serious and fatal accidents that occurred on the way to work as a regressor in the workplace accidents regression, should clean up the systematic di¤erences between the two groups and we are left with a pure contractual e¤ect that includes the human capital and reporting e¤ects. Then using the proportion of all types of accidents on the way to work also controls for the former and in addition it captures the variation in systematic reporting di¤erences or other aspects that can be manipulated by the worker.

After introducing the proportion of serious and fatal accidents on the way to work, the marginal e¤ect of …xed term contracts is 0.066 (see Table 7). So after controlling for systematic di¤erences in accident proneness the contractual e¤ect survives and is about 6.5 percentage points. Further, controlling for all types of systematic di¤erences including reporting biases preserves the positive e¤ect of …xed term contracts on the probability of accidents and yields a marginal e¤ect of 0:039 (Table 8)[6]. That is, after cleaning the contract coe¢cient of the selection and reporting biases the contractual e¤ect results in an increase of 4 points in the

[6] In any case noting the increase in the R^2 in the …rst speci…cation from table 6 to tables 7 and 8 indicates that accidents on the way to work are capturing a variation that explains a lot of the changes in workplace accidents.

accident probability.

6 Conclusion

This paper assesses whether there is a systematic di¤erence between the accident rates of …xed term contracts and permanent contracts that is not just the result of a compositional e¤ect. A pure contractual di¤erential may arise because the nature of the temporary contract, namely its short duration, reduces the incentives to invest in speci…c human capital and hence reduces the expertise of the worker leading to a higher accident rate. On the other hand there may be a systematic selection of workers into either type of contract due to ability for instance that might explain why …xed term contract workers have more accidents. Or alternatively FTC workers may have a systematic reporting bias. I try to separate the di¤erent e¤ects and see if after controlling for all relevant elements, a contractual e¤ect subsists.

I use a sectoral panel with 32 industrial branches over 11 years. The results show that there is a contractual e¤ect at work that explains a very large part of the di¤erential. This e¤ect subsists in the two speci…cations I use, that rely on di¤erent identi…cation assumptions, after controlling for tenure, age, various indicators of the business cycle, overtime hours work and branch and year dummies. Having a …xed term contract increases by about four to seven percentage points the probability of having an accident.

The consequences of these results in terms of social cost and productivity are evident. Workers on temporary contracts su¤er from higher job insecurity both in terms of lower wages and higher accident risk. On the labour demand side, there are negative e¤ects 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 recommendation deduced from these results would be to try to limit the use of FTC to cases where it is really necessary (i.e. seasonal jobs) and bring in labour market ‡exibility using another type of institution that does not have this negative feature; or, set up the conditions so that more FTC are transformed into permanent contracts and the mechanisms through which

the pure contractual effect appears are no longer present.

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8 Descriptive Statistics

Table 1: Descriptive statistics of contract data

	Fixed term contract		Permanent contract	
	mean	std. dev	mean	std. dev.
Accident probability	0.116	0.105	0.0457	0.043
Mean tenure	0.028	0.005	0.126	0.021
Mean age	0.307	0.032	0.405	0.020
Tenure: · 2 months	0.353	0.127	0.016	0.012
2 months 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 year to 3 years	0.075	0.058	0.104	0.036
3 years 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

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

	mean	std. dev.
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		
Mean tenure (years)	0.107	0.028
Mean age (years)	0.389	0.026
Tenure (proportion): · 2 months	0.097	0.045
2 months to 6 months	0.089	0.034
6 months to 1 year	0.121	0.042
1 year to 3 years	0.101	0.036
3 years 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 hours per week)	0.198	0.141

Table 3: Sectoral variables

	Mean	Std. Dev.
Proportion of FTC	0.232	0.092
Prop. …rst time unemployed	0.251	0.047
Sector Unempl. rate	0.136	0.055
Gross value added growth rate	0.029	0.039
Vacancies	30399	28886

Table 4: Simple correlation and regression of FTC proportion on tenure, age and on the way to work accident variables

