FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

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DOCTORAL PROGRAMME IN ECONOMICS, BUSINESS SCIENCE AND LAW

Doctoral Dissertation:

NEW APPROACHES TO OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT:

THE HUMAN CAPITAL PERSPECTIVE

Ph.D. student:
Maite Prieto Fernández

Advisor:
Imanol Núñez Aldaz

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Dedicated to those who have not returned.

“The important thing is not to stop questioning. Curiosity has its own reason for existence.”

Albert Einstein

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Maite Prieto

SUMMARY

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GENERAL INTRODUCTION

In a society where scientific advances and the development of new technologies are constant, occupational accidents continue with overwhelming figures that indicate that we are far from being able to eradicate them. Moreover, according to the ILO, in 2020, the number of work-related deaths was much higher than the number of deaths caused worldwide by SARS-COVID 2019. This data can make us see the problem's magnitude and conclude that occupational accidents could be considered the occupational pandemic of the 21st century.

Deaths and injuries at work are part of the daily news. However, despite the overwhelming data, it has not generated the same social alarm or deployment as in SARS-COVID 2019, to use a current example. This normalization or acceptance of occupational accidents as an intrinsic part of the productive activity has the consequence that OHS is understood as an activity parallel to production, often secondary. Many companies focus their investments and interest on production management. The manufacturing, quality management, or sales departments are the leading players in the organizational context, while OHS technicians are secondary players, necessary but undervalued.

The literature has identified apparent incentive problems that make OHS expenditures suboptimal (Pouliakas, 2013). The externalization of the costs of accidents to the state (medical costs) or the workers themselves (health suffering or loss of income) makes, among other factors, that companies tend to reduce the costs of prevention activities. However, working in conditions that guarantee the safety of workers is an indisputable right of workers, which is why all developed countries regulate OHS activity.

The regulation aims, among other objectives, to reverse the effects of the lack of incentives for OHS by introducing a system of inspection and sanction (Viscusi, 1979). By establishing mandatory standards, companies cannot avoid OHS activities. Regardless of whether managers consider the investment profitable or not, the regulation will oblige companies to assess their OHS risks, take corrective measures or inform workers, among

many other activities. However, some companies may continue to allocate minimal resources to worker safety and are content to comply with the law only formally (Arocena & Nuñez, 2009).

In addition, investment in OHS generates returns for the company that is often challenging to detect. On the one hand, it improves safety at work and therefore reduces the number of accidents. However, this reduction is complicated to quantify since an accident that does not occur does not generate a direct income but a saving. On the other hand, most of the benefits linked to investment in safety are of an intangible nature: workers' health is better and, therefore, their performance, the organizational climate is favourable, and so is the activity. However, unlike other functions such as quality or marketing, which can be transferred to product prices, these improvements generally affect the human capital of companies, which is an asset that is difficult to quantify and manage. In short, investment in OHS faces the handicap of balancing quantifiable costs, such as the salary of a prevention technician or the improvement of technology with income, with intangible income, which is very difficult to quantify and associate with OHS activity.

This thesis aims to contribute to a paradigm shift in the field of OHS. The three chapters of the thesis place human capital and, therefore, the person at the neuralgic center of OHS management.

A NEW PARADIGM FOR OHS: FOCUS ON HUMAN CAPITAL

OHS has traditionally been considered an ancillary activity to production. As such, "the general regulatory strategy initially consisted of establishing safety standards in the workplace, most of which were specification standards, for example, the width and spacing of handrails" (Viscusi, 1979). Subsequently, with the introduction of occupational safety standards, the organizational and managerial factors of the company became more important. From this new perspective, the fundamental causes of accidents were found in the management system's deficiencies. OHS takes the form of a management model, going beyond a more limited vision where corrective measures for obvious risks are added up.

Recently, Salguero-Caparrós et al. (2020) in their research indicated the difficulty of companies, small and medium-sized ones, in applying the current regulation (based on the management system), concluding the need not to base safety management "solely on prescriptive principles and on the detection of non-compliance," but to use proactive principles.

The academic literature has followed a similar path. The starting point is research with an eminently technical approach aimed at solving problems in safety, hygiene, or ergonomics. Over time, the OHS literature adopted a systemic approach, where organizational and management factors analysis became more relevant than before. According to Santos-Reyes & Beard (2008), the systemic approach consists of analyzing it as a whole, a system, and group events, failures, and accidents "within the results of the system's operation." However, despite significant differences between the diverse approaches, they all focus on the system's failure from a prevention perspective. In the case of the older studies of practices and the more recent studies of management systems, there is a lack of a proactive philosophy that places the person and his or her well-being at the center of the OHS.

Therefore, the traditional perspective of OHS in its academic, professional, and regulatory aspects understands the worker as a passive part of a system that suffers the consequences of accidents or occupational diseases. In this thesis, we intend to place workers at the center of the problem and the solution. Instead of giving them a passive role with hardly any responsibility, workers are active agents in the thesis' chapters. In other words, the characteristics of human capital, the actions of workers, or their incentives can alter or influence the OHS system and, thus, the occupational risk.

This thesis aims to contribute to the existing literature by analyzing OHS management differently. People are part of the company and contribute with their knowledge and capabilities to production or services. This knowledge, skills, creativity, and the individual's health are the definition of human capital (Becker, 1996; 2002). In developed countries where markets are increasingly demanding and companies have similar technologies, the company's

human capital is the primary source of competitive advantage (Memon et al., 2009; Preve, 2012).

With investments, organizations protect their strategic physical assets, such as machinery and facilities. This thesis argues that human capital is also susceptible to protection. Many companies invest vast amounts of resources in recruiting or training skilled workers. However, the need to protect and care for them is often unclear. According to Burund & Tumolo (2004), an organization that understands the value of its human capital chooses to invest in people. Therefore, designing effective strategies to protect human capital could be an essential and priority purpose for organizations. From this point of view, OHS management acquires a strategic value of the first order.

Specifically, we divide the thesis into three chapters dedicated to three representations of human capital: a) the stock of Human Capital, b) the behavior of the workers, and c) the deficit of Human Capital.

Chapter 1: THE EFFECT OF HUMAN CAPITAL ON OCCUPATIONAL HEALTH AND SAFETY INVESTMENT: AN EMPIRICAL ANALYSIS OF SPANISH FIRMS

This chapter analyses how firms' human capital influences their investments in occupational health and safety (OHS). We argue that the incentive to protect workers by investing in OHS is a function of the stock of human capital. The empirical analysis was based on data from the official Working Conditions Spanish Survey on OHS management. Our sample was restricted to 1,472 firms from the manufacturing and construction industries. Our results show that firms that place more emphasis on training and have a multiskilled and innovative workforce invest more in OHS. However, having technological and design skills has no impact on the investment in OHS, presumably because these skills are widely available in the labour market. Finally, the analysis suggests that some abilities such as problem solving may be affected by informational asymmetries and therefore firms may suboptimally invest in protecting these capabilities

Chapter 2: AN ANALYSIS OF INCENTIVES TO UNSAFE BEHAVIOR: FINDING EFFECTIVE ORGANIZATIONAL ACTIONS FOR RISKY ACTIVITIES.

Despite the enormous financial and organizational effort companies make to prevent occupational accidents, there are concerns that investments in occupational health and safety (OHS) are not as effective as expected. In that sense, most studies have focused on determining the optimal investment a company should make in OHS. However, a key element in the accident-avoidance process has gone more unnoticed: worker behavior. In this paper, we analyze the impact of ex-ante moral hazard on workers' unsafe behavior. In a European sample, using mediation models, we analyze the behavior of more than 16,000 workers whom their employer required to wear PPE but (some) chose not to do so. Specifically, we observed that the payment of variable wage incentives and the risk of losing their jobs push workers towards this risky behavior. In contrast, organizational mechanisms such as direct control, peer pressure, and the alignment of objectives to reduce moral hazard prevent workers' unsafe behavior and, consequently, occupational accidents. Workers who enjoy favorable employment conditions do not need to risk their health. Reducing occupational injuries requires synergy in OHS between companies and workers. The results and conclusions of this study apply to the design of organizational and public policies to prevent occupational accidents.

Chapter 3: THE IMPACT OF SKILLS MISMATCHES ON OCCUPATIONAL ACCIDENTS: AN ANALYSIS OF THE EFFECTIVENESS OF ORGANIZATIONAL RESPONSES

This chapter analyzes the effect of worker under-skilling on occupational safety. We estimate the impact of skill deficits on the probability of suffering an accident at work and, second, on the duration of sick leave. In addition, we test whether the company's measures to control the actions of these workers reduce this effect. We propose two moderation models in a sample of 42,871 workers obtained from the Sixth European Working Conditions Survey (EWCS6). The results show that under-skilled workers suffer more accidents and longer periods of sick leave. Furthermore, the results suggest that on-the-job training, safety information, and teamwork weaken the relationship between under-skilling and accidents.

However, the duration of sick leave is only reduced by teamwork. Our analysis shows that certain organizational and regulatory practices need to be modified to address the health effects of a lack of skills. The article includes some proposals in this regard.

After almost twenty years as a professional in the field of prevention, I have had the opportunity to actively participate in the design, implementation, and application of OHS systems in many construction projects. In the development of my profession, I have clearly and repeatedly observed the limitations of the current preventive model, which no longer manages to change the current trend of accidents nor to improve the health of workers visibly. Consequently, I decided to look for other ways of focusing on prevention to respond to this need. To do this, I first decided to change my vision of the problem, that is, the perspective from which to seek the solution.

The challenge was to move from an operational and professional vision to an analytical and academic approach that, without disdaining the experience "on the ground," would allow me to tackle the problem at its root. Introducing myself into the academic world has not only allowed me to learn and grow but has also allowed me to find answers to outline an alternative proposal that could change the day-to-day work of OHS and improve workers' health. Therefore, the aim of this thesis is ambitious but based on a real need. In summary, this thesis aims to contribute to the reduction of occupational accidents and the health of workers. To this end, it proposes to promote a paradigm shift in OHS by placing it in the field of human capital.

INTRODUCCIÓN GENERAL

En una sociedad donde los avances científicos y el desarrollo de nuevas tecnologías son constantes, los accidentes laborales continúan con unas abrumadoras cifras, indicándonos que estamos lejos de poder erradicarlos. Además, según la OIT, en 2020, el número de muertes relacionadas con el trabajo fue muy superior al número de muertes causadas en todo el mundo por el SARS-COVID 2019. Estos datos pueden hacernos ver la magnitud del problema y concluir que los accidentes laborales podrían considerarse la pandemia laboral del siglo XXI.

Las muertes y lesiones en el trabajo forman parte de las noticias diarias. Sin embargo, a pesar de lo abrumador de los datos, no ha generado la misma alarma o despliegue social que en el SARS-COVID 2019, por poner un ejemplo actual. Esta normalización o aceptación de la siniestralidad laboral como parte intrínseca de la actividad productiva tiene como consecuencia que la prevención de riesgos laborales se entienda como una actividad paralela a la producción, muchas veces secundaria. Muchas empresas centran sus inversiones y su interés en la gestión de la producción. Los departamentos de fabricación, gestión de la calidad o ventas son los actores principales en el contexto organizativo, mientras que los técnicos de PRL son actores secundarios, necesarios pero infravalorados.

La literatura ha identificado aparentes problemas de incentivos que hacen que los gastos en OHS sean subóptimos (Pouliakas, 2013). La externalización de los costes de los accidentes al Estado (costes médicos) o a los propios trabajadores (padecimientos de salud o pérdida de ingresos) hace, entre otros factores, que las empresas tiendan a reducir los costes de las actividades de prevención. Sin embargo, trabajar en condiciones que garanticen la seguridad de los trabajadores es un derecho indiscutible de los mismos, por lo que todos los países desarrollados regulan la actividad de PRL.

La regulación persigue, entre otros objetivos, invertir los efectos de la falta de incentivos para la SST mediante la introducción de un sistema de inspección y sanción (Viscusi, 1979). Al establecer normas obligatorias, las empresas no pueden eludir las actividades de

SST. Independientemente de si los directivos consideran que la inversión es rentable o no, la normativa obligará a las empresas a evaluar sus riesgos en materia de SST, adoptar medidas correctoras o informar a los trabajadores, entre otras muchas actividades. Sin embargo, es posible que algunas empresas sigan destinando recursos mínimos a la seguridad de los trabajadores y se conformen con cumplir la ley sólo formalmente (Arocena & Núñez, 2009).

Además, la inversión en SST genera unos beneficios para la empresa que a menudo son difíciles de detectar. Por un lado, mejora la seguridad en el trabajo y, por tanto, reduce el número de accidentes. Sin embargo, esta reducción es complicada de cuantificar ya que un accidente que no se produce no genera un ingreso directo sino un ahorro. Por otro lado, la mayoría de los beneficios ligados a la inversión en seguridad son de carácter intangible: la salud de los trabajadores es mejor y, por tanto, su rendimiento, el clima organizativo es favorable y la actividad también. Sin embargo, a diferencia de otras funciones como la calidad o el marketing, que pueden trasladarse a los precios de los productos, estas mejoras afectan en general al capital humano de las empresas, que es un activo difícil de cuantificar y gestionar. En definitiva, la inversión en PRL se enfrenta al hándicap de equilibrar costes cuantificables, como el salario de un técnico de prevención o la mejora de la tecnología con ingresos, con ingresos intangibles, muy difíciles de cuantificar y asociar a la actividad de PRL.

Esta tesis pretende contribuir a un cambio de paradigma en el campo de la PRL. Los tres capítulos de la tesis sitúan al capital humano y, por tanto, a la persona en el centro neurálgico de la gestión de la PRL.

UN NUEVO PARADIGMA PARA LA SEGURIDAD Y SALUD EN EL TRABAJO: CENTRARSE EN EL CAPITAL HUMANO

Tradicionalmente, la PRL se ha considerado una actividad auxiliar de la producción. Como tal, "la estrategia reguladora general consistió inicialmente en establecer normas de seguridad en el lugar de trabajo, la mayoría de las cuales eran normas de especificación, por ejemplo, la anchura y la separación de las barandillas" (Viscusi, 1979). Posteriormente, con la introducción de las normas de seguridad en el trabajo, los factores organizativos y de gestión de la empresa adquirieron mayor importancia. Desde esta nueva perspectiva, las causas

fundamentales de los accidentes se encontraban en las deficiencias del sistema de gestión. La seguridad y salud en el trabajo adopta la forma de un modelo de gestión, superando una visión más limitada en la que se suman las medidas correctoras de los riesgos evidentes. Recientemente, Salguero-Caparrós et al. (2020) señalaban en su investigación la dificultad de las empresas, pequeñas y medianas, para aplicar la normativa vigente (basada en el sistema de gestión), concluyendo la necesidad de no basar la gestión de la seguridad "únicamente en principios prescriptivos y en la detección de incumplimientos", sino utilizar principios proactivos.

La literatura académica ha seguido un camino similar. El punto de partida es la investigación con un enfoque eminentemente técnico dirigido a resolver problemas de seguridad, higiene o ergonomía. Con el tiempo, la literatura sobre salud y seguridad en el trabajo adoptó un enfoque sistémico, en el que el análisis de los factores organizativos y de gestión adquirió más relevancia que antes. Según Santos-Reyes y Beard (2008), el enfoque sistémico consiste en analizarlo como un todo, un sistema, y agrupar los sucesos, fallos y accidentes "dentro de los resultados del funcionamiento del sistema". Sin embargo, a pesar de las diferencias significativas entre los diversos enfoques, todos ellos se centran en el fallo del sistema desde una perspectiva de prevención. En el caso de los estudios más antiguos sobre prácticas y los más recientes sobre sistemas de gestión, se echa en falta una filosofía proactiva que sitúe a la persona y su bienestar en el centro de la PRL.

