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Occupational accidents and the economic cycle in Spain 1994-2014

ABSTRACT

The sensitivity of occupational accidents to the economic cycle can shed light on the effectiveness of occupational health and safety policies. This work analyses the effect of the economic cycle on occupational accidents in Spain in the period 1994-2014. We first perform a regression analysis to evaluate the relation between GDP growth and incidence rate, comparing Spain and Germany. Statistics on GDP growth (OECD) and standardised incidence rates (from Eurostat) are used. Then, from a sectorial perspective, we perform a variance decomposition analysis to measure the effect of the increase in the incidence rates on the growth in the number of accidents in Spain between 2013 and 2014. We use data disaggregated by sector from national databases on occupational accidents to this end.

Our results show a strong association between the economic cycle and occupational accidents in Spain. The recent economic crisis led to a strong reduction in the incidence rate, which accelerated a decrease that began in 2001. With the economic recovery beginning in 2014 the incidence rate has gone up again. This evidence indicates that economic growth in Spain comes at the cost of a high level of occupational accidents, showing the weakness of its prevention system. Moreover, the growth in the number of accidents tends to concentrate in certain sectors, and is more due to an increase in their incidence rate than to the growth in their workforce. Firms in these sectors have also implemented prevention practices less intensely than the firms in other sectors.

Keywords: occupational accidents, economic cycle, incidence rate

1. Introduction

Act No. 31/1995 on Prevention of Occupational Risks (LPRL in its Spanish initials), which implemented the *Council Directive 89/391/EEC*, led to the creation of a new legal framework in Spain in harmony with EU regulation. It promoted an important institutional development that includes new instruments, agents and processes: prevention representatives, external prevention services, management systems, audits, official university courses in the area, and public prosecutors in the area of occupational accidents.

The LPRL has been amended several times since its approval to adapt it to the new organisational forms of work, in particular the various forms of subcontracting in the construction sector. The main objectives have been to encourage an effective and real compliance with the occupational health and safety (OHS) obligations and proscribe a merely formal or documentary compliance. The past few years have seen more legal changes aiming to improve how the external prevention services work and also to simplify compliance with the regulations for SMEs. These reforms address the main weaknesses evident in the national OHS system over time.

The Spanish law was approved 20 years ago, so now seems like a good time to evaluate its contribution to the improvement in working conditions in the country. Studying the Spanish case is particularly interesting because of the size of the problem the country faces and the large number of legal reforms adopted to tackle it. According to Eurostat, in 2000 the Spanish standardised incidence rate reached a maximum of 7,052 accidents per 100,000 workers, and the rate remained above 5,000 accidents per 100,000 workers until 2006. Spain had the highest standardised incidence rate in the EU uninterruptedly between 1995 and 2009. In 2010, France was first in the table and Spain second. In 2011 and 2012 Spain dropped to third place behind Portugal and France. Moreover, less than 5% of Spanish firms have their own prevention service. Most firms (72.8%) resort to an external prevention service, according to the Spanish National Occupational Health and Safety Institute (INSHT in its Spanish initials) in its latest National Survey on Health and Safety Enterprises Management (INSHT, 2009a). We should note that the spirit of the *Council Directive 89/391/EEC* is to resort to external services only as a complement, when the firm's own resources are insufficient. Finally, the impact of this regulation may have been quite uneven. Arocena and Nuñez (2009) observe that while the adoption of the OHS regulation did contribute to a reduction in the number of injuries in advanced manufacturing sectors, the same did not occur in traditional industries. They also find a negative relation between accidents and firm size and that larger firms are better able to implement the OHS law more effectively.

The recent economic crisis has led to a substantial reduction in the number of occupational accidents, with the obvious benefits of fewer days of absence from work, lower healthcare and accident compensation costs, and above all of course, fewer fatalities and serious injuries to workers. But these positive consequences should not blind us to a less favourable aspect. Although accidents tend to fall when growth is weak, if firms lack the right OHS management systems and an authentic safety culture they could be faced by big increases in the number of accidents (INSHT, 2009b). The most recent data confirm this concern: with the improvement in the economy occupational accidents have gone up again in Spain. Thus the strength of the association between the evolution in the economic cycle and the number of occupational accidents represents an authentic test of the quality of the OHS system in Spain.

The twofold objective of the current work is directly informed by this concern. Our main objective is to determine how strongly the economic cycle affects the number of occupational accidents in Spain. For this purpose we carry out a descriptive analysis of the behaviour of the incidence rates in Spain, including as benchmark a comparative analysis with another country – Germany – where the institutional environment is relatively comparable. The second objective of this work is to carry out an exploratory sectorial analysis to identify the possible explanatory hypotheses of a behaviour that – we can anticipate now – we find to be strongly pro-cyclical. This analysis will shed light on the effect of the change in the cycle. The incidence rates go up again with the economic upturn because the number of accidents is increasing faster than employment. It is important to examine whether this behaviour is the same in all sectors or whether some sectors suffer the negative effect of the change in the cycle on the incidence rate more intensely. According to Nichols (1989), at the start of an economic upturn employers take some time before hiring workers, thus resulting in an increase in work intensity and occupational accidents. This argument is based in a well-known relation between the labour market and the economic cycle: the labour market lags behind the economic cycle (Terrés et al., 2004).

Since Kossoris's (1938) pioneering work, a large number of researchers has confirmed the association between economic cycle and occupational accidents (e.g., Ruser, 1985; Viscusi, 1986; Shea, 1990; Lanoie, 1992; Fabiano et al., 1995; Brooker et al., 1997; Davies et al., 2009; Asfaw et al., 2011). Nevertheless, evidence against this does exist and the causes of the phenomenon are unclear. Thus in a study of 16 OECD countries Boone and van Ours (2006) conclude that the positive correlation observed between economic cycle and occupational accident indicators (excluding accidents with fatalities) is a spurious phenomenon caused by a reduction in workers' reporting of accidents due to fear of losing their job in times of crisis (claim reporting effect), in line with Leigh's (1985) hypothesis. In contrast, in expansionary stages workers are more likely to report accidents, because if they lose their jobs as a consequence they will be able to find another job more easily. As extra evidence these authors observe that fatal accidents do not behave cyclically because reporting these accidents does not depend on the worker's propensity to report.

Davies et al. (2009) obtain similar results in a study carried out in the UK. They observe that unemployment is negatively related to the rate of minor injury but independent of the rate of major injury. Thus they offer evidence of the employee reporting behaviour effect attributable to changes in bargaining power. Likewise, Boone et al. (2011) find that workers who report an accident in a particular period of time are more likely to be fired later on. This result supports the idea that recessions have a negative effect on the reporting of minor workplace accidents. But Nielsen et al. (2015) show that changes in reporting behaviour do not seem to play a significant role in the relation between the business cycle and workplace injuries in a Danish context.