	Simple correlation Prop. of FTC	Regression	
Tenure: · 2 months	0.756		
2 months to 6 months	0.853	-0.122	0.099
6 months to 1 year	0.638	-0.301**	0.074
1 year to 3 years	0.151	-0.714**	0.081
3 years to 10 years	-0.133	-0.798**	0.068
more than 10 years	-0.711	-0.692**	0.066
Age: · 25	0.458		
26 to 35	0.230	-0.281**	0.054
36 to 45	-0.329	-0.292**	0.064
46 to 55	-0.304	-0.275**	0.072
more than 55	0.046	0.343**	0.0923
Ac to work, serious+fatal		-34.925**	13.437
Ac to work, light		2.265**	1.065
Constant		1.009**	0.066
Sector dummies		yes	
Year dummies		yes	
Observations		352	

Figure 1: Evolution of FTC and accident rate 1987-1999

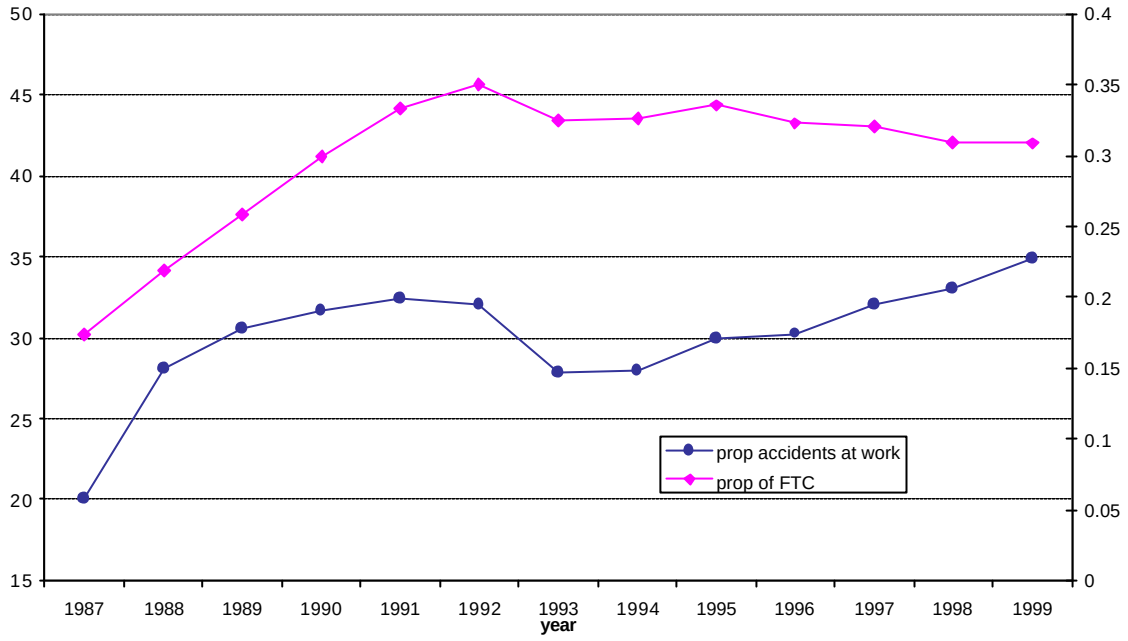
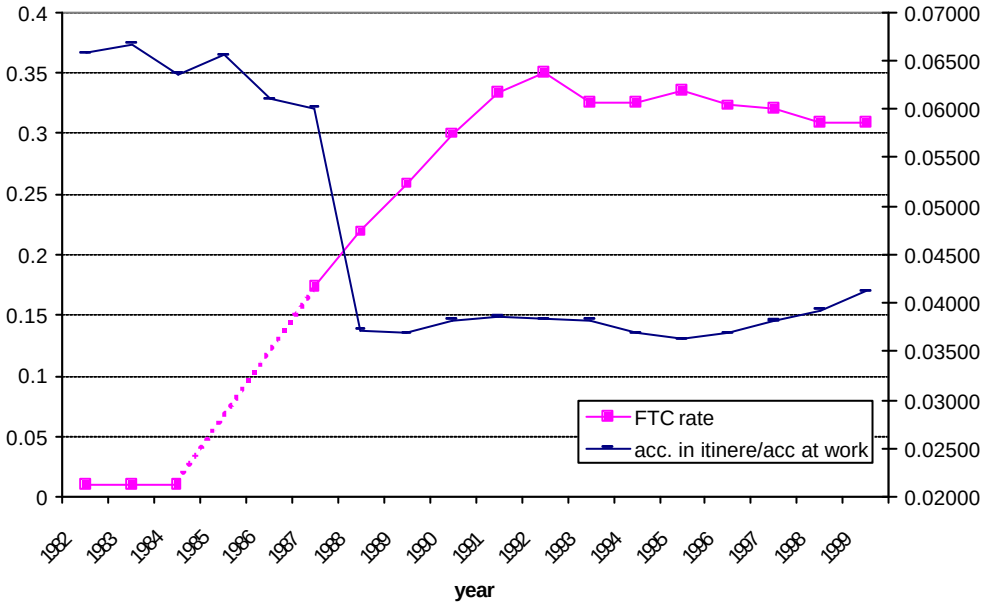
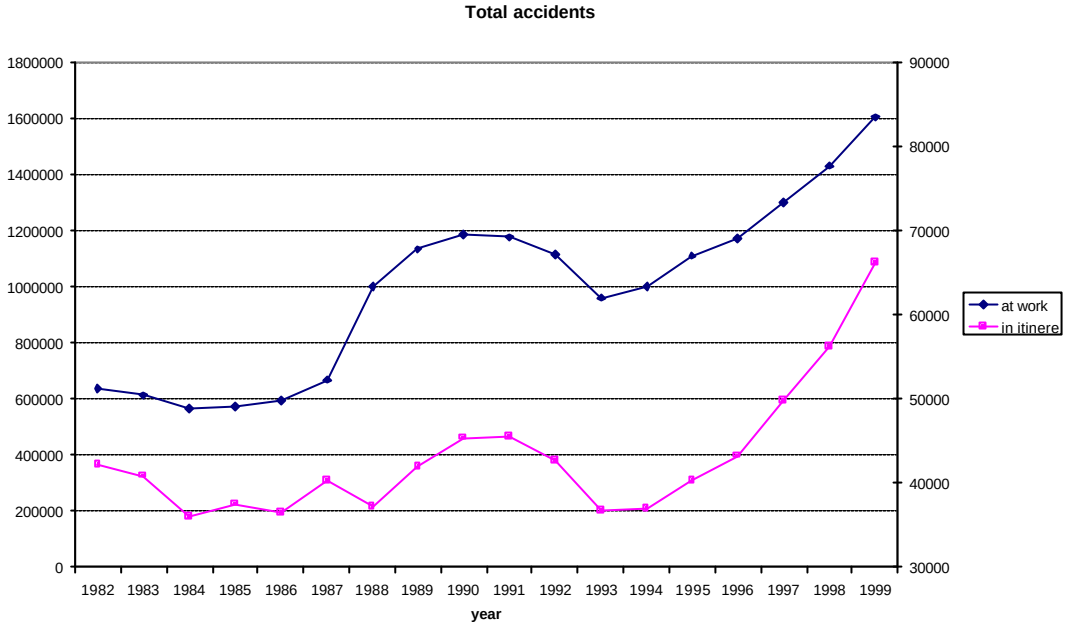