Así, la perspectiva tradicional de la PRL en su vertiente académica, profesional y normativa entiende al trabajador como parte pasiva de un sistema que sufre las consecuencias de accidentes o enfermedades profesionales. En esta tesis, pretendemos situar a los trabajadores en el centro del problema y de la solución. En lugar de otorgarles un papel pasivo sin apenas responsabilidad, los trabajadores son agentes activos en los capítulos de la tesis. En otras palabras, las características del capital humano, las acciones de los trabajadores o sus incentivos pueden alterar o influir en el sistema de PRL y, por tanto, en el riesgo laboral.

Esta tesis pretende contribuir a la literatura existente analizando de forma diferente la gestión de la PRL. Las personas forman parte de la empresa y contribuyen con sus conocimientos y capacidades a la producción o la prestación de servicios. Estos conocimientos, habilidades, creatividad y la salud del individuo son la definición de capital humano (Becker, 1996; 2002). En los países desarrollados, donde los mercados son cada vez más exigentes y las empresas disponen de tecnologías similares, el capital humano de la empresa es la principal fuente de ventaja competitiva (Memon et al., 2009; Preve, 2012).

Con las inversiones, las organizaciones protegen sus activos físicos estratégicos, como la maquinaria y las instalaciones. Esta tesis sostiene que el capital humano también es susceptible de protección. Muchas empresas invierten grandes cantidades de recursos en contratar o formar a trabajadores cualificados. Sin embargo, a menudo no está clara la necesidad de protegerlos y cuidarlos. Según Burund y Tumolo (2004), una organización que comprende el valor de su capital humano opta por invertir en las personas. Por lo tanto, diseñar estrategias eficaces para proteger el capital humano podría ser un propósito esencial y prioritario para las organizaciones. Desde este punto de vista, la gestión de la PRL adquiere un valor estratégico de primer orden.

En concreto, dividimos la tesis en tres capítulos dedicados a tres representaciones del capital humano: a) el stock de Capital Humano, b) el comportamiento de los trabajadores, y c) el déficit de Capital Humano.

Capítulo 1: EL EFECTO DEL CAPITAL HUMANO EN LA INVERSIÓN EN SEGURIDAD Y SALUD LABORAL: UN ANÁLISIS EMPÍRICO DE LAS EMPRESAS ESPAÑOLAS

En este capítulo se analiza cómo influye el capital humano de las empresas en sus inversiones en salud y seguridad en el trabajo (SST). Argumentamos que el incentivo para proteger a los trabajadores invirtiendo en SST es función del stock de capital humano. El análisis empírico se basa en datos de la Encuesta Oficial de Condiciones de Trabajo española sobre gestión de la seguridad y salud en el trabajo. La muestra se limitó a 1.472 empresas de los sectores manufacturero y de la construcción. Nuestros resultados muestran que las empresas que ponen más énfasis en la formación y cuentan con una mano de obra

multicualificada e innovadora invierten más en PRL. Sin embargo, disponer de competencias tecnológicas y de diseño no influye en la inversión en SST, presumiblemente porque estas competencias están ampliamente disponibles en el mercado laboral. Por último, el análisis sugiere que algunas capacidades, como la resolución de problemas, pueden verse afectadas por asimetrías de información y, por tanto, las empresas pueden invertir de forma subóptima en la protección de estas capacidades.

Capítulo 2: ANÁLISIS DE LOS INCENTIVOS AL COMPORTAMIENTO INSEGURO: ENCONTRAR ACCIONES ORGANIZATIVAS EFICACES PARA LAS ACTIVIDADES DE RIESGO

A pesar del enorme esfuerzo financiero y organizativo que realizan las empresas para prevenir los accidentes laborales, existe la preocupación de que las inversiones en salud y seguridad en el trabajo (SST) no sean tan eficaces como se esperaba. En este sentido, la mayoría de los estudios se han centrado en determinar la inversión óptima que debe realizar una empresa en SST. Sin embargo, un elemento clave en el proceso de prevención de accidentes ha pasado más desapercibido: el comportamiento de los trabajadores. En este trabajo analizamos el impacto del riesgo moral ex ante en el comportamiento inseguro de los trabajadores. En una muestra europea, y utilizando modelos de mediación, analizamos el comportamiento de más de 16.000 trabajadores a los que su empresa exigía llevar EPI pero (algunos) decidieron no hacerlo. En concreto, observamos que el pago de incentivos salariales variables y el riesgo de perder el empleo empujan a los trabajadores hacia este comportamiento de riesgo. Por el contrario, mecanismos organizativos como el control directo, la presión de los compañeros y la alineación de objetivos para reducir el riesgo moral evitan el comportamiento inseguro de los trabajadores y, en consecuencia, los accidentes laborales. Los trabajadores que disfrutan de condiciones laborales favorables no necesitan arriesgar su salud. La reducción de los accidentes laborales requiere una sinergia en materia de salud y seguridad en el trabajo entre las empresas y los trabajadores. Los resultados y conclusiones de este estudio se aplican al diseño de políticas organizativas y públicas para prevenir los accidentes laborales.

Capítulo 3: EL IMPACTO DE LOS DESAJUSTES DE COMPETENCIAS EN LOS ACCIDENTES DE TRABAJO: UN ANÁLISIS DE LA EFICACIA DE LAS RESPUESTAS ORGANIZATIVAS

Este capítulo analiza el efecto de la falta de cualificación de los trabajadores sobre la seguridad laboral. Estimamos el impacto de los déficits de cualificación en la probabilidad de sufrir un accidente laboral y, en segundo lugar, en la duración de la baja por enfermedad. Además, probamos si las medidas de la empresa para controlar la actuación de estos trabajadores reducen este efecto. Proponemos dos modelos de moderación en una muestra de 42.871 trabajadores obtenida de la Sexta Encuesta Europea de Condiciones de Trabajo (EWCS6). Los resultados muestran que los trabajadores poco cualificados sufren más accidentes y periodos más largos de baja por enfermedad. Además, los resultados sugieren que la formación en el puesto de trabajo, la información sobre seguridad y el trabajo en equipo debilitan la relación entre la baja cualificación y los accidentes. Sin embargo, la duración de las bajas por enfermedad sólo se reduce con el trabajo en equipo. Nuestro análisis pone de manifiesto la necesidad de modificar determinadas prácticas organizativas y normativas para hacer frente a los efectos sobre la salud de la falta de cualificación. El capítulo incluye algunas propuestas en este sentido.

Tras veinte años como profesional de la prevención, he tenido la oportunidad de participar activamente en el diseño, implantación y aplicación de sistemas de PRL en numerosos proyectos de construcción. En el desarrollo de mi profesión, he observado clara y reiteradamente las limitaciones del modelo preventivo actual, que ya no consigue cambiar la tendencia actual de siniestralidad ni mejorar visiblemente la salud de los trabajadores. En consecuencia, decidí buscar otras formas de enfocar la prevención para responder a esta necesidad. Para ello, primero decidí cambiar mi visión del problema, es decir, la perspectiva desde la que buscar la solución.

El reto era pasar de una visión operativa y profesional a un enfoque analítico y académico que, sin menospreciar la experiencia "sobre el terreno", me permitiera abordar el problema en su raíz. Introducirme en el mundo académico no sólo me ha permitido aprender y crecer, sino que también me ha permitido encontrar respuestas para esbozar una propuesta

alternativa que pueda cambiar el día a día de la SST y mejorar la salud de los trabajadores. Por tanto, el objetivo de esta tesis es ambicioso pero basado en una necesidad real. En resumen, esta tesis pretende contribuir a la reducción de los accidentes laborales y a la salud de los trabajadores. Para ello, propone promover un cambio de paradigma en la SST situándola en el ámbito del capital humano.

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CHAPTER 1

THE EFFECT OF HUMAN CAPITAL ON OCCUPATIONAL HEALTH AND SAFETY INVESTMENT: AN EMPIRICAL ANALYSIS OF SPANISH FIRMS

1.1. INTRODUCTION

The relationship between skills, effort, and workers' health has attracted the attention of the most prestigious economists from the very beginning of the discipline. Adam Smith (1776), for example, in the Wealth of Nations stressed that "mutual emulation and the desire of greater gain frequently prompted them (workers) to overwork themselves, and to hurt their health by excessive labour" To control the effect of work effort on health, the International Labour Organisation (ILO) and the World Health Organization jointly established that the first and foremost objective of the occupational health and safety (OHS) policies should be the "maintenance and promotion of workers' health and working capacity" (ILO, 2013). As firms and governments are responsible for OHS activities, they are obliged to protect workers and their human capital.

According to the Chicago School, human capital is the stock of knowledge and some social and personal attributes (Becker, 1962). This stock determines workers' ability to work and is expected to generate economic value for the organisation. It follows that the value of a firm's human capital depends not only on the "stock" variables belonging to each worker but also on workers' actual capacity to generate economic value, which is determined by, among other factors, the health status of each worker. The professional sports industry illustrates this: Expensive star players only contribute to a team's performance if their health is good enough to play. If they are injured or out of shape, their team's investment in human capital will not obtain the expected yield. This means that protecting and maintaining workers' (players') health is a human resource (HR) priority for professional sports teams; their competitive edge is strongly dependent on player health.

Despite the (allegedly) obvious, the important relationship between human capital and OHS, the link between investment in OHS, and the value of a firm's human capital has not been thoroughly analysed. Colbert (2004) claims that OHS activities have been systematically neglected in analysis of HR functions, which seriously hinders the development and implementation of effective OHS policies. Only some studies have analysed the relationship indirectly and estimated the effect of OHS activities on workers' productivity (Loeppke et al., 2009) or firms' performance

(Fernandez Muñiz, Montes-Peon, & Vazquez-Ordas, 2009). Others have analysed the relationship between organisations' work practices and occupational injuries directly (although without considering investment in OHS), including studies of high performance work systems (Barling, Kelloway, & Roderick, 2003), quality management practices, and technological and organisational innovations (Harrisson & Legendre, 2003).

For the HRM field, the joint analysis of OHS investment and human capital has the potential to generate improved HR policies. MacIntosh, MacLean, and Burns (2007), for example, stressed that the success in the implementation of some HR practices may be determined by workers' health status. Warr and Yearta (1995) analysed how the interaction between motivation and health affected absenteeism in workers. More recently, Van de Voorde and Beijer (2015) studied how high-performance work systems influenced employee's outcomes, including health. They observed that HR practices may improve work performance if they are associated with improvements in health-related variables. Ruiz and Corduras (2015) also investigated how certain HR practices contribute to the humanisation of the production process (one consequence of which is health improvements) and how these HR practices improve some performance indicators such as corporate entrepreneurship and productivity.

In this paper, we argue that the relationship described in the sport industry, between an organisation's human capital and the investment in OHS, may also be in force in other sectors and firms. Hence, firms with a strong human capital should be more interested in investing in OHS to "maintain and promote workers' health and working capacity" as defined by ILO/World Health Organization. We focused our analysis on a sample of 1,474 Spanish manufacturing and construction firms and where occupational risk is quite high in both industries. OHS activities and human capital were measured by responses to the VI Encuesta Nacional de Gestión de la Seguridad survey sponsored by the national body responsible for OHS in Spain, the Instituto Nacional de Seguridad e Higiene en el Trabajo (INSHT)[1].

[1] National Institute of Occupational Health and Safety.

1.2. THEORETICAL CONCEPTUALIZATION. HUMAN CAPITAL INVESTMENT IN OHS.

The human capital of a firm can be analysed, fundamentally, at two levels: individual and organisational. At an individual level, human capital theory was the brainchild of Becker (1962), who recognised health and fitness as components of human capital. This perspective suggests that firms' investments in OHS may increase their stock of human capital, as does, for example, investment in workers' training. Individual health thus becomes an intangible asset of the firm.

At the organisational level, which is the focus of our analysis, human capital is the sum of the skills and capabilities that a firm employs in the production process (Wright, Coff, & Moliterno, 2014). Ployhart and Moliterno (2011) stressed that human capital in this sense is an asset that belongs to the firm. Furthermore, as human capital is a productive asset, it should contribute to the firms' production and value and, therefore, enhance its competitive advantage (Barney & Wright, 1998). At an organisational level, workers' health is not usually considered a component of human capital. With the exception of a small number of sectors that make very specific demands of workers, such as professional sport, it seems unreasonable to suggest that the workers' physical condition can generate a competitive advantage for a normal firm. On the contrary, it is quite clear that poor health or accidents and injuries may hinder the effective use of workers' productive skills and capabilities.

Our theoretical proposition is not that firms invest in OHS to increase their human capital but that they do so to protect it and make it available. In a recent article, Ployhart, Nyberg, Reilly, and Maltarich (2014) discussed the difference between human capital and human capital resources; they stressed that the difference between the constructs is in firms' level of access to their stock of human capital. They argue that traditional human capital components, such as knowledge or skills, are only significant if they are accessible for firm-relevant purposes. On the basis of this distinction, we understand firms' investment in OHS as an organisational mechanism by which the stock of human capital embodied in workers is made available to firms' production

processes; in other words, investment in OHS may transform unproductive human capital into a source of competitive advantage for a firm.

If this conceptual approach is accepted, then investments in OHS and, for example, training, do not contribute equally to a firm's human capital. Investment in training may increase a firm's stock of human capital, but if the trained workers are not fit for work due to accidents or sickness, it will not yield any competitive advantage. Firms with large stocks of human capital thus have a particularly strong incentive to minimise accidents and sickness among their workforce by investing in OHS.

The formalisation of the market of OHS first developed by Henderson (1983) may help to illustrate the relationship we have proposed. Henderson assumes that the investment in OHS is no different to other decisions made by firms and workers and therefore is informed by cost and benefit functions. Rational firms in a competitive market will therefore invest in OHS to the point where marginal costs and revenues are equal. From that starting point, economists have tried to identify the components of these functions, with particular interest in wage differentials (Viscusi, 1993), inspections and sanctions (Shapiro, 1999), or incentives linked to the insurance system (Ruser & Butler, 2009). In this paper, we argue that human capital will depict the form of the OHS benefit function and consequently it will determine the level of optimum OHS investment.

Accordingly, we posit the following:

Hypothesis 1: Investment in safety (OHS) is positively related to human capital stock.

Based on Ployhart and Moliterno's (2011) definition of human capital as an organisational resource that emerges from individuals' knowledge, skills, abilities and other characteristics (KSAO) we operationalised Hypothesis 1 as a series of subhypotheses:

Hypothesis 1a: Firms where the workforce is highly knowledgeable will invest more in OHS.

Hypothesis 1b: Firms where the workforce is highly skilled will invest more in OHS.

Hypothesis 1c: Investment in OHS is positively related to workers' abilities.

1.3. METHOD.

1.3.1. Data and Sample

The sample is based on the IX Encuesta Nacional de Gestion de la Seguridad y Salud en el Trabajo (ENGE 2009)[2], conducted by the Spanish National Institute for Safety and Health at Work. The unit of analysis is the firm, and the survey collected a unique set of data on OHS indicators, management practices, and job design parameters.

The survey was targeted at managers or company owners with at least one registered worker in the social security system. The population comprises 1,120,276 units and comprises companies in all sectors throughout Spain (except Ceuta and Melilla). The random sample survey included a total of 5,147 firms.

In our analysis, we limited the sample to the construction and manufacturing industries, where the level of occupational risk is higher and easier to measure. We excluded the service industries because the occupational risk in this sector is close to $p \approx 0$, and in such cases, the influence of the quantity of human capital on investment in OHS will be very small and therefore difficult to estimate empirically. Finally, we restricted the sample to firms with 10 or more employees to ensure that we only considered firms with a developed HR function and OHS management system.

The resulting sample consisted of 1,472 firms; descriptive statistics for the sample are listed in Table 1.1.

[2] National Survey on Health and Safety Management.