Various authors have observed the pro-cyclical behaviour of occupational accidents in Spain (e.g., Arango and Valdivia, 2000; Castejón, 2000; Arocena and Núñez, 2005; Martín, 2006; Castejón and Crespán, 2007 Amuedo-Dorantes and Borra, 2013; De la Fuente et al., 2014). Martín (2006) tries to verify whether the pro-cyclical behaviour of occupational accidents in Spain can be considered a real phenomenon that reflects changes in the working conditions along the economic cycle, or is instead a purely statistical effect. This statistical effect could be associated with the reporting of accidents, under the hypothesis that workers are more likely to report accidents in growth stages than in recessions. This author uses data on incidence rates aggregated at the provincial level for 50 Spanish provinces in the period 1989-2001, and finds evidence for the claim reporting effect. But he also finds that fatal accidents are pro-cyclical. Amuedo-Dorantes and Borra (2013) analyse the effect of the economic crisis on work injuries and fatality rates in Spain over the decade 2001-2010. They find that the recession reduced work injuries rates, but not fatality rates, exclusively among immigrant workers. This result suggests that the fear of being fired discourages these vulnerable workers from reporting their injuries. Likewise, De la Fuente et al. (2014) analyse the relation between economic crisis and occupational injuries in Spain in the period 2000-2009. These authors conclude that the economic crisis in Spain has reduced occupational injury rates, especially in the construction and industry sectors.

Other factors that may explain the reduction in the accident rate in recessions is the way firms cut workforces in times of crisis, and a type of survival bias, a hypothesis that researchers do not seem to have tested yet in the literature. With respect to cuts in the workforce, in countries where firing long-serving workers is very costly (e.g., Spain) firms fire younger and more inexpert workers. Likewise, De la Fuente et al. (2014) conclude that economic crisis seems to cause a type of "natural selection" in the labour market and only older workers, with more experience and permanent contracts, tend to remain. A more-experienced workforce that has a lower workload because of the crisis will tend to have a lower incidence rate. With high rates of economic growth the inverse mechanism sets in (Arocena and Núñez, 2005). These authors conclude that the entry of new workers in growth stages in the economic cycle increases the incidence rate and that inexpert newcomers tend to increase the frequency of minor accidents, as other authors observe in previous studies (e.g., Blank et al., 1995; Quinlan, 1999; Wright and Lund, 1998).

We understand survival bias as a statistical error or misinterpretation caused by not considering the impact of the firms that have not survived the economic crisis on the occupational accidents data. "Natural selection" can also occur in the market for products. If survivor firms are the most competitive and the ones with the best management, including the OHS management (the ones with the lowest incidence rates), we should see a decrease in the incidence rate in the population of survivor firms. Thus the positive evolution in the incidence rates in economic recessions could be due to a competitive selection effect: the recession expels the worse-managed firms, the ones with the worst incidence rates.

To confirm this hypothesis we should also observe that the survivors have a better, more active or higher-level safety culture and OHS management system. If we compare the results obtained in the two latest National Surveys on Working Conditions carried out by INSHT in Spain in 2007 (pre-crisis) and 2011 (mid-crisis) we obtain some evidence that allows us if not exactly to confirm this hypothesis, at least not to contradict it. Table 1 reports the percentage of affirmative responses to four items concerning the organisation of occupational risk prevention, the prevention activities in place, and the information and training given to employees in Occupational Health and Safety. It is not easy to explain this improvement in the indicators without resorting to the survival bias discussed above.

Table 1. Organisation and prevention activities. % of affirmative responses to questions.

Item	2007	2011
Prevention Representative: • Question: *In the site or centre where you work is there a Representative for the Prevention of Occupational Risks?*	54.5%	61.1%
Job risks study: • Question: *In the past twelve months, has an evaluation or study of the risks to your health and safety in your job been carried out?*	25.5%	35.7%
Existence of training and information on risks: • Question: *In the past two years, have you received training or information about the risks to your health and safety in your work?*	49.8%	57.2%
Evaluation of health and safety information *: • Question: *With regards the risks to your health and safety in your work, to what extent would you say that you are well or very well informed?*	80.9%	86.2%

** % of respondents stating they are well or very well informed*

Source: National Survey on Working Conditions, INSHT database, years 2007 and 2011.

This bias could have an important sectorial component. If the decline in activity and the job losses are more intense in the sectors with high incidence rates, such as construction and industry (Snashall, 2005; Camino et al., 2008; Aires et al., 2010, De la Fuente et al., 2014), the fall in productive activity in these sectors will strongly contribute to improving the incidence rate of the population as a whole. Brooker et al. (1997) consider that the impact of the economic cycle on occupational accidents can be a result of changes in the industrial mix within each sector. During recessions the most hazardous industries with the riskiest jobs lay off more workers. This situation would lead to lower accident rates.

But the incidence rates of sectors may also change in function of the stage in the economic cycle. Thus Asfaw et al. (2011) find that the degree of association and the mechanisms through with the economic cycle affects workplace injuries was not the same across industries. These authors observe the pro-cyclical behaviour of the injury incidence rate in mining, construction and manufacturing, but not in agriculture or trade. This reasoning reinforces the interest in studying the relation between the economic cycle and incidence rates from a sectorial perspective.

Using the same hypothesis of competitive selection, the renewed growth in the number of occupational accidents since the beginning of the Spanish economic recovery in 2014 could be due to the entry of new firms with less experience in OHS. Other factors could also be relevant, like a worsening in the working conditions or greater workload (Ruhm, 2000). In growth periods firms urge workers to intensify their efforts, a hypothesis advanced by Kossoris (1938), Shea (1990), Salminen et al. (1993) and Hokkanen (1998) but rejected by Schuster and Rhodes (1985), as well as to increase their productivity even at the cost of relaxing prevention measures (Nichols, 1994). The increasing number of occupational accidents could also be due to: a lower cumulative investment in OHS; an increase in the hiring of temporary, hourly or part-time workers, or of inexpert workers who do not receive adequate OHS training (Oi, 1974; Arocena and Núñez, 2005); or a greater use of obsolete and unsafe equipment that the firm does not use if it is working at below capacity (Kossoris, 1938). It could even be the consequence of a supposed period of relaxation in the controls by labour inspection, more focused on other priorities such as combating fraud during the crisis, and also lacking staff and material resources (EPSU, 2012).

Economou and Theodossiou (2011) use data on all types of accidents in 13 European countries during the period 1980-2006 and find that the effect of recessions on occupational accidents is more complex than previous studies suggest. In the early stages of a crisis the number of accidents tends to fall because of falls in the economic activity and the intensity of the work, and fewer changes of employment or position. There is also less hiring of new, less-experienced workers. But if the recession is prolonged, the reduced investment in OHS along the recessionary stage of the cycle makes work riskier, and at the same time employment opportunities disappear. This is when the rates begin to rise again. Then, with the recovery, working hours and work intensity increase as firms react to the improvement in the demand conditions by producing more, but initially without increasing the workforce until uncertainty about the future clears. This leads to an even more negative evolution in the occupational accidents in this transition phase.

After this introduction we describe the methodology and the sources of information we use. We then present our results. The final part of this article looks at the main conclusions of our research. They suggest the need for new reforms in the public policies on OHS in Spain aimed at encouraging an authentic safety culture in the workplace.

2. Methodology

We have used different sources of information to carry out this study. We obtained the data on occupational accidents in Spain from the Statistics Yearbooks published by the Spanish Ministry of Employment and Social Security. This database collects the main social and labour data and statistics available in Spain. It includes a broad range of information on indicators relating to occupational accidents, such as the number of accidents or incidence rates. The data are classified by type of accident, characteristics of worker, type of work done, and cause of accident, among others. They are also available by province, autonomous region and sector of activity. The source of this information is the data contained in the compulsory accident reports that employers must provide when an accident occurs that results in days of absence from work. From these Yearbooks we have obtained the data to study the evolution in the number of occupational accidents and in the incidence rate in Spain between 1994 and 2014. We chose 1994 as the base year of this study for three reasons:

1. We wanted to take a full, long cycle of at least 20 years, from the end of a recession to the end of a recession. The year 1994 was the first year of economic growth in Spain after the 1992-1993 recession.
2. 1995, as mentioned in the introduction, saw an important change in the legislation in this country, with the approval of the LPRL.
3. Eurostat's Occupational Health and Safety statistics started in 1994.