Figure 2: Validity of the identi...cation strategy



Source: E.P.A (I.N.E) and E.A.T. (M.T.A.S.); Note: the FTC rate before 1987 is an extrapolation (no data are available before that date).

Figure 3: Total number of accidents at work and on the way to work



Source: E.A.T., M.T.A.S. reported by I.N.E.

9 Results

Table 5: Total accidents at the workplace by type of contract
** indicates 5% signi…cance, * 10% signi…cance; std. errors in parenthesis

	Coe¢cient	Ma e¤ects	Coe¢cient	Ma e¤ects
Constant	-4.879** (0.084)		-156.76** (29.61)	
FTC dummy	1.032** (0.114)	0.058	1.502** (0.278)	0.074
U rate	x		-0.359 (0.615)	
GVA growth rate	x		0.191 (0.365)	
Vacancies	x		2.47e-08 (1.23e-06)	
Tenure distribution: 2-6 m.	x		0.505 (0.350)	
6m to 1yr	x		1.614** (0.228)	
1yr to 3yr	x		1.161** (0.434)	
3 to 10 years	x		0.746 (0.551)	
more than 10 years	x		1.217** (0.390)	
Age distribution:26 to 35	x		1.403** (0.288)	
36 to 45	x		0.253 (0.287)	
46 to 55	x		0.125 (0.379)	
more than 55	x		3.036** (0.580)	
Overtime	x		-1.067** (0.395)	
Year dummies	x		yes	
Sector dummies	x		yes	
Sector trend	x		yes	
Observations	640		640	
R^2	0.212		0.956	