	Frequency/mean (Cronbach´s Alpha)	*σ*	*ENGE Question*
Sample	1.472		
Dependent Variable.			
OHS Index. (y_1)	6.29 (.8354)	2.586	*ENGE 39. Indicate if these OHS activities have been carried out in your firm:*
Development	86.4%		*Development of an OHS plan.*
Planning	81.4%		*Planning of the OHS activities.*
Control	67.7%		*OHS control activities.*
Emergency	74.9%		*Definition of emergency measures.*
Simulacrum	52.3%		*Dealing with simulated emergencies*
Information	83.4%		*Provision of OHS information*
Investigation	75.0%		*Accident investigation and analysis*
Responsibilities	65.8%		*Assignment of OHS responsibilities*
Specific medical examination	42.7%		*ENGE 36. Indicate if your company has offered workers the opportunity to undergo medical examinations in the last year*
Independent Variable			
Knowledge			
Training Scope (x1)	3.06 (.7934)	*1.678*	*ENGE 42. Indicate the groups have received training*
Workers with OHS-related duties	70.2%		Workers with specific OHS-related duties
Directors	59.9%		Senior management or directors
Middle managers	67.9%		Direct and intermediate line managers
Other workers	80.0%		Other employees
Out-sourced staff	28.0%		External employees
Training Frequency (x2)	2.75 (.7805)	2.350	*ENGE 43. Indicate the reasons for training*
New workers	50.7%		Hiring new workers
OHS functions	29.4%		Assigning OHS functions to certain workers
Changing roles	21.9%		The change in the functions performed by the worker
New technologies	19.3%		The introduction of new technologies
Work equipment	18.9%		A change in work equipment
Demands	16.2%		Demands for workers or their representatives
Identification of hazards	34.8%		Hazard identification and risk assessment
Investigation	20.2%		*Investigation of occupational accidents and diseases*
Improvement	64.3%		The general improvement in OHS training
External Training (x3)	30.6%		*ENGE 44. Entity that has* dispensed *the training*
Skills			
Multi-skilling (x4)	58.6%		ENGE 13. Indicate if these management tools have been used in your firm
High-Technology (x_5) (Over 71%)	12.8%		ENGE 45. Indicate what percentage of your companies purchases of machinery (excluding computers) have been new machinery during the past two years.
Design (x_6)	20.8%		ENGE 12. Sort these factors according to your company´s business strategy.

Table 1.1. Variable description.

Abilities			
Innovation (x_7)	5.4%		ENGE 12. Sort these factors according to your company´s business strategy.
Problem-solving (x_8)	45.1%		ENGE 13. Indicate if these management tools have been used in your firm
Control Variables			
Risk Index (x_9)	0.85 (.776)	1.215	*ENGE 11 Indicate if your firm carries out particularly dangerous activities* *ENGE 15. Indicate if there is a risk of workplace accidents, occupational diseases, or other diseases or disorders related to work*
Industry (x_{10})	81.5%		ENGE 4. The main economic activity of the company in the workplace. [Manufacturing]
Company size (x_{11})	133.70	1.335	*ENGE 6. Indicate the number of people your firm employs at present*
Administrative Sanctions (x_{12})	15.1%		*ENGE 16. Indicate if your company has had any:*
Social Security Surcharges (x_{13})	7.3%		*ENGE 16. Indicate if your company has had any:*

Table 1.1. (Continued). Note OHS: Occupational health and safety,

1.3.2. Dependent Variable

We measured investment in OHS using a specially developed additive index of nine measures that have been or have not been implemented by a firm. The index is an ordinal measure of overall investment in OHS, which would, ideally, be measured in monetary units; however, this information was not available from this survey. Furthermore, the lack of accounting standards for the costs and revenues of OHS is a widespread problem that affects not only surveys but also, more importantly, OHS practitioners and firms. In most national accounting systems, OHS costs and revenues are reported under different accounting items, which dramatically reduces the visibility of OHS performance (Rikhardsson & Impgaard, 2004).

We opted to construct an ordinal index of OHS investment as an alternative to a direct monetary indicator based on the assumption that firms implementing a given OHS measure are investing more in OHS than they would if they did not implement that measure. It is important to note that because we used an ordinal construct, we cannot compare OHS investment between firms. For example, if Firms A and B both score 2, this does not mean that they are investing the same amount of resources in OHS. This limitation is particularly important when, as is the case in

practice, there are differences in the resources needed to implement particular OHS measures. For example, it may be more expensive to ensure that all employees undergo a specific medical examination than assigning OHS responsibilities.

To measure the internal robustness of the additive index, we used Cronbach's alpha. We used the usual threshold of values over ($\lambda = 0.70$) to accept that the additive index is measuring the same construct. The internal robustness of the index was very good ($\lambda = 0.83$), and we found that, on average, firms implement 6.29 measures out of nine. As expected, basic measures such as development of an OHS plan (86.4%) or planning OHS activities (81.4%) are more widely implemented than more specific measures such as medical examinations (42.7%) or simulated emergencies (52.3%). It is important to note, however, that firms have a legal duty to implement most of these measures, and so, what appears to be high implementation frequencies actually indicates that firms are not complying with the law quite frequently. We deliberately excluded OHS training activities from our OHS investment index as some human capital variables include training, and we wanted to avoid the risk that we would be measuring the same factor as dependent and independent variables.

1.3.3. Independent Variables.

As explained above, we determined firms' stock of human capital by measuring the KSAO embedded in their workforce. In this analysis, we will focus on the stock of knowledge, skills, and abilities, as it is difficult to define and measure what is embedded in the more generic other dimension. The unit of analysis is the firm, and therefore, frequencies in Table 1.1 show the percentage of firms implementing each preventive or organisational practice.

First, we tested Hypothesis 1a, by estimating knowledge based on the scope and content of firms' training activities. We simply assumed that the stock of knowledge is higher in firms where more workers receive training (greater scope) and where training is delivered more frequently, because "knowledge contained in any given process is proportionate to the time it takes to learn it" (Pavlou, Housel, Rodgers, & Jansen, 2005). We observed that on average, firms provide training for 3.06 out of five worker categories and the category least likely to receive training was outsourced

staff, as only 28.0% of the firms in the sample provide training to this group. Inspection of data on training frequency also showed that firms are most likely to provide training when hiring new staff (50.7%) and when improvement programmes are introduced (64.3%). Finally, to control for the source of training, distinguishing between internal and more specific training and external and more generic training, we include a dummy variable that identifies firms (30.6%) that provide training by using external institutions such as universities, unions, or consulting firms.

To test the next two subhypotheses, we introduced a set of variables measuring skills and abilities. Unfortunately, it is not always easy to distinguish and separately measure workers' skills and abilities. This is even more complicated when the unit of measure is the firm and not the individual worker, as in our case, and also the case of many of previous studies on human capital (Wright & McMahan, 2011).

The following measures are therefore proposed in order to approach the stock of skills and abilities embedded in the firm but do not attempt to provide a clear-cut differentiation between skills and abilities, as we are aware that some readers may understand skills and abilities differently in the proposed classification. Nevertheless, we understand that they are adequate measures for our analysis, as they are clearly and positively related to firms' average stock of human capital.

To test Hypothesis 1b, we used a set of variables measuring the skill mix of firms: frequency of multiskilling (58.6%) and the percentage (12.8%) of firms that are strong in new technologies. We assumed that firms where workers have multiple skills and firms where new technologies are introduced have a richer skill mix among their workforce and therefore have more incentive to protect their workers by investing more resources in OHS. We also include a dichotomic variable identifying firms where the design of new products is among the two major strategic goals (20.8%). Leonard-Barton (1992) identifies some core technical and managerial skills or capabilities that are key to the development of new products. In our analysis, we simply expect that these design-oriented firms will need to incorporate these skills and, as a result, their stock of human capital will be larger.

Third, to test Hypothesis 1c, we introduced two variables, workforce ability to solve problems (45.1%) and a dichotomic variable that identifies firms (5.4%), where innovation is among their strategic priorities. Sullivan and Ford (2010) stress that innovation is linked to some personal abilities or attributes broadly embodied in the concept of creativity. We expect that these innovative firms will also have a more creative workforce, making their stock of human capital higher.

Finally, we included some control variables in order to gauge the level of occupational risk in firms. First, we created a risk index based on respondents' assessments of firms' OHS risk. In particular, the respondents assessed the risk of accidents, occupational diseases, and special activities that involve high risk. We also included the industry and size of the firm in order to control structural and institutional characteristics of the firm. This sample was mainly composed of firms in the manufacturing industry (81.5%) and medium-sized firms (133.70 employees). Finally, we included past administrative sanctions (15.1%) and surcharges in the social security fees (7.3%) paid by firms in order to control the effect of the enforcement of OHS regulations.

1.4. RESULTS

1.4.1. The Ordered Probit Model.

Human capital variables are usually correlated and therefore multicollinearity becomes an important methodological issue when their relationship is econometrically analysed (Heckman & Vytlacil, 1998). Lack of independence between human capital variables is quite common as, for example, individual knowledge may be the origin of personal skills, or the result of the ability to learn. First, in order to identify possible multicollinearity problems, in Table 1.2, we computed the pairwise Pearson's correlation coefficients for the explanatory variables.

Variables	Correlations (Significance level)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Training Scope	1.000												
2. Training Frequency	.559**	1.000											
	(.000)												
3. External Training	.299**	.503**	1.000										
	(.000)	(.000)											
4. Multi-skilling	.169**	.160**	.097**	1.000									
	(.000)	(.000)	(.000)										
5. High technology	.098**	.169**	.153**	.095**	1.000								
	(.000)	(.000)	(.000)	(.000)									
6. Design	-.074**	.090**	-0.027	-.035	-.010	1.000							
	(.004)	(.001)	(.293)	(.184)	(.689)								
7. Innovation	.079**	.062*	.025	.060*	.017	.034	1.000						
	(.002)	(.018)	(.334)	(.022)	(.508)	(.192)							
8. Problem-solving	.157**	.154**	.059*	.325**	.013	-.040	.057*	1.000					
	(.000)	(.000)	(.023)	(.000)	(.616)	(.121)	(.030)						
9. Risk Index	.221**	.300**	.191**	.088**	.106**	.118**	.031	.084**	1.000				
	(.000)	(.000)	(.000)	(.001)	(.000)	(.000)	(.236)	(.001)					
10. Industry	-.041	-.018	-.041	.083**	.004	.037	.059*	.087**	206**	1.000			
	(.114)	(.494)	(.114)	(.001)	(.882)	(.087)	(.024)	(.001)	(.000)				
11. Ln Company Size	.354**	.477**	.336**	.170**	.111**	.014	.058*	.233**	.188**	.091**	1.000		
	(.000)	(.000)	(.000)	(.000)	(.000)	(.591)	(.026)	(.000)	(.000)	(.000)			
12. Administrative sanctions	.176**	.301**	.238**	.113**	.105**	-.058*	.000	0.051	.158**	-.058*	.231**	1.000	
	(.000)	(.000)	(.000)	(.000)	(.000)	(.027)	(.992)	(.050)	(.000)	(.027)	(.000)		
13. Surcharges	.166**	.250**	.189**	.119**	.120**	-.066*	-.009	.093**	.150**	-.015	.204**	.378**	1.000
	(.000)	(.000)	(.000)	(.000)	(.000)	(.011)	(.741)	(.000)	(.000)	(.565)	(.000)	(.000)	

**. The correlation is significant at the .01 level (bilateral).

*. The correlation is significant at the .05 level (bilateral).

Table 1.2. Pairwise Pearson's correlations for explanatory variables.

As expected, this revealed that most variables were positively related. However, in most cases, the level of correlation was reasonably low. Some additional tests such as the variance inflation factor confirm that the multicollinearity problem was not grave enough to bias the estimations.

We defined the following model to estimate the relationship between investment in OHS and the stock of human capital. The first model is specified in Equation (1) and is estimated by means of an ordered probit regression.

In order to avoid possible heteroscedasticity bias, we used the robust errors option available in STATA 14.

Model 1

$$y_1 = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} + \varepsilon_j \quad [1]$$

The direct effects are listed in Table 1.3.

		Robust Standard Errors	
Independent Variable	Beta	Errors	*p*
Knowledge			
Training Scope	.177	.020	.000
Training Frequency	.126	.017	.000
External Training	.039	.071	.577
Skills			
Multi-skilling	.276	.059	.000
High technology	.018	.083	.827
Design	-.039	.069	.573
Abilities			
Innovation	.220	.113	.052
Problem-solving	.235	.058	.000
Risk Index	.083	.024	.001
Industry	.252	.074	..001
Ln Company size	.087	.025	.001
Administrative sanctions	.384	.090	.000
Surchages	-.101	.122	.405
Cut (0)	*-1.205*	*.296*	*.000*
Cut (1)	*-.609*	*.289*	*.035*
Cut (2)	*-.119*	*.286*	*.172*
Cut (3)	*.209*	*.285*	*.535*
Cut (4)	*.656*	*.285*	*.021*
Cut (5)	*1.201*	*.286*	*.000*
Cut (6)	*1.792*	*.286*	*.000*
Cut (7)	*2.627*	*.286*	*.000*
Cut (8)	*4.329*	*.286*	*.000*

Table 1.3. Ordered Probit regression analysis on OHS investment index.

The results provide strong support for *Hypothesis 1*. There is an association between human capital stock and investment in OHS. In particular, *Hypothesis 1a* is supported by the coefficients of

training scope (β=.177, ρ=.000) and frequency (β=.126, ρ=.000), both strongly significant coefficients. In line with our theoretical proposal, the results show that when firms have enhanced their human capital through training, they protect it by devoting more resources to OHS. The results also reveal that the external source of training does not affect the investment in OHS. In other words, both specific and generic human capital gains are equally protected by firms' investment in OHS.

The results also provide support for *Hypothesis 1b:* there was strong evidence that the multi-skilling dimension of human capital (β=.276, ρ=.000) influenced investment in OHS. However, we find no evidence that investment in OHS was related to the need for technological skills, or to design skills. As we will discuss further, these results may indicate that firms in the sample do not consider these skills of strategic value or, alternatively, they find it easy to replace these types of skills using external markets.

We also found support for *Hypothesis 1c*, as coefficients for abilities linked to innovation (β=.220, ρ=.052) and problem-solving (β=.235, ρ=.000) were positive and significant. The results reveal that firms find it necessary to protect their workforce more intensely when their employees have these particular and quite rare abilities. Finally, we obtained the expected results for the control variables; all coefficients were positive and significant: risk index (β=.083, ρ=.001), industry dummy (β=.252, ρ=.001), company size (β=.087, ρ=.001) and administrative sanctions (β=.384, ρ=.000).

1.4.2. Analysing the endogeneity problem.

The rigorousness of the results presented above is based on the assumption of a unidirectional relationship between human capital stock and investment in OHS. However, this relationship may work the other way around leading to a classical endogeneity problem where the stock of human capital may be explained by the OHS investment. In particular, it can be argued that skilled workers may prefer safer firms as suffering an accident or illness may be more costly for them in terms of the loss of the opportunity to develop their (more optimistic) careers. The wage premium theory precisely stresses that workers will be sorted in firms according to their

preferences between risk and wage (Viscusi, 1993), and therefore, it is likely that the workforce of safer firms will be composed of workers with better career prospects or, in other words, workers with higher human capital stock.

The instrumental variable (IV) estimation models are the common solution to endogeneity problems. The IV models are estimated in two stages. In the first stage, the endogenous variables (human capital variables) are used as dependent variables and the IVs are used as explanatory variables. In the second stage, the dependent variable (OHS investment) is regressed against the predicted values of the endogenous variables estimated in the first-stage regression. IV models have to comply with two conditions in order to become valid and robust estimators. First, IV variables have to significantly relate to the endogenous variables, and as a second condition, they should remain unrelated to the dependent variable (Angrist & Pischke, 2009).