Aggregate data on occupational accidents for the country were also obtained from the Report on Occupational Accidents in Spain edited annually by the INSHT (2007, 2013). These reports analyse in aggregate the occupational accidents in Spain by year, examining variables such as sector, severity, activity, or accident type. Their source is the data from the above-mentioned Statistics Yearbooks.

The most recent Spanish data on occupational accidents, which go up to September 2015, were obtained from the Inter-Annual Reports published online quarterly by the Spanish State Observatory on Working Conditions (OECT in its Spanish initials), which is dependent on the INSHT. These reports offer advance provisional data that are subject to periodic updating.

Another important source of information on the OHS conditions in the workplace in Spain that we use is the National Survey on Working Conditions, conducted periodically by the INSHT since 1987. This survey aims to obtain reliable information about the working conditions of different groups of workers using information provided by the workers themselves. The database of this survey offers information on the frequency of exposure to various occupational risks, the factors in the workplace that affect workers' health, and the prevention activity carried out in the firm. The data is available disaggregated by age, sex, occupation, type of labour contract and sector of activity, among others. We have used data from the two latest editions of this survey (2007 and 2011) to illustrate the survival bias mentioned in the Introduction. We will also use this survey to compare the OHS management between the "critical sectors" (those that concentrate most of the increase in the number of accidents between 2013 and 2014) and the other sectors of the economy.

We work with data on the number of occupational accidents in the course of work involving days of absence from work and also with data on the incidence rate. This indicator calculates the number of occupational accidents in the course of work involving days of absence from work occurring in a particular period (usually one year) per 100,000 workers exposed to the risk of accident. Thus it offers a relativised measure of the occupational accidents taking into account the number of workers exposed to those risks. Consequently, the incidence rate is a good indicator of the quality of OHS management and is frequently used in previous research (Parejo-Moscoso et al., 2012; Suárez-Cebador et al., 2015).

In the case of the Spanish sources, the incidence rate is calculated in terms of the annual average population of workers signed on with Social Security with the contingency of occupational accidents and professional diseases covered. The rate is also a measure of the occurrence of accidents in the course of work with loss of working days, implying an absence from work of at least one day, not including the day of the accident. These figures do not, therefore, include accidents en route to and from work.

To make the comparison with Germany, we use data on standardised incidence rates (as do Morillas et al., 2013) for 1994-2012, the period for which Eurostat's Health and Safety at Work Statistics database is currently available. Eurostat publishes its standardised incidence rate with more than three days of absence from work. In order to obtain this incidence rate in a standardised form, Eurostat makes a correction that takes into account the different composition of the employment structure in the different EU countries. Without this correction the incidence rates would be higher in countries with higher employment in high-risk sectors (e.g., construction). This correction allows us to make comparisons between countries, but these comparisons are still not completely reliable (Aires at el., 2010; López Arquillos et al., 2012). Thus comparisons should be made with caution: a higher number of accidents are declared in countries where an accident must be reported to receive the corresponding compensation (e.g., Spain and Germany).

Spain and Germany's national OHS systems share a basic and common legal framework that complies with the health and safety provisions in *Council Directive 89/391/EEC*. This Directive provides the legislative baseline for managing health and safety in the European Union. But there are differences in transposing this legislation to national laws among the European countries. Thus in many countries (e.g., Belgium, Demark, France, Finland and Sweden) it is obligatory for firms to have an internal prevention service. The organisation of prevention is more flexible in Germany, where the focus is on where the firms should get to rather than how they should organise their resources to get there. And in Spain, the internal prevention service is only obligatory in certain cases to do with firm size (firms employing more than 500 employees) and the danger of the activity.

Both countries have also in place a comparable national strategy for health and safety at work since 2007 (Lissner et al., 2010). One of the idiosyncrasies of the German prevention system is that it is a dual system, made up of the legislation at the federal level, executed by the regional state authorities (Länder), and of internal accident prevention regulations established by the institutions for statutory accident insurance and prevention ("Berufsgenossenschaft", or BGs). Likewise, Spain is divided into 17 autonomous regions and most of them have broad responsibilities in labour issues.

Moreover, Germany and Spain both have a decentralised organisation for labour inspection services, with a similar scope of competences (EPSU, 2012). But in Germany the duality of the national prevention system is also reflected in a double firm inspection service in the form of state and federal inspection bodies and the technical inspection services of the BGs. These institutions are structured and specialised in sectors (construction, industry, transport, mining, public sector, among others). All the BGs are non-profit bodies that offer prevention services, as well as rehabilitation services and insurance for its member firms. Firms must join the corresponding BG.

Spanish mutual insurance firms for occupational accidents and diseases are also private, non-profit bodies. These mutual firms (associations of entrepreneurs and firms) work together with the public administration (National Insurance System) in the management of the economic and welfare benefits for occupational accidents and professional diseases. Previously, they could offer external prevention services, but in 2015 they were totally prohibited from doing this. These organisations once controlled over half the market for external prevention services.

Both countries register 100% of accidents and use insurance-based systems with notification procedures based on accident reports to insurance institutions, with some differences in criteria for notification and/or

registration. Spain registers all accidents leading to one or more days of absence from work (in addition to the day of the accident itself). Germany registers accidents of more than 3 days (Jacinto and Aspinwall, 2004).

In the comparison between Spain and Germany, we analyse the sensitivity of occupational accidents to the economic cycle in each country. We will estimate the relation between the incidence rate and the economic cycle via a regression analysis in which the dependent variable is the standardised incidence rate estimated by Eurostat and the independent variable is the annual GDP growth rate at constant prices according to the OECD Statistics database.

The second objective of this study is to conduct a sectorial analysis of the recent evolution in the accident statistics in Spain. To do this we will use the latest data on occupational accidents and incidence rates, which are available at the two-digit level (divisions) in the Statistical Classification of Economic Activities (CNAE-2009)[1]. These data are published in the Statistics Yearbook of the Spanish Ministry of Employment and Social Security for the years 2013 and 2014. With the economic recovery beginning in 2014 the number of occupational accidents has risen again, reversing a downward trend since 2000 and throwing doubt on the effectiveness of the country's national OHS system.

The sectorial analysis will allow us to detect different behaviours in function of the economic activity and identify whether the increase in the number of accidents concentrates in certain sectorial divisions. It will also allow us to verify whether the growth in the number of accidents in these divisions (which we call "critical sectors") is explained more by the negative evolution in their "objective dangerousness" than by the growth in employment.