Table 6: Total accidents at the workplace
** indicates 5% signi...cance, * 10% signi...cance; std. errors in parenthesis

	Coe¢cient	Ma e¤ects	Coe¢cient	Ma e¤ects
Constant	-5.094** (0.417)		-5.989** (1.074)	
Proportion of FTC	1.847** (0.679)	0.091	0.855 (0.565)	0.042
U rate	x		-0.357 (0.666)	
GVA growth rate	x		-0.051 (0.3324)	
Vacancies	x		1.75e-06* (9.06e-07)	
Tenure distribution: 2-6 m.	x		1.502 (1.413)	
6m to 1yr	x		3.424** (0.905)	
1yr to 3yr	x		2.931** (0.941)	
3 to 10 years	x		0.616 (1.018)	
more than 10 years	x		2.150** (0.841)	
Age distribution:26 to 35	x		-0.784 (0.781)	
36 to 45	x		1.140 (0.801)	
46 to 55	x		0.197 (1.053)	
more than 55	x		-0.543 (1.345)	
Overtime	x		-1.730** (0.510)	
Year dummies	x		yes	
Sector dummies	x		yes	
Observations	352		352	
R^2	0.033		0.970	

Table 7: Total accidents at the workplace, control for quality
** indicates 5% signi...cance, * 10% signi...cance; std. errors in parenthesis

	Coe¢cient	Ma e¤ects	Coe¢cient	Ma e¤ects
Constant	-5.495** (0.118)		-6.764** (0.854)	
Proportion of FTC	1.872** (0.495)	0.092	1.348** (0.473)	0.066
Prop. ser.+fat. ac. to work	1795.01** (110.0)		782.41** (71.3)	
Set of controls	x		yes	
Year dummies	x		yes	
Sector dummies	x		yes	
Observations	352		352	
R^2	0.386		0.969	

Table 8: Total accidents at the workplace, control for all unobservable hazard
** indicates 5% signi…cance, * 10% signi…cance; std. errors in parenthesis

	Coe¢cient	Ma e¤ects	Coe¢cient	Ma e¤ects
Constant	-5.366** (0.122)		-6.883** (-0.6884)	
Proportion of FTC	1.533** (0.555)	0.075	0.786* (0.409)	0.039
Prop. total acc. to work	115.03** (7.540)		71.813** (5.191)	
Set of controls	x		yes	
Year dummies	x		yes	
Sector dummies	x		yes	
Observations	352		352	
R^2	0.454		0.983	

10 Construction of the Variables

Sectors: I had to homogenise the categories of CNAE74, CNAE 92 and the sectors as de…ned in the EAT (which groups the subsectors - 2 digits - into 44 industrial groups). This forced me to group further some categories and I ended up with 32 “branches” or ”sectors”.

- Work accidents: I have three datasets

1) Total number of accidents at the workplace per industrial branch, year and type of contract. My analysis considers …xed term and permanent workers only.

2) Total number of accidents at the workplace per industrial branch, year and seriousness of the accident. This is divided into light, serious and fatal.

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.

Source: Estadistica de accidentes de trabajo, Ministerio de Trabajo y Asuntos sociales

- To obtain the risk of having an accident I built the series of employment per sector (and type of contract where relevant) from the second quarter of the Spanish labour force survey (EPA).

- Fixed term contracts: own elaboration of the series

Source: Spanish labour force survey, 2nd quarter 1987-1998, EPA INE

- Unemployment: number of unemployed in the reference week. This is divided into the number of unemployed in the sector (i.e. those who previously held a job in the sector) and the

proportion of …rst time unemployed in total unemployment. Own elaboration

Source: 2nd quarter 1987-1998, EPA INE

- Overtime hours worked: proportion of employed who worked more than 40 hours in the reference week.

Source: 2nd quarter 1987-1998, EPA INE

- Vacancies: number of vacancies posted in the national employment institute (INEM)

Source: Instituto Nacional de Empleo 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 price indeces as follows (price indeces were monthly and I took their quarterly average):

Energy: IPRI (industrial price index)energy

Construction and Industry: IPRI general (without energy)

Agriculture: index of prices paid to agriculture (indices de precios pagados a los agricultures)

Services: IPRI services (except rents)

Source GVA: Valor añadido bruto a precios basicos de la Contabilidad Trimestral de España (provided by INE), in million pesetas

Source IPRI: indicadores economicos del ministerio de economia (series)

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