Finding adequate instruments is a difficult task, particularly when the model contains multiple endogenous variables. In our case, we needed eight instruments for the equivalent number of endogenous variables. In order to estimate our model, we used several official regional educational and health indicators listed in Table 1.4 as IVs. The relationship of early education and health with future human capital is straightforward and well documented in the literature (Schulz, 1961), and therefore, these variables will observe the first condition. Regarding the second condition, it seems quite reasonable to think that variables such as the number of students per teacher or the per capita expenditure on education will not inform a firm's private decision to invest in OHS. Hence, only through the effect of human capital may these educational variables affect OHS.

It is also worth stating that the educational and health variables are obtained for each Spanish autonomous region and not for each firm. We understand that this is not a problem as the education in Spain is a fully decentralised system where each autonomous region decides key variables such as investment in education, per teacher ratios, or teaching methodologies. This decentralised system does create strong differences in the performance of the educational system, and indicators such as the Programme for International Student Assessment (PISA) scores by region, for example, are notably different (Economic and Social Council of Spain, 2009). Furthermore, the Spanish labour market is also characterised by its geographical rigidity (Huber, 2004) and therefore

is very likely that workers educated (differently) in each regional system will also be employed in the same region. We believe that these two characteristics of the Spanish case reinforce the validity of our instruments.

In Table 1.4 we list the coefficients obtained for the IV models in each of the eight first stage equations.

	Endogenous Covariate								
Instruments [regional data]	Mean [dev]	Training Scope	Training Frequency	External Training	Multi-Skilling	High Technology	Design	Innovation	Problem Solving
Education Spending per capita	1.00 [0.107]	.006** [.002]	.005** [.003]	.025** [.005]	.017** [.008]	.048* [.042]	.021** [.005]	.058** [.001]	-.154 [.142]
Primary Schooling rate	85.23 [6.97]	-.003* [.012]	-.012** [.004]	-.001** [.002]	-.003** [.002]	-.003** [.000]	-.005** [.000]	-.001** [.001]	-.001** [.001]
Higher education rate	24.04 [6.41]	.011** [.005]	.042* [.013]	-.004** [.004]	.005** [.002]	.009** [.001]	.004** [.001]	.004** [.000]	.007** [.006]
Early school leaving rate	28.77 [5.958]	-.046** [.006]	.016* [.015]	-.010** [.004]	.010** [.003]	-.007** [.002]	-.003** [.002]	-.003** [.002]	.008** [.007]
Pisa Score Science	500.03 [15.429]	.009** [.001]	.003** [.002]	.003** [.004]	-.001** [.003]	.001** [.000]	.005** [.003]	.005** [.000]	.002** [.000]
Students per teacher	11.00 [.940]	-.019* [.041]	-.196 [.051]	-.078* [.010]	-.064* [.022]	-.049* [.011]	.015* [.010]	-.012** [.004]	-.006* [.014]
Universities per habitant	0.16 [.069]	.054* [.011]	-.001* [.014]	-.003** [.004]	.009** [.002]	.003** [.001]	.012** [.001]	.002** [.002]	.001** [.002]
Child mortality rate	2.04 [.462]	-.280 [.075]	.132 [.086]	.064* [.022]	-.034* [.036]	-.068* [.021]	.050* [.011]	-.002** [.008]	-.016* [.021]

**. The correlation is significant at the .01 level.
*. The correlation is significant at the .05 level.

Table 1.4. First Stage Regression for Endogenous Covariates.

Briefly, we observe that IVs are, in general, significantly related to the endogenous variables. We also find a better fit with knowledge and skills variables where most of the instruments are positively and significantly related. Not surprisingly, the fit of the IVs with the abilities variables is not that good, as these are understood to be more innate (less educational) attributes. In any case, the Programme for International Student Assessment (PISA) score in science is related for the case of problem solving and innovation, and for the former, some other good instruments are also found.

The results of the first-stage equation suggest that the proposed IV model provides a reasonable control for the alleged endogeneity bias.

Independent Variable	Normal distribution	Ordinal Distribution
Knowledge		
Training Scope	1.29**	.411***
	[.505]	[.053]
Training Frequency	.241	.409***
	[2.00]	[.057]
External Training	-2.93	.007
	[12.3]	[.051]
Skills		
Multi-skilling	10.5*	.172***
	[5.22]	[.049]
High technology	-11.4	-.005
	[8.26]	[.048]
Design	-4.70	-.017
	[3.24]	[.047]
Abilities		
Innovation	3.72**	.193***
	[1.68]	[.049]
Problem-solving	-15.01	.054
	[19.7]	[.048]
Risk Index	.634***	.302***
	[.016]	[.042]
Industry	.315***	.463***
	[.074]	[.124]
Ln Company size	.738***	.466***
	[.025]	[.039]
Administrative sanctions	.180	.945***
	[.326]	[.150]
Surchages	1.61	-.166
	[3.34]	[.205]
Constant	*.878*	
	[.028]	
Cut (0)		*-2.418****
		[.288]
Cut (1)		*-1.835****
		[.279]
Cut (2)		*-1.358****
		[.275]
Cut (3)		*-.604***
		[.272]
Cut (4)		*-.077*
		[.272]
Cut (5)		*.491**
		[.272]
Cut (6)		*1.300****
		[.274]
Cut(7)		*2.964****
		[.282]
Cut (8)		*4.321*
		[.286]

Table 1.5. Structural equation of the analysis of OHS investment with endogenous covariates.

As we explained above, our dependent variable is an Ordinal variable with nine possible levels of OHS investment. The estimation of Ordered Probit models with eight instrumental variables is an econometric challenge, as the main econometric packages do not offer the option to estimate Instrumental Variables in non-linear models. In order to provide some robust estimates, in the first column of Table 1.5, we list the results obtained with STATA 14, assuming that our dependent variable is normally distributed. It is important to acknowledge that our dependent ordinal variable has nine categories and therefore it quite closely represents the continuous and normally distributed latent variable (i.e OHS investment in euros).

In order to improve the robustness of our results, we also applied a two-step procedure proposed by Sajaia (2008) in which we estimate the eight predicted values of the instrumental variables listed in Table 1.4, and then, we use these variables as independent variables in the structural Ordered Probit model. Results are shown in the second column of Table 1.5, and they are quite similar to results obtained assuming normality. In any case, in order to ensure that our hypothesis are empirically supported, we have only considered the coefficients that are significant in both models.

Table 1.5 shows the results for the structural equation where coefficients are estimated once the endogeneity is controlled by the IV model in the first-stage regression. Results in Table 1.5 will therefore capture the unidirectional relationship between human capital and firms' decision to invest in OHS.

We find that results for training scope (β=1.29, ρ=.010), multi-skilling (β=10.5,ρ=.053) and innovation (β=3.72,ρ=.048) are positive and significant, and therefore, we can confirm the hypothesis above. These results suggest that, regardless of the preferences and behaviours of skilled workers, firms do increase their investment in OHS when training is extended to more types of workers, when the workforce provide a multiple and diverse of set of skills and, finally, when workers provide some abilities and attitudes linked to innovation.

The main difference between the ordered probit model Table 1.3 and the IV models in Table 1.5 is the results obtained for the problem-solving ability. In Table 1.3, the coefficient was positive and significant whereas once endogenity is controlled, the problem-solving ability becomes

nonsignificant. The problem-solving ability is a mainly innate characteristic and therefore may be easier to be observed by the worker than by the firm. In the case of unobservability or asymmetric information, firms will not be able to incorporate the information regarding the value of their problem-solving asset to the decision on OHS investment. The results obtained in the linear model will therefore be clearly endogenous, as only the preference of workers with this ability for safer firms may explain the estimated positive relationship.

We also found some differences between the ordered probit model and the IV models regarding training frequency. In particular, the coefficient changes from significant (β=.126, ρ=.000) to non-significant (β=.241, ρ=.812). This result may suggest that, as stressed by Acemoglu and Pischke, (1999), highly skilled workers may select jobs offering intensive training programmes. The positive relationship between human capital and safety investment estimated in the ordered logit model may not be related to firms' decision to invest in OHS, and therefore disappears when endogeneity is controlled.

1.5. DISCUSSION AND CONCLUSIONS.

In this paper, we have shown that firms' human capital stock and their decisions about investment in OHS are positively related. We argued and demonstrated empirically that firms protect their human capital by investing in OHS resources. We believe that this analysis opens up some interesting avenues for further research into HRM, particularly in relation to clarifying what the core HR activities should be and for the better integration of the OHS management in the firms' decision-making process.

This paper broadly contributes to the human capital field of study in the following form: First, it shows that firms are not only devoted to hiring or creating human capital, as previous literature has extensively studied, but are also worried about protecting human capital assets. Our empirical analysis, therefore, reinforces the idea of human capital resources stressed by Ployhart et al. (2014) where the emphasis is made in the level of access (or availability) to human capital rather than in the stock. Second, our paper also shows that firms do not protect the components of human capital equally, suggesting that human capital is also managed strategically. In particular, we find

that firms are mostly interested in protecting the human capital components that are rare (innovation) or difficult to replace (multiskilling). Finally, our analysis on endogeneity suggests that some informational asymmetries between firms and workers may lead to some nonefficient investment decisions. It may be the case of innate abilities such as problem solving that appears to be correlated to OHS investment only by workers' choice of safe firms.

We draw the following conclusions from our results. First, there is a clear relationship between firms' investment in the internal creation of human capital (training) and their investment in OHS. This is particularly important given that training is part of the HR function and therefore is specifically and internally designed by firms. Other HR factors such as skills or abilities, for example, can be obtained by hiring from the external market and are therefore affected by informational asymmetries (Lazear & Gibbs, 2015). Furthermore, our analysis of endogeneity reveals that some valuable abilities such as problem solving may be observed by workers but remain unnoticed by the firm. This evidence gives even more relevance to the long-term issue of human capital signalling. Our study suggests that skills that are easier to be signalled such as formal education or training may induce firms to overinvest in safety. On the contrary, less visible abilities such as problem-solving or creativity may not be optimally protected.

Second, our results show that the flexibility and adaptability associated with multiskilling are valued more than purely technical skills. It should be noted that this finding may only apply to the Spanish labour market, whose rigidity and low mobility are partly responsible for the high rates of unemployment (Dolado & Jimeno, 1997). Workers in Spain tend to spend long periods of their working life working for a single firm and to specialise in certain roles and tasks. This ability is dependent on the versatility of the workforce; having workers who can perform tasks in several different production processes reduces the costs of direct and indirect recruitment (Gomar, Haas, & Morton, 2002). In short, workers who offer a variety of skills are difficult to replace and therefore valuable to the firms.

In this sense, besides traditional human capital variables (i.e., knowledge and training), our results are in line with some authors that claim that the true competitive advantage lies in some social and organisational competences such as the autonomy to take decisions and the capability of sharing such decisions with the organisations (Wright, Dunford, & Snell, 2001). Ployhart et al.

(2014) stress that competitive advantage depends precisely on human capital resources at the unit level. This capital is formed by a unique and complex combination or interrelation of individual skills and capabilities that are observed at firm or departmental level. For a normal firm, incentives will therefore lie in the protection of the "workforce" rather than the protection of "star workers." Furthermore, these organisational and social capabilities are, in general, specific to a particular organisational context as they depend on mutual trust and organisational compromise (McKnight, Cummings, & Chervany, 1998); they may not be available in external labour markets, and therefore, strong incentives to protect this intangible asset will arise.

In contrast, we found that some elements of KSAO are not rewarded with increased investment in OHS; for example, neither technical nor technological skills were positively related to the OHS index. There are two possible reasons for this, which are consistent with our theoretical perspective: (a) Technical skills do not have a strategic value for firms, and (b) workers with these skills are easy to replace from external labour markets. Although we do not rule out the first possibility, the second seems more plausible if the particularities of the Spanish labour market are taken into consideration. In the recent decades, the number of moderately and highly educated workers in Spain has increased; however, despite this strong transformation, changes towards an economy based on advanced technologies are slow. Traditional industries, such as the construction industry, are still reliant on physical and manual work. In some senses, Spain has become a paradigmatic example of what happens when the workforce is overeducated (Garcia-Mainar, Garcia-Martin, & Montuenga, 2014): Many educated workers are driven to accept low-skill jobs in order to avoid unemployment or even emigration.

As explained above, one of the most important objectives of our paper is to show that firms' investment in OHS does respond to incentives, and therefore, in some circumstances, the administration may not need to spend vast public resources on the enforcement of occupational safety legislation. However, our results also show that, sometimes, firms fail to observe the real value of their human capital and therefore their investment in OHS may be suboptimal. Furthermore, some firms may not possess or need a large stock of human capital, and therefore, their incentives to invest in OHS may be weak. This is the case of firms where workers perform simple and routine tasks, and therefore, their workforce is low skilled and easy to replace. In these

firms, incentives to protect workers will be lower and the administration should intervene to guarantee workers' safety.

The results of this study also offer insights that may be of interest to those seeking to improve the management of OHS. First, our findings are consistent with a statement by the European Commission-funded European Network for Workplace Health Promotion (1997, p. 3) in the Luxembourg Declaration that "the future success of organisations is dependent on having well-qualified, motivated and healthy employees" and its efforts to encourage firms' to include OHS policy in their corporate strategy. The strategic importance of OHS was also emphasised in the Barcelona Declaration (European Network for Workplace Health Promotion, 2002, p. 2), which stated that "good workplace health practice is a driver for social and economic success in Europe. The 'business case' for investment in workplace health promotion has been understood by successful organisations." New models of management based on the principle that "healthy companies are made up of healthy workers" are gaining traction in the current economic climate, in which different norms, standards, and certification schemes are being developed and promoted by different organisations in different parts of the world.

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CHAPTER 2

AN ANALYSIS OF INCENTIVES TO UNSAFE BEHAVIOR: FINDING EFFECTIVE ORGANIZATIONAL ACTIONS FOR RISKY ACTIVITIES.

2.1. INTRODUCTION

Occupational health and safety (OHS) legislation worldwide makes companies (above the employee) responsible for taking preventive measures available that protect workers' health and safety. Companies are responsible, for example, for ensuring that technologies are safe, that the necessary protective equipment is available, or, among many other measures, that workers are properly informed and trained in terms of OHS. Workers are therefore taken as subsidiary parts of the system, as their actions and behavior in terms of OHS can be modeled and controlled by the company. Only in clear cases of negligent actions will workers be held responsible for the consequences of a safety failure (Gunningham, 1999).

Although it has been shown that acting on organizational factors is essential to reducing the accident rate, a percentage of accidents could be caused or co-caused by the worker's own failure to comply with preventive measures. Therefore, despite the imbalance in the distribution of legal responsibilities between companies and workers, the motivation and commitment of the latter are key to implementing an effective OSH system. Finding out the causes that could motivate people to neglect their own safety becomes key in a changing society, where the use of personal protective equipment is becoming extremely necessary for their survival.

In this regard, Yoshikawa and Kogi (2019), for example, stress that worker involvement increases health-risk sensibility, making the OHS improvement programs in companies more effective. Turner et al (2001) indicate that empowerment (greater autonomy and participation) of workers is related to a lower accident rate. However, the European Agency for Safety and Health at Work (2010) claims that the workers' behavior in complying with safety rules and procedures is influenced by economic incentives, and, therefore, their active participation cannot be taken for granted. Furthermore, following safety norms and procedures may also have a cost for them as workers may find it difficult, tedious, or unnecessary to accomplish these measures. In the same vein, even if drivers know that an appropriate speed or wearing a seatbelt is good for them, they do not always follow road traffic norms in order to save costs (effort) or obtain other preferred (time) benefits (Schneider, 2010).

This typical case of ex-ante moral hazard has been widely studied in the field of road traffic and insurance (Rowell et al., 2017). In this field, moral hazard has been observed such that it affects both the driver's behavior, increasing violations and accidents (Tay and Choi, 2016) and the maintenance of the vehicle itself (Schneider, 2010). In fact, road traffic policies increasingly use incentive mechanisms such as point-record driving licenses in order to mitigate the strong effects of ex-ante moral hazard in driving (Dionne et al., 2011).