To carry out this analysis we first calculate the contribution of each branch of economic activity (division *i*) to the increase in the number of accidents in the country (S_i). This contribution (S_i) is calculated as the product of the weight of that activity (division *i*) in the total number of accidents occurring in initial year 2013 ($w_{i,2013}$) and the rate of variation in the number of accidents in that division *i* between 2013 and 2014 (g_i):

$$S_{i=} w_{i,2013} * g_i,$$

where S_i = the contribution of division *i* to the growth in the total number of accidents (in %)

$$w_{i,2013} = \frac{\text{Occupational accidents involving absence in division } i,2013}{\sum_{i=1}^{87} \text{Occupational accidents involving absence in division } i,2013}$$

$$g_i = \frac{\text{Occupational accidents involving absence in division } i,2014 - \text{Occupational accidents involving absence in division } i,2013}{\text{Occupational accidents involving absence in division } i,2013}$$

After identifying those divisions considered critical because of their big contribution to the generation of accidents, we will study what characterises them or differentiates them from other divisions. For this purpose, data on accident numbers and employment by divisions are aggregated in two groups: "critical sectors" and "other sectors" of the economy. Then we will decompose the total variation observed in the aggregated number of accidents in these two groupings into two explanatory effects:

- Employment effect (EE), which refers to the effect from the growth in the workforce in each group, the incidence rate being the same both years,
- Incidence effect (IE), which comprises the effect from the negative evolution in the objective dangerousness conditions in each grouping. We call it incidence effect because it calculates the increase in the number of accidents in the grouping that would have occurred as a result of the effect of the increase in the grouping's incidence rate if the workforce had remained unchanged.

[1] CNAE-2009 is the Spanish version of the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2) and has been compiled according to the conditions set out in the Regulation establishing NACE Rev. 2.

To make this decomposition, we calculate the following:

$$\text{Employment effect} = (N_{2014} - N_{2013}) * IR_{2013}$$
$$\text{Incidence effect} = (IR_{2014} - IR_{2013}) * N_{2013}$$
$$\text{Composition effect} = (N_{2014} - N_{2013}) * (IR_{2014} - IR_{2013})$$

where:

IR_t = incidence rate in year *t*
N_t = employment (signed on) in year *t*

We obtain the employment (signed on) in each year for each division (N_{it}) as follows:

$$N_{it} = \frac{\text{Occupational accidents involving absence in division } i,t * 100{,}000}{\text{Incidence rate in division } i,t} \quad t = 2013, 2014$$

This technique allows us to explain the variation in the number of accidents between two moments in time by decomposing the variation into two parts: the part due to the change in the level of employment (employment effect) and the part due to the change in the incidence rate (incidence effect). The employment effect measures the change in accident numbers resulting from the 2014 employment being different from the 2013 employment. The incidence effect measures the change in accident numbers resulting from the 2014 incidence rate being different from the 2013 incidence rate. The composition effect (also called mixed effect) is the product of the interaction between both sources of change, and cannot be attributed to either of the other two parts in particular.

If we observe a high incidence effect in one of the two groups of sectors this would indicate that with the recovery work has become more risky in that group. In other words, that group of sectors would be showing a negative dynamic in terms of the dangerousness of the work. There may be many causes behind this greater dangerousness: increase in workload, changes in the make-up of the workforce (hiring of younger, less-experienced workers), use of obsolete machinery, or entrance of new, less-experienced firms in the management of OHS activities, among others.

The simplicity of this technique, both in the calculation and in the interpretation of the results, makes it particularly useful for descriptive purposes. One limitation it does have is that it does not allow us to determine the nature of the possible interrelation between both effects, although we can estimate its importance via the composition effect.

3. Results

3.1 Aggregate analysis

The number of occupational accidents is a typically cyclical variable: it goes up in the expansionary stage of the economic cycle and goes down again in the recessionary stage when the GDP falls. There is an immediate reason for this: the working population increases during economic growth, and this increases the number of accidents. In times of lower growth or economic crisis the reverse mechanism sets in: less people at work leads to fewer accidents (Terrés et al., 2004; De la Fuente et al., 2014).

Between 2007 and 2013, with a period of lower economic growth and even with negative annual GDP growth from 2009 to 2013 at the same time as falling employment, the total number of accidents in Spain fell by more than 50%, while the number of fatal accidents fell by almost half (Table 2). In 2014, with the improvement in the economic situation, the number of occupational accidents began to go up again and at an increasing rate, in line with the pace of the economic recovery (Table 3).

Table 2.
Occupational accidents in the course of work involving one or more days of absence from work. *Source:* Annual Report on Occupational Accidents in Spain, INSHT (2007, 2013).

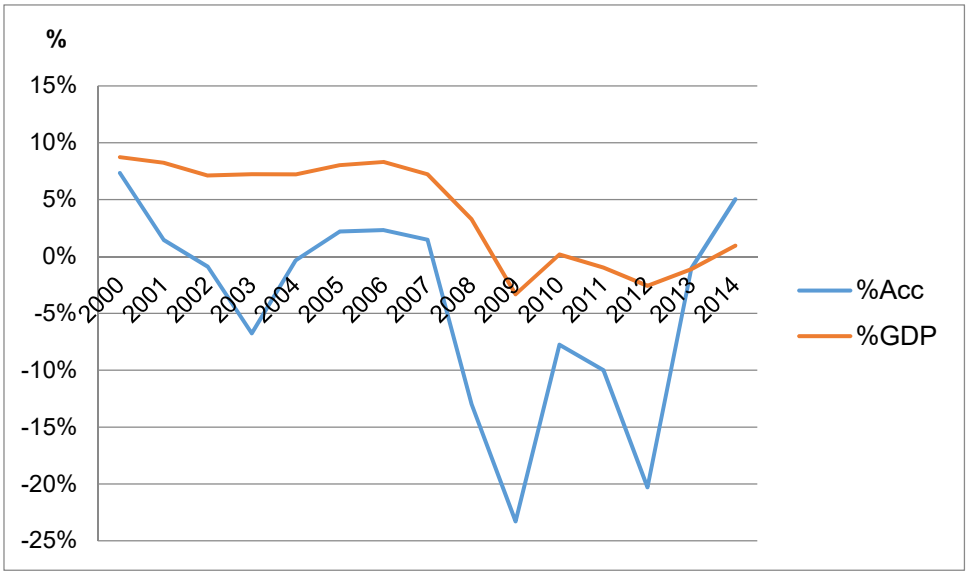
Occupational accidents	2007	2013	Variation 2007-2013
Involving absence	924,981	404,284	-56.29%
Fatal	826	447	-45.88%

Table 3.
Variation in total number of occupational accidents in the course of work involving absence in inter-annual periods. *Source:* OECT, Inter-Annual Reports.