In the field of occupational safety, moral hazard has also been thoroughly analyzed. However, most of the theoretical studies and the bulk of the empirical analyses have focused on the ex-post (accident) moral hazard. These studies are mainly interested in the reporting behavior of injured (or uninjured) workers and the consequences in terms of absenteeism (De Paola et al., 2014), employment protection (Bradley et al., 2014), compensation (Bolduc et al., 2002), and insurance premiums (Trontin and Bejean, 2004). The interest of this research is undisputable; however, analyzing ex-ante moral hazard rather than ex-post moral hazard may have a fundamental advantage in terms of improving the OHS system. In particular, we argue that studying the behavior of workers before the occupational accident occurs could help to design more effective incentive schemes to avoid (and not remediate) injuries and accidents.

Research has also investigated the risky behavior of workers from the perspective of OHS practice. Focusing only on recent investigations, Wong et al. (2020), for example, have studied the factors affecting the use of Personal Protective Equipment (PPI) amongst construction workers. This qualitative analysis stresses of the effectiveness of safety supervision and monitoring in preventing unsafe behavior. Along this line, Pek et al. (2017) find that compulsory safety norms established by formal and informal (family) supervisors are effective in reducing the risky behavior of young workers. Liang and Zhang (2019), however, also stress that safety workers could imitate the unsafe behavior of their supervisors. From another perspective, Barbaranelli et al. (2015) have also investigated the effect of the safety climate and the impact of worker behavior and organizational performance.

By analyzing the set of incentives of the (ex-ante) moral hazard problem, our study depicts a more comprehensive picture of worker behavior. As we will explain, workers may

need (or want) to produce at a faster pace and abandon safety procedures depending on the salary or employment relationship. In this paper, we argue that the contract theory may provide some valuable insights in order to understand the problem of workers' hidden action in the implementation of OHS practices.

2.2. (EX-ANTE) MORAL HAZARD ON WORKERS' EFFORT ON SAFETY

The typical contracting problem with moral hazard is based on the hiring of an agent to perform a task for the principal (Arrow, 1964, 1971). The agent chooses the level of (safety) effort that determines the performance or outcome of the task, in this case, suffering (or not) an occupational accident. We argue that, even if the safety effort benefits workers' health and safety, following OHS norms and procedures also has a cost for the worker. Moral hazard may then occur when the preventive effort provides (net) disutility for the agent, and therefore could benefit from the asymmetric information in order to hide his/her more demanding insecure behavior.

Disutility may arise, for example, when workers need to spend time and effort to follow the safety indications and procedures. The time devoted to safety may slow down the production pace and could also make the activity uncomfortable and tedious. Workers will also need to invest time and energy into learning and training for the appropriate use of (PPE) and other safety procedures and instructions. Knudsen (2009), for example, stresses that the administrative and bureaucratic cost associated with the OHS paperwork could affect worker motivation and effort. Dekker (2014) also points out that the bureaucratization of safety may also affect personal freedom and creativity. In sum, if workers do not fully perceive the benefits of the safety procedures, they may not make an optimal effort on safety.

We therefore argue that a non-optimal safety effort will depend on the following factors:

i) Expected profit of unsafe behavior: Incentives to produce

As explained above, workers will choose the level of safety effort that will maximize their productivity. In that sense, worker incentives to perform their tasks safely will be reduced if the opportunity cost of their action is high. In other words, if workers need to choose between, for example, producing more and faster instead of producing less and safer, they may prefer the former if they can benefit directly from the increase in production. This may be the case, for example, of remuneration schemes based on output, where workers' wages depend on production and therefore the cost of devoting time to safety is higher. On the contrary, if workers' wages are fixed and are not dependent on output or effort, the incentives to produce faster will be reduced.

In a different theoretical setting to the ex-ante moral hazard framework, some studies have already ascertained the negative impact of output-based wages on safety performance. Sawacha et al. (1999) found that incentives to increase productivity at construction sites have a negative impact on safety records, as workers tend to increase their working pace and abandon some safety procedures and recommendations. For the same industry, Oswald et al. (2020) observe that safety decisions are negatively affected by the cost of projects, which in turn depend on working time and productive pace. In the same vein, Wiengarten, Fan, Lo, and Pagell (2017) show that decreased operating slack harms the safety of workers by increasing role overload and increasing accidents and injuries. Therefore, we posit that:

$H_{1:}$ The incentives to produce increase ex-ante moral hazard and employees' unsafe behavior.

ii) Expected cost of unsafe behavior: Employment protection

The classical literature on ex-ante moral hazard is, practically, fully devoted to analyzing the behavior of the agent with different levels of insurance against the negative outcomes of their actions. It is argued that the behavior of the agent becomes riskier or less careful when the consequences of their actions are covered by insurance (Arrow, 1971; Dave and Kaestner, 2009). In addition, Ehrlich and Becker (1972) stated that the moral hazard caused by the relation between self-protection and insurance can happen for all uncertain

events that can be influenced by human actions but always depending on the costs and benefits associated with each situation. In the case of occupational accidents, the cost for workers is clear, from suffering injuries and health problems, to losing some of their wages or their employment. However, not all workers suffer the consequences of accidents and injuries in the same way.

In particular, in occupational safety, employment protections such as an employer's accident insurance or income benefits to injured workers may cover some of the cost of accidents (Kaestner and Carroll, 1997). In these situations, some agents may feel more protected when their expectations regarding keeping their wages while injured are stronger and therefore the incentives to behave safely may be lower. However, protection against the consequences of accidents may not only be provided by insurance. In particular, in Europe, most of this protection is linked to the employment contract, being either fixed-term contracts or employment regulated by beneficial collective bargaining. On the contrary, precarious employment and self-employment are, usually, less protected. In sum, according to moral hazard theory, workers with stronger protection against occupational accidents may have lower incentives to behave safely and therefore, we posit:

H_2: Strong employment protection increases ex-ante moral hazard and workers' unsafe behavior.

iii) The effect of ex-ante moral hazard on occupational accident

As we argued before, safety measures and procedures will not be effective if workers do not perceive them as compatible with the required production (McLain and Jarrell, 2007). The execution of safety activities and investment will therefore depend on worker behavior and, as we explained before, this behavior may be influenced by moral hazard. The problem of hidden action regarding safety procedures and its impact on actual accidents may be even graver because, precisely, it is hidden and may escape the controls established by the company. The company may follow all the safety requirements and, for example, provide adequate protective equipment to workers. In these situations, companies may therefore believe that the productive activity is being performed safely, and therefore reduce control

and monitoring. The combination of workers' unsafe behavior and a company's complacency could undoubtedly increase the risk of occupational accidents.

In fact, while employment protection regulation and safety investment should improve worker health, the results of different studies point in a different direction (Ichino and Riphahn, 2005). For example, enforcing employment protection legislation can lead to a decrease in fatal accidents but does not affect the number of non-fatal accident notifications (Radulescu and Robson, 2020). In particular, it is argued that non-fatal accidents may directly depend on worker behavior and preferences, while fatal accidents are clearly unaffected by incentives, particularly, ex-post. These differences in the trend of major and minor accidents are also found for other situations. Davies et al. (2009), for example, indicate that "temporary employment is negatively related to the rate of minor injuries and independent to major injuries," and some authors believe that this may be caused by a smaller report of accident notifications for fear dismissal (Boone and van Ours, 2011).

In sum, we argue that ex-ante moral hazard will be positively related to the likelihood of the occurrence of occupational accidents, while ex-post moral hazard will be related to reporting occupational accidents. The choice of the occupational accident dependent variable will therefore be key to distinguishing both types of moral hazards.

H_3. Ex-ante moral hazard incentives increase the likelihood of the occurrence of occupational accidents.

2.3. ORGANIZATIONAL ACTIONS TO EX-ANTE MORAL HAZARD

Organizations have different procedures to reduce moral hazard. Basically, these mechanisms will try to narrow the gap between a company's goals and worker actions by, first, trying to create shared objectives and, second, by reducing the informational asymmetries monitoring worker actions. If these mechanisms are effective, workers will voluntarily or compulsorily follow the company's instructions and, therefore, in our case, behave safely. In this paper, we analyze the effect of three mechanisms on ex-ante moral hazard: (i) objective alignment, (ii) peer pressure, and (iii) monitoring.

(i) ***The effect of aligning objectives on ex-ante moral-hazard.***

The most natural form of resolving a conflict of interest is, precisely, avoiding the conflict itself or, in other words, aligning objectives. In the moral hazard framework, workers pursue their own interest, which is different from that of the company and, therefore, they may take advantage of information asymmetries to disobey the company's instructions. However, if workers share the company's objectives, this incentive to disobedience will disappear. In the field of occupational health and safety, the concept of safety culture summarizes this idea accurately. Cooper (2000) defines safety culture as sub-facet of organizational culture that is used to describe the "shared corporate values that affect and influence members' attitudes and behaviors."

In companies with a strong safety culture, we can expect a higher level of awareness and compromise regarding safety among employees. In this environment, workers may prefer to comply with the company's instructions rather than follow their own objectives. In this sense, there is some empirical work that shows that companies with a stronger safety culture are also safer. Feng et al. (2014), for example, show that safety practice greatly improves when safety investments interact with safety culture. In other words, improvements in safety are more likely when a company's investment is accompanied by worker compromise and, presumably, the avoidance of moral hazard problems. Further, Markey and Patmore (2011) argue that the effectiveness of workers' participation depended on a complex complementarity of variables, including the relationship with the unions, the nature of management commitment,and the labor relations climate of the organization.

H_4. The impact of ex-ante moral hazard on workers' unsafe behavior is reduced when objectives are aligned.

(ii) The effect of peer pressure on ex-ante moral hazard

In addition to formal control and monitoring systems, there are other informal mechanisms that are very effective in controlling opportunistic behaviors. Peer pressure is one of the best-known and most effective tools. Kandel and Lazear (1992) highlight the role played by individuals' shame or sense of guilt when they are observed by their peers.

Carpenter et al. (2009) stress the effectiveness of peer monitoring systems, particularly in simple activities, where specialized supervision is not necessary. In our environment, peer pressure can act as a deterrent mechanism and workers who adopt risky attitudes may be pressured to behave safely.

There is some empirical work, much of it experimental, confirming the mitigating peer impact of opportunistic behavior in some tasks such as packing or stocking shelves in a supermarket (Falk and Ichino, 2006). However, in the field of occupational safety there are no specific studies on the issue. Mitropoulos and Cupido (2009) study the effect of teamwork on safety practices according to the task demand-capability. Zacharatos et al. (2005) also studied the effect of teamwork within a wider range of practices known as high-performance work systems. All of these studies are devoted to analyzing other issues such as capabilities, information, or coordination rather than ex-ante moral hazard and their results are mixed. In our paper, despite the absence of empirical evidence, we base the following hypothesis on the aforementioned theory (Kandel and Lazear, 1992), and therefore we posit:

H_5. Peer pressure reduces the impact of ex-ante moral hazard on workers' unsafe behavior.

(iii) The effect of monitoring on ex-ante moral hazard

Direct supervision and monitoring of workers' effort is the main mechanism with which a company tries to mitigate the effect of moral hazard (Alchian and Demsetz, 1972). The company will try to avoid the opportunistic behavior of workers by establishing some control over their activity. Control of the ex-ante moral hazard could affect worker behavior in two ways. First, irregular actions may be avoided because of the mere observation and correction by the supervisor. If monitoring is intense, supervisors will more likely anticipate an unsafe action performed by the worker. Second, the effect of individual incentives may also be reduced when the employees believe or know that they might be observed by the principal. In both cases, workers will more likely follow the safety procedures given by the company. Therefore, we posit:

$H_{6.1.}$: The monitoring of workers' actions reduces the effect of ex-ante moral hazard on the unsafe behavior of workers.

In addition, strong control mechanisms and intense monitoring by the company may also have an effect on the impact of moral hazards on a more relevant magnitude: occupational accidents. In particular, adequate organization of a company's activity could help to correct irregularities (other than worker behavior) that could result in accidents and injuries. Making a parallel with road safety, the consequences of not using a seat belt (unsafe behavior) will be less damaging in the context of strict speed controls. In occupational safety, accidents are usually the result of a chain of events, including the unsafe behavior of workers; therefore, the likelihood of an accident will be reduced if all other factors are properly controlled. Accordingly, we posit:

$H_{6.2}$: The effect of monitoring reduces the impact of ex-ante moral hazard on occupational accidents.

2.4. MATERIAL AND METHODS

2.4.1. Sample

The sample is based on the Sixth European Working Conditions Survey (EWCS6), published in 2017. The unit of analysis is the worker, self-employed or employed. The population comprises 43,850 units in 35 European countries, covering the 28 EU member states, the five EU candidate countries (Albania, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, and Turkey), as well as Switzerland and Norway. The survey collected data on job quality indices about physical environment, work intensity, working time quality, social environment, skills and discretion, and prospects and earnings (Eurofound, 2017).

In our research, we limited the sample to jobs where workers are required to wear personal protective equipment (question Q31 of the survey affirmative). We excluded items from the sample that had a negative response because, in cases where PPE are not needed, we cannot distinguish safe from unsafe actions. The resulting sample consisted of 16,832 workers; descriptive statistics for the sample are listed in Table 2.1.

	Frequency Mean	***σ***	***EWCS 2015 Question***
Sample	*16.832*		
Dependent Variable			
Occupational Accidents	4.2%		EWCS Q83A. Indicate if your absence resulted from the accident
Mediator Variable			
Moral Hazard behavior	9.1%		EWCS Q 32. Indicate if you always use the personal protective equipment when it is required
Independent Variable			
Expected profit: Incentives to produce			
Individual payments: Productivity rate	11.8%		EWCS Q101B. Indicate if these payments have been included your earnings from your main job: Piece rate or productivity payments
Team payments: Performance of team	8.1%		EWCS Q 101G. Indicate if these payments have been included your earnings from your main job: Payments based on the performance of your team/working group/department
Self-Employed	16.1%		EWCS Q7. Indicate if you are working as an employee or you are self-employed
Potential consequences: Employment protection			
Contract of unlimited duration	65.4%		EWCS Q11. Indicate which kind of employment contract you have in your main job
Fear of job loss	16.5%		EWCS Q89G. Indicate if you agree or disagree: you might lose your job in the next 6 months.
OHS delegate or committee	48.4%		EWCS Q71B. Indicate if there is a health and safety delegate or committee at your organization.
Firm's organizational measures			
Monitoring	39.6%		EWCS Q50. Indicate if your pace of work is dependent on direct control of your boss
Alignment of objectives	2.90	1.63	EWCS Q61C. Select the response which best describes if you are consulted before objectives are set for your work.
Peer pressure	61.3%		EWCS Q58. Indicate if you work in a group or team that has common tasks and can plan its work
Control Variables			
Enterprise size	2.77	1.11	EWCS Q16B. Number of employees in total work in your business
Age	43.34	12.16	EWCS Q2B. Age
Risk	80.3		EWCS Q 29. Indicate if you are exposed at work to: a) vibrations from hand tools, machinery etc.; b) noise so loud that you would have to raise your voice to talk to people; c) high temperatures which make you perspire even when not working; d) low temperatures whether indoors or outdoors; e) breathing in smoke, fumes, powder, or dust, etc.; f) breathing in vapors such as solvents and thinners; g) handling or being in skin contact with chemical products or substances; or i) handling or being in direct contact with materials which can be infectious.
Gender (male)	62.8%		EWCS Q2A. Gender

Table 2.1. Descriptive Statistics.

2.4.2. Dependent Variables

The dependent variable classifies the sample in respondents that have or have not suffered an occupational accident in the previous 12 months (4.2%). Although the variable is not an official record, the individual and anonymous response in relation to accidents has certain advantages when measuring ex-ante moral hazard. On the one hand, it avoids distortions related to the amount and duration of sick leave. On the other hand, the worker is free to report minor accidents that he/she may have concealed from the company. Table 2.2 shows the frequency of occupational accidents for each European country.

Country	*Occupational Accidents Frequency*	*Moral Hazard Behavior Frequency*
Albania	1.88 %	16.43 %
Austria	6.03 %	7.94 %
Belgium	7.52 %	10.40 %
Bulgaria	1.14 %	6.82 %
Croatia	2.01 %	5.28 %
Cyprus	3.32 %	4.56 %
Czech Republic	3.13 %	8.93 %
Denmark	5.03 %	17.34 %
Estonia	0.93 %	9.98 %
Finland	8.53 %	9.24 %
France	6.53 %	11.84 %
Germany	5.38 %	7.35 %
Greece	4.62 %	14.62 %
Hungary	1.79 %	7.18 %
Ireland	6.09 %	8.11 %
Italy	2.86 %	4.30 %
Latvia	2.48 %	12.38 %
Lithuania	1.96 %	9.22 %
Luxembourg	7.25 %	7.00 %
Malta	4.25 %	9.17 %
Netherlands	2.74 %	10.50 %
Poland	1.47 %	6.14 %
Portugal	2.55 %	6.37 %
Romania	2.58 %	5.62 %
Slovakia	1.02 %	4.48 %
Slovenia	5.29 %	5.87 %
Spain	4.42 %	8.70 %
Sweden	2.35 %	12.82 %
UK	3.65 %	7.42 %
Montenegro	4.72 %	6.60 %
FYROM	3.27 %	11.56 %
Serbia	5.74 %	14.50 %
Turkey	6.72 %	9.57 %
Norway	3.58 %	13.42 %
Switzerland	7.28 %	10.13 %

Table 2.2 Frequency of Variables Dependent and Mediator by Country.

2.4.3. Mediator Variable

Moral Hazard Behavior

Measuring a latent magnitude such as the ex-ante moral hazard is not a simple matter. However, the survey offers a great opportunity to measure this magnitude through a worker's action that fits well with the conceptual framework. On the one hand, the principal (company) requires the use of PPE. On the other hand, likely taking advantage of some informational asymmetries, the agent (worker) decides not to use it. The mediator variable is therefore generated from the worker's responses about whether he or she uses individual protective equipment whenever he or she is required to use it. As mentioned above, only workers who must at some point use work equipment have been selected for the sample. Therefore, when the worker replies that he or she does not use them when they are required (value 1), we assume that there is a case of ex-ante moral hazard (9.1%).

As can be seen in Table 2.2, countries that are candidates for EU membership (except Montenegro) and that are currently in the process of "transposing" (or incorporating) EU legislation into national law, as well as non-member countries, have a higher frequency of unsafe behavior caused by ex-ante moral hazard. Curiously, the Scandinavian countries, where social security systems are highly developed, also have a high frequency.

2.4.4. Explanatory Variables

We divided the explanatory variables into two groups according to the posited hypotheses. First, we subdivided the possible causes of moral hazard behavior: (i) expected benefit from unsafe behavior, and (ii) expected cost of unsafe behavior. Additionally, we also included the (iii) measures that the company takes to reduce unsafe behavior.

i) Expected profit of unsafe behavior: Incentives to produce.

To measure the expected profit, we differentiated between two dummy variables: (a) *individual incentives* and (b) *team incentives;* both are financially-based incentives on employee performance. In this case, it can be seen that the application of individual incentives to improve production (11.8%) is slightly more extended than the incentives related to team production (8.1%), although their implementation in Europe seems to be marginal. We also

included a dichotomic variable identifying if the worker is (c) *self-employed* (16.1%), assuming that their profit entirely depends on their production.

ii) Expected cost of unsafe behavior: Employment protection.

In measuring the protection of workers, we used some indicators suggested by the United Nations Economic Commission for Europe (2015) such as the level of employment protection or job quality; the duration of the contract, and the coverage provided by a trade union representative. The measure of the duration of the contract was calculated by a dichotomic variable that takes the value of 1 when the worker's contract is a (i) *contract with unlimited duration* (65.4%). We measured the union representation when the presence of an *OHS delegate or committee* in the company is affirmative (value 1) or negative (value 0), assuming that they are workers' representatives focused on occupational risk prevention (48.4%).

The worker's own perception of work security and perspective is also important for completing the information obtained from the objective employment protection indicators. This was measured by the subjective indicator *fear of job loss* (16.5%), which has been widely used in previous investigations (Nappo, 2019).

iii) Company's organizational responses.

To test the hypotheses H_4, H_5, $H_{6.1}$, and $H_{6.2}$, we included different variables to measure the organizational responses to reduce or eliminate the unsafe behavior of workers.

Peer pressure. Peer pressure was measured by means of a categorical variable that considered the value of 1 if the agent (worker) works in a group or team that has common tasks and can plan its work (61.3%).

Alignment of objectives. The alignment of objectives was measured by an ordinal variable (m= 2.90, σ=1.6). Respondents were asked to rate how often they were consulted before the goals for their job were set, where the worker answered with responses based on a Likert frequency scale, type 1 = *always* or 5 = *never*. We changed the order of the assigned values assuming an ascending value based on the frequency increase, according to 1= *never*, 2 = *rarely*, 3 *sometimes*, 4 = *almost always*, and 5 = *always*.

Monitoring. Monitoring was measured as a dichotomic variable based on the data provided by workers on whether their pace of work to produce depends on the direct control of their boss (value 1). It can be noted that 39.6% of sample workers claim to have

Direct supervision. This variable is included in Model B, in the first stage as an independent variable, and in the second stage as a moderating variable to check $H_{6.2.}$

2.4.5. Control Variables

In addition to the individual characteristics of the worker such as sex and age (introduced as a continuous variable), we considered the size of the company (introduced as a continuous variable) as control variables; to control the organizational risk level we included a variable measuring whether the worker was exposed to any risk of those risks collected in the survey.

2.5. RESULTS

The Pearson correlation coefficients between variables are shown in Table 2.3. As expected, some variables present correlation, however, in most cases, its level is reasonably low.

Correlations (Significance level)															
Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Occupational accidents	1.000														
2. Moral hazard behavior	0.016*	1.000													
	(0.035)														
3. Individual payments: Productivity rate	0.024**	0.009	1.000												
	(0.002)	(0.251)													
4. Team payments: Performance of team	0.007	-0.022**	0.247**	1.000											
	(0.382)	(0.004)	(0.000)												
5. Self-employed	-0.013	0.084**	-0.146**	-0.125**	1.000										
	(0.089)	(0.000)	(0.000)	(0.000)											
6. Contract of unlimited duration	0.028**	-0.081**	0.070**	0.127**	-0.599**	1.000									
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)										
7. Fear of job loss	0.023**	0.028**	0.031**	-0.009	-0.053**	-0.152**	1.000								
	(0.003)	(0.000)	(0.000)	(0.233)	(0.000)	(0.000)									
8. OHS delegate or committee	0.028**	-0.082**	0.057**	0.124**	-0.421**	0.385**	-0.050**	1.000							
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)								
9. Monitoring	0.042**	-0.043**	0.081**	0.047**	-0.295**	0.125**	0.095**	0.097**	1.000						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)							
10. Alignment of objectives	-0.019*	-0.038**	0.031**	0.095**	-0.125**	0.145**	-0.055**	0.123**	0.009	1.000					
	(0.013)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.221)						
11. Peer pressure	0.005	-0.047*	0.038**	0.110**	-0.254**	0.187**	-0.011	0.211**	0.122**	0.224**	1.000				
	(0.559)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.158)	(0.000)	(0.000))	(0.000)					
12. Enterprise size	0.031**	-0.072**	0.049**	0.116**	-0.492**	0.420**	-0.012	0.465**	0.148**	0.117**	0.254**	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.129)	(0.000)	(0.000)	(0.000)	(0.000)				
13. Age	-0.018*	-0.013	-0.029**	-0.018*	0.162**	-0.001	-0.035**	-0.006	-0.136**	-0.004	-0.92**	-0.077**	1.000		
	(0.018)	(0.088)	(0.000)	(0.018)	(0.000)	(0.905)	(0.000)	(0.418)	(0.000)	(0.575)	(0.000)	(0.000)			
14. Gender (male)	0.030**	0.027**	0.063**	0.059**	0.081**	-0.063**	0.017*	-0.041**	0.028**	0.027**	0.007	-0.040**	-0.002	1.000	
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.023)	(0.000)	(0.000)	(0.001)	(0.359)	(0.000)	(0.813)		
15. Risk	0.057**	0.038**	0.043**	0.001	0.031**	-0.044**	0.033**	-0.022**	0.073**	-0.050**	0.040**	-0.009	-0.037**	0.101**	1.000
	(0.000)	(0.000)	(0.000)	(0.877)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.231)	(0.000)	(0.000)	

Note. **. The correlation is significant at the .01 level (bilateral). *. The correlation is significant at the .05 level (bilateral).

Table 2.3 Pairwise Pearson's Correlations for Explanatory Variables.

To analyze multicollinearity problems, we calculated the variance inflation factor (VIF) obtaining values lower than 3 (Thompson et al., 2017), so the possible existence of multicollinearity problem was not relevant.

In addition, we performed Harman's single factor test on the data to examine whether there is common method variance (CMV) bias. For this test, a PCA with a single factor and no rotation was calculated. The result showed an explained variance of 14.60%, well below 50% (Chang et al., 2010), indicating no CMV bias.

2.5.1. Model A. Mediation

As mentioned above, our study proposes mediation and moderate mediation methodologies for Model A and Model B, respectively. We adopted the multiple step approach proposed by Baron and Kenny (1986) to test the effect of mediation of ex-ante moral hazard on occupational accidents and check the validity of the proposed hypotheses in Model A (Figure 2.1).

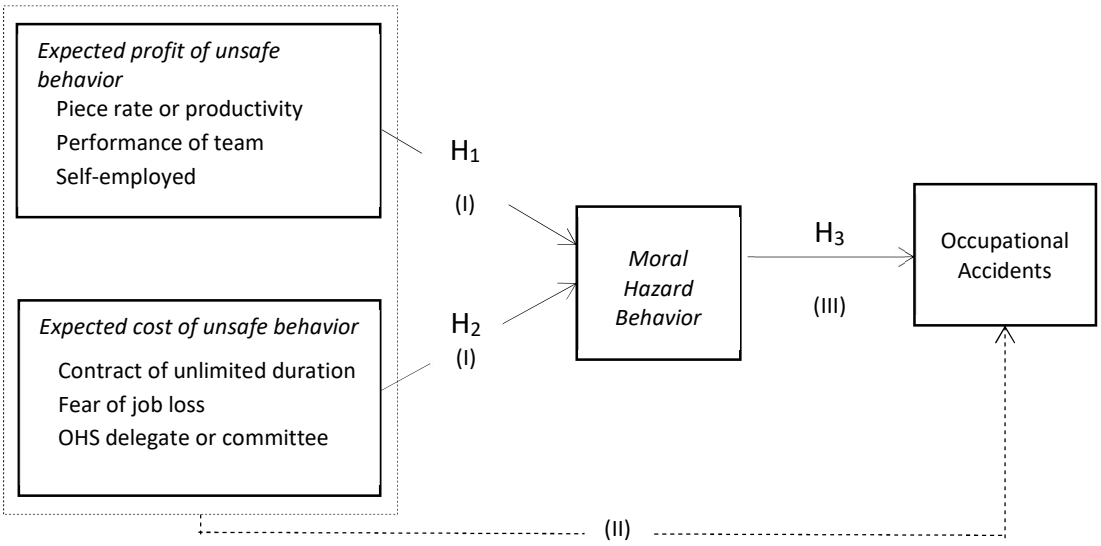

Figure 2.1. Theoretical Model A and Hypotheses. Mediation.

First, we performed a logit regression analyzing the effect of employment protection and incentives on the mediation variable, moral hazard behavior. This estimate allowed us to check H_1 and H_2. Next, we estimated the effect of independent variables on occupational accidents (dependent variable) using another logit regression, checking H_3. Finally, we added moral hazard behavior as a mediator variable in this last equation. The overall analysis of the data resulting from the three logit regressions listed in Table 2.4 allows us to know the effect of mediation and validate H_3. The effects are listed in Table 2.4.

	I	II	III
Independent Variable	Moral Hazard Behavior	Occupational Accidents	Occupational Accidents
Expected profit: Incentives to produce			
Individual payments: Productivity rate	0.224 (0.083) **	0.269 (0.113) *	0.265 (0.113) *
Team payments: Performance of team	-0.176 (0.113)	-0.097 (0.143)	-0.094 (0.143)
Self-employed	0.323 (0.090) ***	0.489 (0.157) **	0.479 (0.158) **
Potential consequences: Employment protection			
Contract of unlimited duration	-0.168 (0.072) *	0.434 (0.115) ***	0.439 (0.115) ***
Fear of job loss	0.195 (0.070) **	0.353 (0.099) ***	0.348 (0.099) ***
OHS delegate or committee	-0.325 (0.064) ***	0.201 (0.092) *	0.208 (0.093) *
Control Variables			
Enterprise size	-0.064 (0.027) *	0.111 (0.044) *	0.113 (0.045) *
Age	-0.005 (0.002) *	-0.007 (0.003) *	-0.007 (0.003) *
Gender (male)	0.108 (0.057)	0.269 (0.083) ***	0.268 (0.083) ***
Risk	0.297 (0.075) ***	0.909 (0.133) ***	0.904 (0.133) ***
Mediator Variable			
Moral hazard behavior			0.260 (0.122) *
Log pseudolikelihood	-5,025.704	-2,892.225	-2,890.084
Pseudo R2	0.0216	0.0223	0.0230
Pseudo R2 with control variables only	0.0118	0.0166	0.0166
n	16,832	16,832	16,832

Note. The table shows unstandardized β coefficients. Robust standard errors in parentheses. All estimations include the control variables listed in Table 2.1. *p≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001

Table 2.4 Model A. Logistic Regression for Mediation

The results obtained in the first logistic regression show that hypothesis H1 is partially supported. There is a significant relationship between incentives to produce and moral hazard behavior, but it is only significant when the profits are personal, individual payments ($\beta = 0.224$, $\rho \leq 0.01$) and when the worker is self-employed ($\beta = 0.323$, $\rho \leq 0.001$). Incentives based in team payments are found to be non-significant.

On the other hand, the results support the existence of a relationship between employment protection and a worker's moral hazard behavior, but in the opposite direction formulated in H_2. For all four variables the values are significant, but the sign is negative for the coefficients of contract of unlimited duration ($\beta = -0.168$, $\rho < 0.05$), OHS delegate or committee ($\beta = -0.325$, $\rho \leq 0.001$), and positive if the worker is afraid of losing his/her job ($\beta = 0.195$, $\rho \leq 0.01$). Therefore, the proposed employment protection measures, including the security of maintaining the job, reduce the worker's moral hazard behavior. Then, hypothesis H_2 is not supported, with the strong employment protection producing a reduction (not an increase) of the ex-ante moral hazard effect on workers' unsafe behavior.

The results of the control variables are those expected and similar to those contained in other studies, except for gender, which is inferred to have no impact on unsafe behavior, as it is not significant.

The second column in Table 2.4 details the results of the regression that analyzes the effect of independent variables on accidents. Both the individual incentives to produce ($\beta = 0.269$, $\rho < 0.05$) and the expected gains from being a self-employed worker are positively linked with the accident rate ($\beta = 0.489$, $\rho \leq 0.01$), but the performance of the team variable is not significant ($\beta = - 0.097$, $\rho > 0.05$). On the other hand, there is a positive and significant relationship of the employment protection variables with accidents. This indicates that an unlimited duration of the contract ($\beta = 0.434$, $\rho \leq 0.001$) and presence of a trade union in the company (OHS delegate or committee $\beta = 0.201$, $\rho < 0.05$), increase the number of accidents suffered (or reported) by the worker. On the contrary, job insecurity increases the rate of accidents (fear of loss job $\beta = 0.353$, $\rho \leq 0.001$).