Period	%
January 2012 – December 2012	-20.1%
April 2012 – March 2013	-20.0%
July 2012 – June 2013	-14.2%
October 2012 – September 2013	-4.6%
January 2013 – December 2013	-0.9%
April 2013 – March 2014	+3.1%
July 2013 – June 2014	+4.0%
October 2013- September 2014	+3.4%
January 2014 – December 2014	+5.1%
April 2014 – March 2015	+2.4%
July 2014 – June 2015	+4.0%
October 2014- September 2015	+6.0%

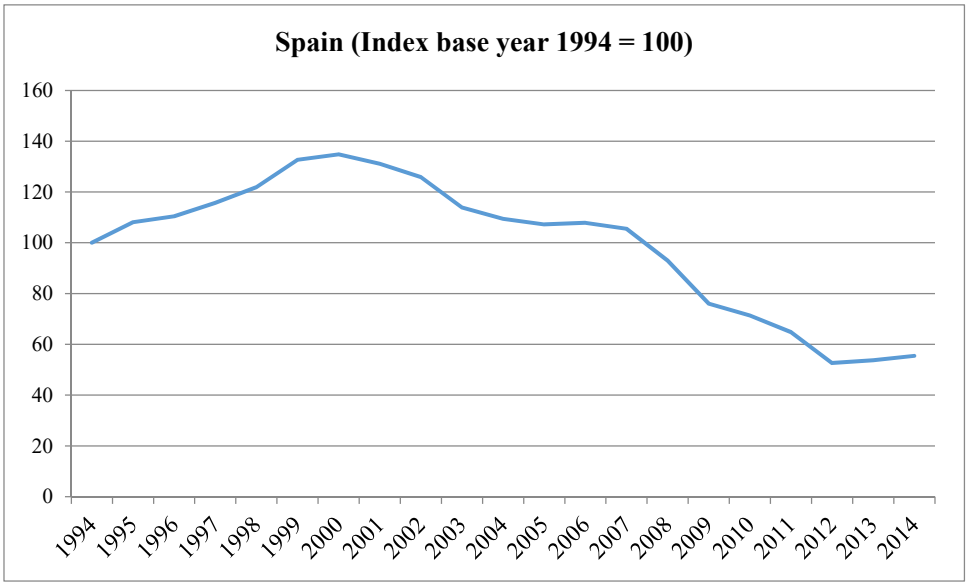
Figure 1 shows the association between the variations in the economic growth rate and the percentage variation in the occupational accidents in the course of work involving one or more days of absence from work in Spain from 2000 to 2014. As we can see, the annual percentage variation in the number of accidents is extremely sensitive to the economic cycle. Falls in GDP are accompanied by very significant drops in the number of accidents, while upturns in the economic activity cause big increases in the number of accidents.

Figure 1.
GDP (current prices) and occupational accidents in the course of work growth rates in Spain 2000-2014. *Source*: INE-National Statistics Institute, Spanish National Accounts (GDP growth rates), and Spanish Ministry of Employment and Social Security, Statistics Yearbook (number of accidents growth rates).



The incidence rate also shows a markedly pro-cyclical behaviour in Spain. Figure 2 shows the evolution in the incidence rate index (incidence rates based on year 1994=100) in Spain between 1994 and 2014.

Figure 2.
Evolution in the incidence rate index 1994-2014, occupational accidents in the course of work involving one or more days of absence from work. *Source*: Spanish Ministry of Employment and Social Security, Statistics Yearbook.

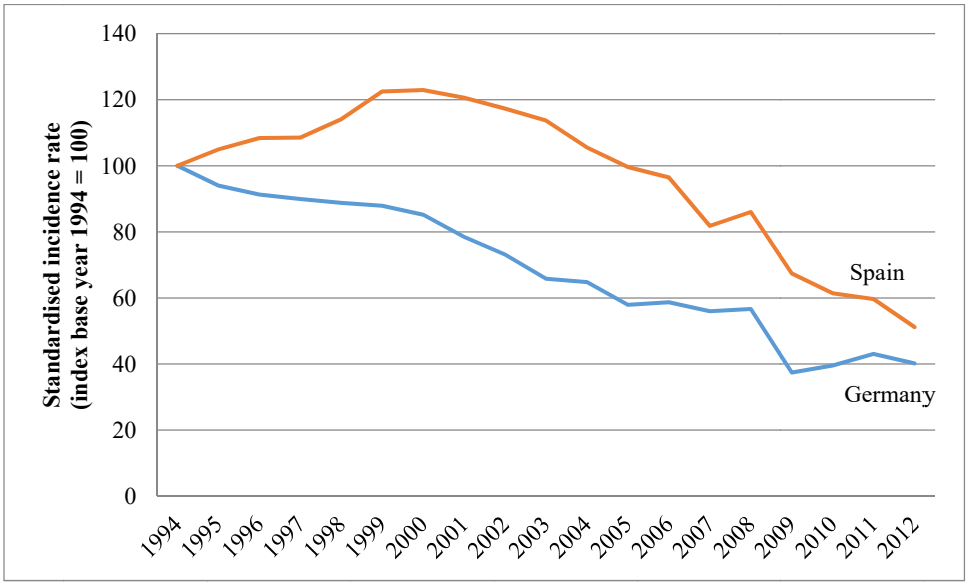


The series begins in 1994 (base year), with an incidence rate of 5,606.6 accidents per 100,000 workers signed on and peaks at 7,558.4 in the year 2000. It then begins a continuous descent (at an annual accumulated rate of -4.5%) until 2006, when a slight upturn occurs. Until 2008 the rate remains above its 1994 level, then falling sharply to just under 3,000 accidents for every 100,000 workers signed on in 2012, the minimum in the time series. Between 2008 and 2012 the rate falls at a double-digit annual accumulated rate of -13.27%: almost 3 times higher than for the period 2000-2006.

It is somewhat surprising that in the decade following the enactment of the Act on Prevention of Occupational Risks it did not prove possible to reduce the incidence rate of accidents significantly in Spain. The behaviour of the incidence rate appears to be strongly determined by the economic cycle. And as we mention in the introduction, this may be suggesting that the system of occupational risk prevention in Spain is weak and incapable of cushioning the forces of the economic cycle.

Figure 3 shows the evolution in the standardised incidence rate (index base year 1994=100) for Spain and Germany between 1994 and 2012, the last year the standardised indicator is available from Eurostat. The behaviour of the incidence rate for Germany is very revealing. The rate drops slowly but continuously between 1994 and 2005. In 2006, it goes up again slightly. According to OECD data, in that year Germany's GDP rose sharply by 3.7% (after growth of only 0.7% in the previous year), which pushes up the rate, but not to the level reached in 2004. The rate rises again very slightly in 2008 before it drops back in 2009. Between 2008 and 2012 Germany's standardised incidence rate falls significantly, by around 30%. But in this same period the same rate falls by over 40% in Spain.

Figure 3.
Evolution in standardised incidence rates index 1994-2012, occupational accidents in the course of work involving over three days of absence from work. Index base year 1994 =100. *Source:* EUROSTAT, Health and safety at work database.



Figures 4 and 5 show the results of a regression analysis of the standardised incidence rates published by Eurostat (base year 1994 = 100) vs. GDP (constant prices) growth rates for Spain and Germany obtained from OECD.Stat. For Germany, no significant association exists between economic growth and occupational accidents (measured by the standardised incidence rate). In contrast, for Spain the relation is significant, positive and very strong: economic growth would appear to explain 70% of the variation in the standardised incidence rate. Looking at the regression coefficient, every percentage point variation in Spain's GDP growth rate would appear to cause a variation of eight points in the incidence rate.

A highly developed and effective OHS system, designed to improve the management of occupational risks, is less sensitive to the ups and downs of the economic cycle. Systematically, and almost independently of the stage in the economic cycle at any point in time, it should be able to achieve reductions in the number of occupational accidents and avoid big swings over time, because if the risk of accidents is reduced to a minimum, only marginal improvements are possible. When economic activity picks up again, this should have only a slight impact on the incidence rates.