By comparing the results of the regressions in columns II and III in Table 2.4, we can check the H_3 hypothesis. First, it is important to note that the McFadden pseudo-R squared

obtained in all three regressions are too low (pseudo $R^2 < 0.2$-0.4) to consider an appropriate fit of the explanatory model causes of accidents. This was expected, confirming that occupational accidents are systemic failures that involve multiple factors, and the unsafe behavior of the worker is only one of those that may or may not intercede. As "log-likelihood-based pseudo-R^2s do not represent the proportion of explained variance but rather the improvement in model likelihood over a null model" (Hemmert et al., 2018), introducing the mediator variable in the model (regression II pseudo $R^2 = 0.0223$ and regression III pseudo $R^2 = 0.0230$) increases the likelihood by 3.14%.

In the third regression, the relationship between the individual payments ($\beta = 0.265$, $\rho < 0.5$) and self-employed ($\beta = 0.479$, $\rho \leq 0.01$) variables with occupational accident drops compared to regression II, but they are still significant, so there is only partial mediation. However, the contract of unlimited duration and an OHS delegate or committee variables have slightly higher and significate coefficients, so there is no mediation. Their effect is direct.

There is a partial mediation of the agent's moral hazard behavior between expected individual benefits (incentives to produce) and accidents, but there is no such mediation between measures of employment protection and the number of accidents. It should be investigated whether the non-aversion to the worker's risk would moderate the relationship, mediated by the moral hazard behavior, between an indefinite contract and accidents, and therefore, a variable of the worker's own personality would determine the meaning and strength of the effect.

2.5.2. Model B. Moderated Mediation

The Moderated Mediation model is depicted in Figure 2.2.

Model B is used to verify hypotheses H_4 and H_5 and $H_{6.1}$ by a moderated mediation. We adopted the multiple step approach proposed by Baron and Kenny (1986), and later developed by Muller et al. (2005) to test the effect of mediation of ex-ante moral hazard on accident concretion when a moderator intervenes. The results are noted in Table 2.5.

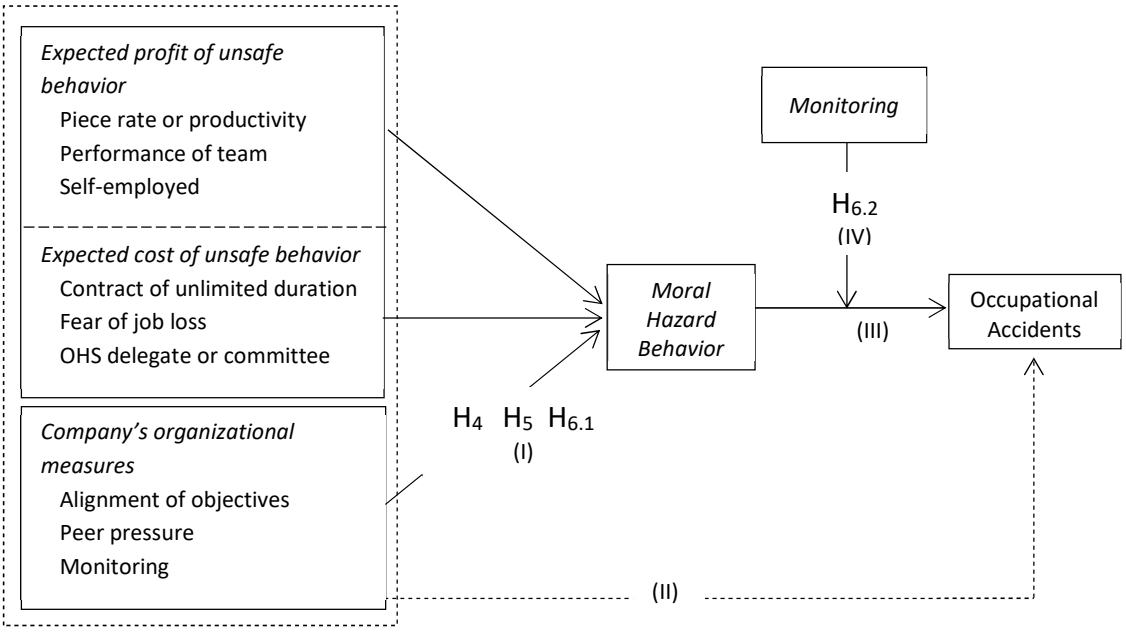

Figure 2.2 Theoretical Model B and Hypotheses. Mediation and Moderated mediation

First, we checked the effect of a company's organizational measures when the dependent variable is the mediator (moral hazard behavior). The results are collected in column I of Table 2.5. It is confirmed that the three coefficients of variables are negative and significant; the monitoring (β = -0.232, $\rho \leq 0.001$), the alignment of objectives (β = -0.032, $\rho \leq 0.05$), and peer pressure (β = -0.118, $\rho \leq 0.05$) reduce the ex-ante moral hazard and, consequently, the unsafe behavior of workers. Hypotheses H_4, H_5, and $H_{6.1}$ are therefore supported.

To check the $H_{6.2}$ hypothesis, we calculated regressions II and III of Table 2.5, with occupational accidents as a dependent variable, comparing the values of the coefficients in the presence of the mediating moral hazard. In both regressions, peer pressure is not significant. In contrast, the alignment of objectives, slightly mediated by ex-ante moral hazard, reduces accidents (β = -0.065, $\rho \leq 0.01$). The monitoring of the workers' production by the direct supervisor increases the occupational accidents and increases in the presence of the mediator variable (β_{II} = 0.336, $\rho \leq 0.001$; β_{III} = 0.341, $\rho \leq 0.001$).

Independent Variable	I Moral Hazard Behavior	II Occupational Accidents	III Occupational Accidents	IV Occupational Accidents
Expected profit				
Individual payments: Productivity rate	0.233 (0.083) **	0.250 (0114) *	0.245 (0.114) *	0.0241 (0.114) *
Team payments: Performance of team	-0.146 (0.114)	-0.063 (0.144)	-0.062 (0.144)	-0.063 (0.144)
Self-Employed	0.208 (0.094) *	0.620 (0.165) ***	0.613 (0.165) ***	0.630 (0.166) ***
Potential consequences				
Contract of unlimited duration	-0.170 (0.073) *	0.473 (0.115) ***	0.477 (0.115) ***	0.477 (0.115) ***
Fear of job loss	0.209 (0.071) **	0.314 (0.100) **	0.309 (0.100) **	0.310 (0.100) **
OHS delegate or committee	-0.316 (0.065) ***	0.223 (0.093) *	0.231 (0.093) *	0.236 (0.093) *
Firm´s organizational measures				
Monitoring	-0.232 (0.061) ***	0.336 (0.083) ***	0.341 (0.083) ***	0.288 (0.086) ***
Alignment of objectives	-0.032 (0.016) *	-0.066 (0.025) **	- 0.065 (0.025) **	-0.065 (0.025) **
Peer pressure	-0.118 (0.059) *	-0.059 (0.084)	- 0.056 (0.084)	-0.056 (0.084)
Control Variables				
Enterprise size	-0.050 (0.028)	0.113 (0.045) *	0.115 (0.045) *	0.115 (0.045) *
Age	-0.006 (0.002) **	-0.007 (0.003) *	-0.006 (0.003) *	-0.006 (0.003) *
Gender (male)	0.125 (0.057) *	0.264 (0.084) **	0.262 (0.084) **	0.260 (0.084) **
Risk	0.316 (0.075) ***	0.870 (0.133) ***	0.863 (0.133) ***	0.863 (0.133) ***
Mediator Variable				
Moral hazard behavior			0.266 (0.122) *	0.024 (0.176)
Iterations				
Moral hazard behavior*Monitoring				0.512 (0.246) *
Log pseudolikelihood	-5,013.279	-2,879.298	-2,877.088	-2,874.905
Pseudo R2	0.0240	0.0266	0.0274	0.0281
Pseudo R2 with control variables only	0.0118	0.0166	0.0166	0.0166
n	16,832	16,832	16,832	16,832

Note. Table shows unstandardized β coefficients. Robust standard errors in parentheses. All estimations include the control variables listed in Table 2.1. * p≤0.05; ** p ≤ 0.01; *** p ≤ 0.001

Table 2.5 Model B. Logistic Model for Mediation and Moderated Mediation

To explain the effect of the company's monitoring on worker accidents, we analyzed the moderated mediation relationship, when the mediator, ex-ante moral hazard behavior, is moderated by monitoring. The results in column IV of Table 2.5 indicate that there is a moderated mediation, where the interaction moral hazard behavior * monitoring is significant ($\beta = 0.512$, $\rho < 0.05$), and the effect of moral hazard behavior is annulled (not significant). The monitoring direct effect is reduced ($\beta = 0.288$, $\rho \leq 0.001$). The pseudo R^2 in the regression IV (pseudo $R^2 = 0.0281$) shows that the likelihood presents an increment of Δ 0.0041 respect regression of direct effect.

Therefore, Hypothesis H6.2 is not validated; the effect of the monitoring does not reduce the impact of ex-ante moral hazard on occupational accidents, but contrarily to expected, increases it.

2.6. DISCUSSION

Empirical analysis shows, primarily, that there is a certain degree of ex-ante moral hazard in workers' safety behavior. In particular, we found that financial and employment incentives, besides the more considered safety incentives, also alter workers' risky behavior. However, not all incentives have a significant or the expected effect.

Specifically, we find that individual, but not collective, incentives influence workers' unsafe behavior. Workers who are paid for their productivity and the self-employed, who earn all the income from their work, are more likely not to follow safety instructions. These results suggest that, indeed, workers, at some point, make a choice between producing (more or faster) or following safety procedures. Thus, when their income depends on their activity, this incentive to produce results in unsafe behavior. However, when the payment is collective, as the classic coalition problem predicts, the incentives for individual effort are diluted in the proportional pay among team members. Limiting personal incentives to production could be achieved through collective bargaining agreements in sectors with high occupational accident rates, as collective bargaining agreements "offer a highly responsive form of regulation that can be adapted to particular circumstances" (Hayter and Visser, 2021).

The results obtained for employment protection radically contradict our hypothesis. Namely, instead of increasing the unsafe behavior, open-ended contracts and union protection reduce the ex-ante moral hazard. Conversely, workers who fear losing their job, and therefore are less protected against the financial consequences of injuries, behave more insecurely. In this sense, it is possible that the variables included in the model are, in some way, capturing a similar effect to the variables that measure the expected profit. Workers in more precarious employment situations may need to work harder and faster in order to try to consolidate their employment. In contrast, workers who enjoy favorable employment conditions do not fear for their future employment and, therefore, do not need to risk their

health. Therefore, increasing the protection of employed workers would not only lead to an increase in employment and a decrease in long-term unemployment, but could also contribute to a reduction in the accident rate.

The presence of OHS trade union delegates does not increase the unsafe behavior of workers. Although the academic literature relates union presence or density to a higher number of accidents, as workers feel more protected from their own negligence, our research shows that their presence reduces the ex-ante moral hazard of unsafe worker behavior. In particular, union delegates can act as a double supervision mechanism, both for the workers and for the company, since one of their tasks is precisely to identify and denounce non-compliance with safety standards. This result suggests that the positive relationship with the number of accidents could be due to the fact that workers in higher-risk sectors or in companies with more unsafe or unfavorable working conditions may be motivated to join a trade union, as they may believe that unions will contribute to a more secure working environment. In other words, the results suggest that companies with more accidents may have a higher union density, rather than the other way around.

In the same way, we found strong evidence of the moderated mediation of the organizational responses to ex-ante moral hazard. First, we found that peer pressure is effective in reducing moral hazard, confirming that team-work is a valuable mechanism in controlling opportunistic behavior. This result, together with the non-significant effect of collective incentives, suggests that team organization may be an interesting alternative for companies where moral hazard is high.

Second, the results show that the alignment of objectives is effective in reducing accidents, both directly and indirectly (by reducing moral hazard). This result is in line with previous studies that identify organizational culture, in general, and safety culture, in particular, as a solution to the problem of safety in the workplace. Our analysis reinforces the role of shared objectives by observing that workers who contribute to define company goals are more likely to comply with the company's safety instructions. Furthermore, the results indicate that the direct effect of shared objectives is also favorable, reducing accidents. This

result suggests that cohesion within the company translates into greater compliance with safety instructions and standards, beyond the actual use of PPE.

Third, the results on monitoring are mixed. First, as expected, we observe a strong relationship between supervision and moral hazard. Specifically, our results indicate that control is very effective in reducing unsafe behavior. However, its direct effect on accidents and the mediating effect on moral hazard point in the opposite direction. There are several possible explanations for this result. First, supervisors can only control those actions that are easily observable, such as wearing or not wearing PPE. However, actions that are more difficult to observe, such as work pace, following instructions, or observing breaks, may go unnoticed. Moreover, the results indicate that direct monitoring can worsen hazardous conditions. Using the same argument above, it is possible that in situations where the middle manager's salary depends on productivity, he or she may pressure subordinates to produce more, even at the cost of taking more risks.

Fourth, control of the activity is generally carried out by supervisors who are not specialized in safety. These intermediate positions are therefore instructed and supervised by the health and safety unit, who evaluates risks and establishes procedures. Somehow, a new agency problem arises between those in charge of production and those in charge of safety. As we mentioned above, this situation can be easily solved in cases where it is easy to supervise the actions (PPEs) but not so much in other more hidden actions. It is possible, therefore, that depending on the incentive system, the company may also have to establish mechanisms to monitor the actions of supervisors.

2.7. CONCLUSION

This work can be understood as a contribution to the old and recurring discussion of the choice between production effectiveness and safety (Pagell et al, 2015). Beyond the academic environment, many companies and workers face a key decision every day: to produce more and faster or to produce less but safer. In our analysis, we have clearly shown how incentives linked to moral hazard favor risky behavior and, consequently, occupational

accidents. Investment in safety may therefore lose its effectiveness as individuals have incentives not to fulfill their responsibilities.

This circumstance, already relevant in itself, takes on even greater importance in a post-pandemic society. In today's circumstances, it is evident that the dichotomous choice between production and safety has been turned upside down. Nowadays, productive activity is not conceivable without maximal safety conditions. In a society traumatized by the effects of the pandemic, preferences for a safe work environment will undoubtedly grow. The effort that companies and prevention services are making to adapt production systems to this new reality is already enormous. New evaluations, new procedures, and new measures are being developed in order to be able to sustain, at least in some sectors, a certain level of activity.

Our work shows that this revolution in safety must not lose sight of one key element: individual behavior. Hence, in order to achieve a real reduction in the number of accidents at work, a joint safety effort is required from the main agents involved: the company and the worker. It is foreseeable that, in the future, workers will continue to respond in a similar way to incentives in areas such as salaries, promotions, and prestige as they did in the past. Therefore, irresponsible and unsafe actions of those that prefer to pursue their own objectives instead of following the company's safety instructions, will continue to happen and thus now, they constitute a greater risk.

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CHAPTER 3

THE IMPACT OF SKILLS MISMATCHES ON OCCUPATIONAL ACCIDENTS: AN ANALYSIS OF THE EFFECTIVENESS OF ORGANIZATIONAL RESPONSES

3.2. INTRODUCTION

When we start a new job, we feel insecure due to our lack of experience. If we think of jobs we have done in the past, no matter how simple they were, it is easy to remember the feeling of self-doubt and even fear we suffered until we gained some experience. The real-life examples are countless, from a teacher facing his first-class to a brilliant medical graduate going through her first consultation or a young student in a new job at a fast-food restaurant. In all cases, the lack of skills will cause them problems for a more or less long period. This is not exclusive to the first few days on the job but reappears when we incorporate new technology into our work, we change departments or locations, or when our clients demand something new.