Figure 4.
Linear fit, standardised incidence rate vs. GDP growth, Spain (1994-2012)

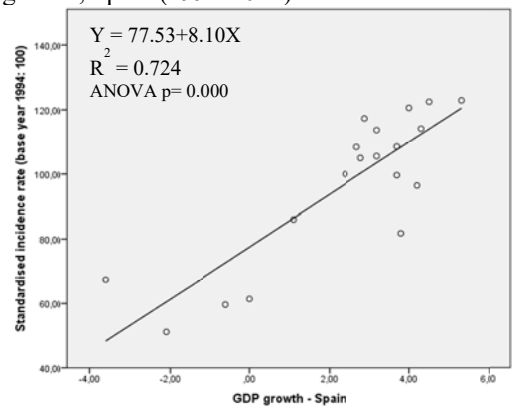
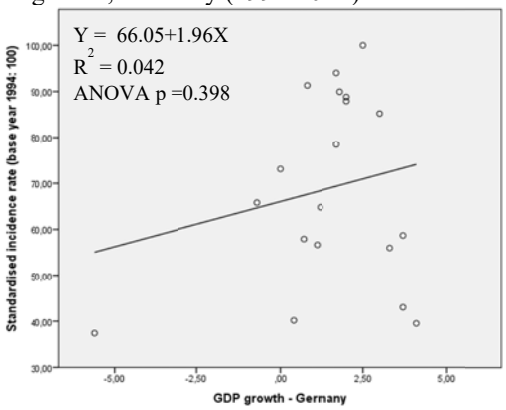


Figure 5.
Linear fit, standardised incidence rate vs. GDP growth, Germany (1994-2012)



Source: Eurostat, Health and safety at work database (standardised incidence rate obtained) and OECD.Stat (GDP growth rates)

As the Spanish National Occupational Health and Safety Institute, INSHT (2014) states: "the pro-cyclical nature of the accident rate is almost invisible in countries where the national prevention system is well designed and well managed: in other words, the strength of the association between accident rate and economic growth is inversely proportional to the intensity of efforts made in national prevention". Consequently, assuming the previous hypothesis, which holds that an effective OHS system mitigates or neutralises the effects of the economic cycle, the evidence presented here suggests that the OHS system in Spain is weak.

3.2 Analysis by economic sectors

The regression analysis carried out in the previous section shows that a large part of the evolution in the Spanish incidence rate can be explained by the economic cycle, but another part is not explained by the cycle and could have something to do with what Castellá (1999) labels "objective dangerousness". This term refers to the structural conditions that determine the objective risk of accidents in a production centre or firm. These conditions include: factors relating to the organisation of the production (intensity of workload, production incentives); personnel policies (turnover in the workforce); the level of development of the OHS management system (carrying out of periodic evaluations of risk and introduction of appropriate corrective measures; communication, specific training and information on OHS for new workers; availability of qualified OHS technicians); and how demanding is the safety culture reigning in the firm, from the top management down to the supervisors and the co-workers in the workplace.

Looking at the latest published data for the years 2013 and 2014 (Source: Spanish Ministry of Employment and Social Security Statistics Yearbook), and disaggregating by sectorial divisions (at two-digit level numerical codes, according to the Spanish CNAE-2009 statistical classification of economic activities) will help us to understand the scope of the problem (the negative evolution in the objective dangerousness) and its possible causes. There is an important statistic in this respect: we have calculated the correlation coefficient between the growth rate of the number of occupational accidents and the growth rate in the employment for the 87 sectorial divisions in the 2013-2014 period, obtaining a significant, positive value, 32.05% ($p < 0.01$). Thus the growth or shrinkage in the employment explains part of the variation in the number of accidents but there is another important part that is not correlated with the evolution in the employment.

At the same time this sectorial analysis may uncover differences between the economic sectors in the behaviour of occupational accidents. This is well known in Spain because of the high incidence rate in sectors like construction (López Arquillos et al., 2012; De la Fuente et al., 2014; Rubio-Romero et al., 2014), characterised by intense subcontracting and the use of temporary workers, while others such as agriculture tend to report from far fewer accidents (Arocena and Núñez, 2005; Castejón and Crespán, 2007).

In 2014 there were 424,625 accidents in Spain, which is 5.03% up on 2013. But the number of accidents did not rise in all 87 sectorial divisions: in 23 of them it continued to fall. Analysing the contribution of the different divisions to the global increase in the number of accidents shows that this increase does indeed concentrate mainly in 18 of the 87 divisions (as listed in Table 4). We label the divisions listed in this table "critical sectors". These 18 divisions (ranked in the table in decreasing order of their contribution to the increase in the number of accidents, S_i) were responsible for 51.19% of the accidents in 2013 (this is the weight they accumulate), but they contribute 3.81 percentage points of the total increase in the number of accidents, 5.03%. In other words, they contribute 75.66% of the increase in the number of accidents. The remaining 69 divisions (which we label "other sectors") consequently explain 24.34% of the increase in the number of accidents.

The "critical sectors" grouping includes divisions the contribution of which is explained by their significant weight in the total number of accidents, directly related to the number of workers employed in them. This is the case of Trade (retail and wholesale trade), Specialised construction activities, and Manufacture of fabricated metal products, in which the number of accidents grows more slowly than the total number of occupational accidents does ($g_i < 5.03\%$).

In other cases, such as with Employment activities (this division includes temporary employment agencies), their contribution is explained more by the big increase in the number of accidents (57.26%),

than by their weight in the total number of accidents occurring. A total of 12 of these 18 divisions are in the service sector, four in manufacturing, one is related to construction and the other agriculture.

Table 4.
Contribution of divisions to generation of occupational accidents. *Source:* Spanish Ministry of Employment and Social Security Statistics Yearbook (years 2013 and 2014).

Occupational accidents in the course of work involving one or more days of absence from work, by CNAE-2009 two-digit level (divisions)	**2013**	**2014**	$w_{i,2013}$	g_i	S_i
Food and beverage service activities	23,767	26,215	0.05879	10.30%	0.61%
Services to buildings and landscape activities	14,128	15,840	0.03495	12.12%	0.42%
Accommodation	10,892	12,234	0.02694	12.32%	0.33%
Retail trade, except motor vehicles and motorcycles	28,500	29,839	0.07049	4.70%	0.33%
Manufacture of food products	15,512	16,758	0.03837	8.03%	0.31%
Residential care activities	10,365	11,577	0.02564	11.69%	0.30%
Land transport and transport via pipelines	15,733	16,559	0.03892	5.25%	0.20%
Specialised construction activities	22,895	23,695	0.05663	3.49%	0.20%
Social work activities without accommodation	6,049	6,800	0.01496	12.42%	0.19%
Wholesale trade, except motor vehicles and motorcycles	20,750	21,476	0.05133	3.50%	0.18%
Employment activities	936	1,472	0.00232	57.26%	0.13%
Manufacture of fabricated metal products, except machinery and equipment	13,133	13,584	0.03248	3.43%	0.11%
Warehousing and support activities for transportation	7,964	8,373	0.01970	5.14%	0.10%
Forestry and logging	2,310	2,691	0.00571	16.49%	0.09%
Waste collection, treatment and disposal activities; materials recovery	5,752	6,119	0.01423	6.38%	0.09%
Repair and installation of machinery and equipment	2,626	2,955	0.00650	12.53%	0.08%
Manufacture of machinery and equipment n.e.c.	4,553	4,849	0.01126	6.50%	0.07%
Air transport	1,122	1,340	0.00278	19.43%	0.05%
TOTAL CRITICAL SECTORS	206,987	222,376	0.5119	7.43%	**3.81%**
OTHER SECTORS	197,297	202,249	0.4881	2.51%	**1.22%**
TOTAL	**404,284**	**424,625**		**5.03%**	**5.03%**

$w_{i,2013}$: division *i*'s weight in the total number of occupational accidents occurring in initial year 2013.
g_i: division *i*'s rate of variation in the number of occupational accidents between 2013 and 2014.
S_i: division *i*'s contribution to the increase in the number of occupational accidents between 2013 and 2014.

We now try to examine if occupational accidents behave differently in these "critical sectors". For this purpose we use data on aggregate employment, the number of occupational accidents, and incidence rates for the two groups of divisions identified: "critical sectors" and "other sectors" (Table 5).

Table 5.
Occupational accidents in the course of work involving one or more days of absence from work, incidence rate and employment by sector grouping. *Source:* Spanish Ministry of Employment and Social Security Statistics Yearbook (years 2013 and 2014).

	Accidents involving absence			**Incidence rate**			**Employment**		
	2013	**2014**	**2014/13**	**2013**	**2014**	**2014/13**	**2013**	**2014**	**2014/13**
Critical sectors	206,987	222,376	7.43%	3,594.90	3,787.81	5.37%	5,757,804	5,870,831	1.96%
Other sectors	197,297	202,249	2.51%	2,569.95	2,600.60	1.19%	7,677,065	7,777,001	1.30%
TOTAL	**404,284**	**424,625**	**5.03%**	**3,009.21**	**3,111.30**	**3.39%**	**13,434,869**	**13,647,833**	**1.59%**

The first question we would like to answer is to what extent the increase in the number of accidents is due to a worsening of the incidence rates and to what extent it is due to the growth in employment. For this calculation we carry out the decomposition described in the methodological section. It permits us to differentiate two main effects:

- Employment effect (EE): estimates the increase in the number of accidents between 2013 and 2014 due to the increase in employment, if the incidence rate had stayed the same as in 2013.

- Incidence effect (IE): estimates the increase in the number of accidents between 2013 and 2014 due to the increase in the incidence rate, if the level of employment (signed on) had stayed the same as in 2013.

This decomposition is useful because it allows us to isolate two very different effects. The "employment effect" measures the increase in the number of accidents due to the increase in the population signed on to social security, considering the different risks involved in different sectors, differences that are reflected in higher or lower incidence rates depending on the sector. In other words, the same increase in employment produces a greater increase in the number of accidents in a sector with a high incidence rate than in one with a low incidence rate. This is captured in the "employment effect". The "incidence effect" refers to something different: the number of accidents in a sector increases not because the employment goes up but because the sector has become riskier (the incidence rate has grown in this sector).

According to the decomposition carried out (see Table 6) we can conclude that in the "critical sectors" grouping the increase in the number of accidents is mostly (72.18%) due to the growing incidence rate (i.e., these sectors have become riskier, or more dangerous). In the "other sectors" grouping the higher number of accidents is due almost equally to the two factors: the increase in employment as a result of the economic recovery and the higher incidence rate. For the economy as a whole, including all the sectors, the incidence effect (66.18%) is stronger than the employment effect (32.60%). The composition effect is of minor importance in all cases.

Table 6.
Decomposition of variation in number of occupational accidents due to employment and incidence effects. *Source:* Spanish Ministry of Employment and Social Security Statistics Yearbook (years 2013 and 2014).

	Increase in accidents	**Absolute values**			**% due to**		
		Employment effect	**Incidence effect**	**Composition effect**	**Employment effect**	**Incidence effect**	**Composition effect**
Critical sectors	15,389	4,063	11,108	218	26.40%	72.18%	1.42%
Other sectors	4,952	2,568	2,353	31	51.86%	47.52%	0.62%
TOTAL	**20,341**	**6,631**	**13,461**	**249**	**32.60%**	**66.18%**	**1.22%**

To obtain additional evidence, in this case from the data disaggregated by division, we carry out a means difference t-test for two independent samples, which correspond to the two groups of economic activities ("critical sectors" and "other sectors"). This will allow us to test whether statistically significant differences exist between both groups. We consider the following three variables:

1. growth in employment (signed on), measured in each division *i*
2. contribution of each sectorial division to increase in the number of accidents, measured in each division *i* by variable S_i
3. importance of incidence effect in increase in the number of accidents, measured in each division *i* by difference between incidence effect and employment effect: IE_i - EE_i.

Table 7.
Means difference t-test for independent samples Source: Spanish Ministry of Employment and Social Security Statistics Yearbook (years 2013 and 2014)

Variable	Sectors	Descriptive		Levene test		t-test	*P* Sig.
		No.	Mean	F	Sig.		(2-tail)
Growth in employment	Critical	18	2.56%	0.331	0.566	Variances equal	0.179
	Other	69	8.5%			Variances different	0.172
Contribution to growth in no. of accidents (S_i)	Critical	18	0.0021	17.77	0.000	Variances equal	0.000
	Other	69	0.0002			Variances different	0.000
Incidence effect versus Employment effect (IE_i - EE_i)	Critical	18	481.47	4.281	0.042	Variances equal	0.000
	Other	69	27.80			Variances different	0.000

From the results of these t-tests (Table 7) we can conclude that no significant differences exist in the growth in employment (signed on) between the divisions in both groups. But significant differences do exist in:

- the contribution of the divisions to the increase in the number of accidents, which is greater in the "critical sectors" group
- the importance of the incidence effect, which is much higher in the "critical sectors".

Summing up, the analyses carried out indicate that behind the increase in the number of accidents in the "critical sectors" – those that accumulate 75.66% of the increase in the number of accidents – a common factor is pushing up the incidence rates, making the number of accidents grow at a higher rate than we would expect given the growth in employment.

According to what we have seen in previous sections, this factor could have something to do with the fact that less efforts are being made in OHS or that the OHS management is less well developed or of poorer quality in these "critical sectors". We do not have the data to test this hypothesis, but using similar items from the latest National Survey on Working Conditions (INSHT database, 2011) as used above (see Table 1) we can obtain evidence in support. We recall that the items were as follows:

1. Prevention representative
2. Job risks study
3. Existence of training and information on risks
4. Evaluation of health and safety information (% of respondents stating they are very well informed in this area).

Table 8 shows the percentage of divisions above the sample mean for 2011 in these four items in each divisional grouping. According to this classification, 83.33% of the "critical sectors" (15 out of 18) are below average in some of these items. In the "other sectors" grouping this proportion drops to 72.46%, a difference of over 10 percentage points.

Table 8.
Classification of sectors according to level of compliance in OHS management.

	Critical sectors	**Other sectors**
% Higher than mean	16.67% (3 out of 18)	27.54% (19 out of 69)
% Lower than mean	83.33% (15 out of 18)	72.46% (50 out of 69)

We can also perform a means difference t-test on a variable that we call "OHS effort" that measures the level or quality of the OHS management. We calculate the value of this variable in a particular division of activity by multiplying the proportion of affirmative responses in the four items together. Thus, a sectorial division in which 50% of the respondents have an occupational risk prevention representative in the centre where they work, 50% say that an evaluation or study of the risks to health and safety in their job has taken place in the past 12 months, 50% have received training or information about the risks to their health and safety in their job in the past two years, and 50% declare themselves to be very well informed about the risks to their health and safety in their job, would give us the following value for this variable:

$$\text{OHS effort} = 0.5*0.5*0.5*0.5 = 0.0625$$

Table 9.
Means difference t-test for independent samples. OHS effort

Variable	Sectors	Descriptive		Levene test		t-test	*P* Sig.
		No.	Mean	F	Sig.		(2-tail)
OHS effort	Critical	18	0.0420	12.14	0.001	Variances equal	0.120
	Other	69	0.0743			Variances different	0.013

The t-test (Table 9) again confirms that the firms in the "critical sectors" grouping have made less efforts in the area of OHS or their OHS management is poorer quality. This group of activities can be differentiated because of its significant contribution to the increase in the number of accidents, due more to the increase in the incidence rates than to the increase in employment, and also because of a greater number of divisions in which the OHS effort or quality of the OHS management is lower than average. Taken together, both results seem to be pointing to a group of sectors in which poor working conditions and/or less OHS effort or a lower quality in the management translate ultimately into higher incidence rates.

4. Conclusion

The number of occupational accidents registered in Spain is not only very high in comparison with its European neighbours but is also markedly pro-cyclical. While the incidence rate stayed above its 1994 level in the 12 years following the implementation of *Council Directive 89/391/EEC* on the introduction of measures to encourage improvements in the health and safety of workers at work, in the next five years (2008-2013) it dropped by more than 40%.

This fall in the number of occupational accidents – a result of the economic crisis – is of course good news, but if we look more closely the situation is less positive. The extreme sensitivity of the incidence rate to the economic cycle in Spain – again confirmed by the upturn recorded in 2014 in parallel with the incipient economic recovery – reveals the weakness of the OHS system in this country. The crisis has to a

large extent helped Spain to reduce the number of occupational accidents. But it is impossible to claim that there has been a continuous and progressive improvement in the levels of OHS in this country.

The sectorial analysis carried out on the latest data available for Spain has confirmed the existence of differential behaviours in certain divisions of activity: we have identified a group of divisions (18 out of a total of 87) that concentrates a large part (75%) of the increase in the number of occupational accidents (while they provide approximately only half of the new employment).

We have also found that the growth in the number of occupational accidents in these economic activities is more due to the increase in their incidence rate than to the increase in their employment: these divisions have become riskier in terms of occupational accidents. They also share another characteristic: their OHS effort, which measures the quality of their OHS management, is lower.

Despite the idea of a safety culture promoted in Spanish safety law, all this previous evidence seems to show that OHS management systems in most Spanish firms are still mainly focused on a formal rather than an effective compliance with the legislation and prevention obligations. Promoting an authentic safety culture in the workplace does not necessarily require a profound transformation in the culture or the fundamental national values or norms. As Mearns and Yule (2009) suggest, the commitment of the management or the effectiveness of the OHS systems in place determine to a greater extent than national culture employee behaviour and the organisation's performance in the safety area. For this reason, an effective public OHS policy should focus on those agents whose behaviour or decisions in OHS management can decisively influence the OHS conditions in their firms. According to Morillas et al. (2013), government agencies should encourage the implementation of safety management systems based on standards such as OHSAS 18001, since previous research has shown that accident rates in the workplace are significantly lower in firms with the OHSAS 18001 certification (Abad et al., 2013).

It is essential to incentivise firms to take on more responsibility in the OHS area. European policy-makers are increasingly interested in economic instruments to improve the working environment. These economic instruments often involve linking fiscal incentives to a firm's good OHS performance, for example with lower accident insurance premiums or tax rates (Elser et al., 2010). France and Germany have "bonus-malus" type mechanisms in their occupational accident insurance, a system that internalises the costs deriving from a bad management of occupational risks. Measures to this effect have been proposed in Spain. In 2010 a system was introduced based on a less powerful incentive, which envisages a partial reimbursement of firms' social contributions for professional contingencies (between 5 and 10%) to firms that have significantly reduced their number of occupational accidents, as long as they have made investments for this purpose, added new OHS resources (designated workers, own prevention service), have been audited, and do not exceed certain accident indicators, among other requisites. A new reform has been announced recently that would eliminate or relax these requisites, and link the incentive exclusively to an improvement in the accident indicators.

"Bonus-malus" systems are not without their disadvantages (see Tompa et al., 2007). For example they can encourage firms to hide accidents (particularly when they eliminate requisites like the ones mentioned above linked to an improvement in the firm's OHS performance), and they can put small firms at a competitive disadvantage because they lack sufficient scale to optimise resources dedicated to OHS. Thus in France the "bonus-malus" mechanism is not applied to micro-firms with fewer than 10 employees and is only applied fully to firms of more than 250 employees. In the case of SMEs, programmes for supporting and economically promoting OHS, with subsidies from the state or the insurance companies, may be effective as they help firms to reduce the costs of their investment in OHS. France has a system of prevention contracts in which insurance finances almost 25% of the investment. In Germany "bonus-malus" has been particularly effective in combination with other measures such as authorising the insurance companies to inspect and if necessary sanction firms, and the public programmes of technical assistance to SMEs (Castejón, 2011).

Finally, the sectorial differences we have found in this study imply that different sectors should be treated differently: improvement efforts should focus on sectors we find to be critical because of their dangerousness. In the Spanish case the incidence rate has a typical profile: it is higher in recently founded firms and in SMEs than in micro-firms or large firms (INSHT, 2013). We have also identified those divisions concentrating most of the increase in the number of accidents. And the division with the highest increase in the number of occupational accidents (over 50%) includes the temporary employment firms. Fabiano et al. (2008) also find that temporary workers in three large manufacturing firms in Italy,

supplied by temporary-help agencies, have a higher injury frequency index and worse accident severity than the rest of the workforce. This evidence shows that the growth in the incidence rate is particularly high in firms and occupations with a high turnover of temporary employment. This high turnover prevents workers from accumulating experience and specific knowledge in the job, and the firms employing them have little incentive to invest in OHS training for a human resources that will only stay a short time with them. As a general policy implication, the evidence obtained here highlights the need to encourage a better OHS management in these critical sectors. This could be done by complementing economic incentives with more inspections.

It is too early to say whether the battery of legal reforms can help to slow down the growth in the number of occupational accidents associated with the current economic recovery, but Spain has undoubtedly become an authentic laboratory in OHS policies. A detailed study of their impact over the next few years would provide important lessons to other countries wishing to improve their national prevention systems.

In the Methodology we pointed out the limitations of the decomposition technique used to quantify the effects of the changes in the employment level and incidence rate on the increase in the number of occupational accidents. This technique is useful for analytical and descriptive purposes, but it does not allow us to study the interrelations between these effects. The analysis was also at the aggregate level, differentiating the critical sectors contributing most to accident generation from the rest of the sectors. Having found the differences between these two groups of sectors in how accidents behave, future work should focus on the relations between the two effects considered using data disaggregated by sector. Researchers should also examine the relation between occupational accidents and sector-specific business cycle indicators such as gross value added or working hours.

And considering the decentralisation of labour policies and collective bargaining in Spain, another possible extension of this study would be to carry out an analysis based on Dunn's (1960) shift-share methodology. This methodology has been widely used in regional economic analysis to study the economic structure of regions and the evolution of the main variables that determine that structure. This would add the geographic factor into the analysis, observing how occupational accidents behave differently in the different Spanish autonomous regions and provinces compared to the national average for the different sectors of the economy. This approach could also apply at the European scale using data available for the different sectors from the different countries.

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