This insecurity linked to the skills deficit can manifest itself in a number of factors that can affect occupational risk. The worker with fewer skills will be clumsier, will be unaware of the risks or will react with less agility to unexpected situations, among others. Furthermore, lack of confidence can also affect their self-esteem in such a way that stressful or distressing situations can arise. All these circumstances are not unknown to OHS systems, which, for example, require risk assessment whenever there is an organizational change or stipulate that new employee must be adequately trained.

The skills leveling up to the activity has a clear and documented effect on productivity and performance. The classic learning curve sums it up nicely. In either form of the curve, experience gained over time and repetition of tasks is associated with learning and efficiency in task performance (Arthur and Huntley, 2005). However, not many studies measure the impact of skills deficits (gains) on workers' health. For example, Ford and Wiggins (2012) find a close relationship between accident rates and high cognitive occupations, where the skills required are high. Christian et al. (2009) find that safety skills, together with motivation, were most closely related to safety behaviors, followed closely by organizational variables such as psychological safety climate and group safety climate.

In an indirect way and focused on OHS, some studies identify the benefits of training workers or gaining skills in occupational health. Vinodkumar and Bhasi (2010) identify safety

training as an essential management practice because of its effect on safety knowledge, motivation, and compliance. Aziz and Osman (2019) find that training significantly improves the implementation of OHS measures and, therefore, workers' health. From a more critical point of view, Laberge, MacEachen, and Calvet (2014) consider that OHS training is ineffective, particularly among younger workers where, precisely, the lack of experience and skills can undermine the effectiveness of the training.

On the other hand, existing research on skills underutilization shows that selecting skilled and competent personnel is one of the critical elements for the competitiveness of companies. Therefore, the mission of human resources departments is to define the competencies needed by the company and look for the workers to provide them. However, companies do not always make the right choice or, sometimes, they do not find the workers they need in the labor market. Companies that do not have the skills they need are more likely to be less productive and competitive (Acemoglu and Autor, 2011), require significant investments in training (McGuinness et al., 2018), or less satisfied and less motivated workforce (Badillo-Amador and Vila, 2013).

We argue that there is a relevant gap in the literature related to the impact of under-skilling on workers' health. The health effects of under-skilling can be persistent over time, even if the period in which the skills gap is short. A severe occupational accident, for example, can occur at any time, even on the day of joining the company, and its consequences can be fatal. In our opinion, this health issue is especially relevant since practically all workers, usually at the beginning of their career, have found themselves in a situation in which our abilities have not been sufficient, at least apparently, to carry out their task.

The main contributions of this article are the following. First, using a sample of workers from 35 European countries, we analyze the impact of skill deficit on the risk of suffering an occupational accident. Second, using Cox duration models, we estimate the impact of under-skilling on the number of days a worker is off work. Third, using moderation models, we estimate the effect of certain organizational practices on the relationship between under-skilling and health indicators.

3.3. UNDER-SKILLING EFFECT ON OCCUPATIONAL ACCIDENTS.

3.3.1. The effect of underkilling on the likelihood of occupational injuries.

The causes of an occupational accident have been widely analyzed and studied in the academic literature. Zarei et al. (2001) stress that occupational accidents are caused by various factors, not only due to factors extrinsic to the worker, such as the risk inherent to the activity, working conditions, or organizational factors but can also be caused by intrinsic human factors. Islam et al. (2018) estimate that human factors cause 80% of occupational accidents. In this line, some empirical studies, such as Fabiano et al. (2010), conclude that the inexperience of young workers generates a shocking increase in the probability of accidents.

There are two main, non-exclusive arguments for associating lack of skill with the likelihood of an accident. First, workers without sufficient skill to perform their job may have to focus all efforts on the correct performance of the task. They may then ignore the occupational risks of the task, or the use of the appropriate safety devices, increasing the likelihood of an occupational injury. An inexperienced construction worker, for example, will have trouble keeping up with the pace of work imposed by his co-workers and may forget some safety measures. A package delivery woman starting her activity in a new city will have a higher risk of suffering an accident simply because she has to look at the GPS while driving, for example.

Secondly, the preventive measures adopted by the company may not be equally effective for all workers. Firms use these measures to protect their regular workers so that they may be insufficient for those workers with skills deficits. The standard rate of production in a manufacturing company, for example, is usually established through the timekeeping of the "normal" worker, so the under-skilled may have trouble meeting production targets. As noted above, the OHS management standards already anticipate this situation and try to correct it by reinforcing risk assessment when there are organizational changes or by intensifying the training of new workers. However, it is also true that firms have less incentive

to train and instruct workers whose contribution to human capital is analogously lower (Nuñez and Prieto, 2019).

Accordingly, we posit:

Hypothesis 1. The probability of suffering an occupational accident is higher for under-skilled workers.

3.3.2. The effect of under-skilling on sick leave duration.

The duration of sick leave depends mainly on two factors: the severity of the health problem and the willingness/pressure to return to work. Regarding the second circumstance, there is prolific literature associating job insecurity with a greater need to return to work (Leigh,1985). Therefore, workers who do not have job security need to signal their effort and commitment by attending work as much as possible. This pressure increases when workers do not have many alternatives in the labour market, either because the unemployment rate is high or, as in our case, their skills are low. In these circumstances, they will try to shorten their absence to the point of coming to work when sick, as indicated in the literature on presenteeism (Johns, 2010).

In the case of under-skilled workers, there are additional incentives to shorten sick leave beyond their contractual vulnerability. In the case of these employees, working is a way to correct their skills problem. They will gain experience, learn from their peers, and receive training to perform their tasks correctly. Sick leave will only delay the learning process and is, therefore, an impediment to the consolidation of their position. Moreover, in the current context where teleworking can open the door to hybrid forms of face-to-face work, the under-skilled will more likely choose to attend to the workplace where they can find the support they need.

Hypothesis 2: The sick leave will be shorter for under-skilled workers.

3.4. ORGANIZATIONAL RESPONSE TO THE IMPACT OF UNDER-SKILLING ON HEALTH.

Ensuring the professionalization of the workforce is essential to guarantee the competitiveness of companies. Therefore, when the staff's qualifications are inadequate, companies will adopt different practices or organizational measures to either reduce the skills deficit or minimize its impact.

3.4.1. On-the-job training.

Job training is the most straightforward way to reduce skills deficits in the workplace. Apprenticeship programs have positive effects on the satisfaction and well-being of those groups that may suffer from skills mismatches, such as older workers (Koc-Menard, 2009), young workers (Messinis and Olekalns, 2007), or low skilled (Büchel and Mertens, 2004; Verhaest and Omey, 2006). In addition to the direct effect on skills, training programs provide workers support, resources, and assistance. Participants in these programs can quickly consult their doubts, ask for assistance in those tasks they do not have mastered, or express their needs for additional knowledge or resources.

The mandatory nature of the training is proof of its paramount importance. The OHS regulation obliges the company to provide sufficient, adequate, and continuous training to all its employees. This norm means that it must have a mandatory general training plan for all workers, supplemented with job-specific information when necessary. Training (both basic and specific) enhances workers' abilities to behave safely in the workplace. Organizations offer different training programs to reduce their employees' lack of specific skills. In this way, under-skilled workers will perform their tasks more safely if accompanied by trainers.

Hypothesis 3: Training weakens the effect of underkilling on a) The probability of suffering, an accident at work, and b) the duration of sick leave.

3.4.2. Teamwork.

In teams, workers share their skills to accomplish the same task. Team members must coordinate, adapt and communicate permanently. The specialty of another member can compensate for the shortcomings of one member and, in this way, take advantage of the synergies of knowledge and the transfer of knowledge, and the combination of knowledge within the team (Ployhart et al., 2013). This form of organization can facilitate the task of under-skilled workers, who can find in the team the help they need and compensate for their difficulties. From the perspective of under-skilled workers, we argue that teamwork can function as a compensatory mechanism. As opposed to the individual alternative, these workers can take advantage of the knowledge of their peers and ask for help when needed, including performing risky tasks.

Furthermore, work teams are very effective mechanisms for peer supervision (Buchanan and Preston, 1992). Simultaneous task execution provides team members with direct and symmetrical feedback on the performance of their teammates. In this way, if a team member carries out a task incorrectly or unsafely, the teammates can correct him or her. There are not many studies that determine the impact of teamwork on occupational safety. Tong et al. (2015) conclude that the OHS performance of teams depends to a large extent on leadership and commitment. It seems reasonable to think that an under-skilled worker will work more safely with an experienced team than alone.

Hypothesis 4: Work teams weaken the effect of under-skilling on a) The probability of suffering, an accident at work, and b) the duration of sick leave.

3.4.3. Monitoring:

One of the main functions of supervisors is to ensure the correct execution of processes and the quality of results. Supervisors ensure the correct coordination of processes and must therefore identify and prevent problems that may occur. For this reason, the supervisor will pay special attention to those workers with lesser abilities, as they are more likely to have difficulties in developing their tasks. In this sense, Gommans et al. (2017) point out that monitoring the workforce allows organizations to detect skill deficiencies and take measures

"to avoid its negative consequences." Therefore, intense and effective supervision can compensate for workers' skills deficiencies (Chae, Park and Choi, 2019).

In the field of OHS, Sloat (2005) presents the functions of supervisors and highlights the importance of their role as communicators and leaders. Among the functions that correspond to the company, the regulations establish that it must ensure the correct execution of the task and the proper use of safety devices (Council Directive 89/391/EEC, 1989). Most OHS management systems are based on the monitoring and supervision of the worker's actions, which may have incentives other than safety (Purse, 2000). The supervisor must ensure the correct execution of the task, the proper use of PPE, and, in the event of an accident, investigate its causes and establish new safety measures (Niskanen, Louhelainen and Hirvonen, 2014). The importance of this supervision is, if possible, more significant in the case of inexperienced workers where the possibility of an error or omission leading to an accident is higher.

Hypothesis 5: Monitoring weakens the effect of under-skilling on a) The probability of suffering, an accident at work, and b) the duration of sick leave.

3.4.4. Quality Standards.

The magnitude of the skills mismatch depends not only on the capabilities of the workers but also on the task's difficulty. By definition, simple tasks are easier to perform, so it is more difficult for a skills deficit to occur. The most common way to simplify tasks is to formalize them. The establishment of precise quality standards implies the formalization not only of the processes, generally through ISO-type norms, but also requires the standardization of the final product. By setting quality standards, workers will not only have instructions on how to perform their task but will also receive guidelines regarding the final result of their work.

Establishing stable rules and processes is the basic principle of bureaucratic management to simplify production processes (Adler and Borys, 1996). Under-skilled workers will find a great ally in the formalization of the workflow. In the same way that an inexperienced user needs instructions to assemble a piece of furniture, for example, an

inexperienced worker will be able to perform his task efficiently and autonomously if this task is standardized. Folger, Brosi, and Stumpf-Wollershein, (2021) show that formalization favoring worker performance is more significant in unstable and turbulent environments such as the current one.

From risk assessment to process standardization, the OHS system is based on formalizing processes (OHSAS 18001:1999; International Organization for Standardization, 2018). Standardization of processes and tasks by conforming to external and internal norms allows workers to have a precise guide to their work. In this sense, one of the fundamental pillars of OHS is the definition of clear and safe standards for the execution of the task. Through safety standards, employees know how they should perform their tasks and can identify when a deviation from what is expected occurs. These protocols are beneficial for those workers who, due to their inexperience or inability, cannot use their skills to resolve a dangerous situation.

Hypothesis 6: Establishing quality standards weakens the effect of under-skilling on a) The probability of suffering, an accident at work, and b) the duration of sick leave.

3.4.5. OHS information.

Workers have the right to receive precise, reliable, and updated information on the risks involved in their work (Council Directive 89/391/EEC, 1989). The company must analyze and evaluate occupational risks and communicate them effectively. However, firms have specific incentives not to report occupational hazards, especially when the company must compensate workers through risk premiums (Viscusi and Aldy, 2003). Therefore, compensation for occupational hazards is affected by information asymmetries to the extent that the company should not compensate workers for hazards of which they are unaware. This situation is potentially hazardous in that uninformed workers will not be able to prevent accidents effectively.

To avoid the negative effects of withholding information, the regulations are strict in terms of the obligation to inform workers. Although the obligation to inform is general, most prevention regulations stress the importance of informing workers about risks when they join

the company (Council Directive 89/391/EEC, 1989). This guideline is aimed precisely at mitigating the effects of the lack of experience and skills that often occurs at the beginning of a professional career. In this sense, the management of information, from its collection to its analysis, constitutes one of the fundamental tools on which the most current OSH management models are developed (Ejdys and Lulewitz-Sas, 2010).

Hypothesis 7. OHS information weakens the effect of under-skilling on a) The probability of suffering, an accident at work, and b) the duration of sick leave.

3.5. MATERIAL AND METHODS

3.5.1. Sample

We used the Sixth European Working Conditions Survey (EWCS6), published in 2017, as the basis of the sample. It covered responses from 43,850 workers in 35 European countries, not only the 27 EU Member States and the five EU candidate countries (Albania, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia, and Turkey), but also countries such as Switzerland, the United Kingdom, and Norway. Rafferty (2020) points out that this is a "unique source of information" as it includes self-reports on the relationship between workers' skills and their jobs.

In our research, we limit the sample to 42,871 units, with 5,188 (12.1%) under-skilled workers. In addition, we eliminated the units without reporting on some variables included in the survey, e.g., age. Table 3.1 shows the descriptive statistics of the sample.

Variables	Sample	Under-skilled workers	*EWCS 2015 Question*
	Frequency/mean [σ]	*Frequency/mean [σ]*	
Dependent Variables			
Occupational injures	2.7%	3.3%	EWCS Q83A. Indicate whether your absence has resulted from an accident
Days of absence	4.861 [16.225	0.578 [6.068]	EWCS Q82. Over the past 12 months, indicate how many days in total you were absent from work due to sick leave or health-related leave
Independent Variables			
Under-skill	12.1%	-	EWCS Q64.1 Indicate whether the following statements would best describe your skills in your own work: 1. You need further training to cope well with your duties
Moderator Variables			
Firm*'s measures*			
On-the-job training	29.5%	52.7%	EWCS Q65a. Indicate whether you have undergone any of the following types of training to improve your skills over the past 12 months or since you started your main paid job: Training paid for or provided by your employer
Teamwork	52.5%	65.3%	EWCS Q58. Indicate whether you work in a group or team that has common tasks and can plan its work
Monitoring	34.3%	38.3%	EWCS Q50. Indicate if your pace of work is dependent on direct control of your boss
Quality Standards	71.0%	76.7%	EWCS Q53A. Indicate whether generally your main paid job involves meeting precise quality standards
Information	2.221 [0.799]	2.263 [0.797]	EWCS Q33.Indicate how well informed you would say you are regarding the health and safety risks related to the performance of your job
Control Variables			
Age	43.394 [12.75]	40.802 [12.213]	EWCS Q2b. Age
Enterprise size: Firms > 250 employees	25.5%	32.5%	EWCS Q16B. Number of employees in total work in your business
Contract of unlimited duration	62.3%	67.3%	EWCS Q11. Indicate which kind of employment contract you have in your main job
Gender (male)	50.4%	49.3%	EWCS Q2A. Gender
Risk	60.9%	63.5%	EWCS Q 29. Indicate whether you are exposed at work to: a) Vibrations from hand tools, machinery, etc.; b) noise so loud that you would have to raise your voice to talk to people; c) high temperatures which make you perspire even when not working; d) low temperatures whether indoors or outdoors; e) breathing in smoke, fumes, powder or dust, etc.; f) breathing in vapours such as solvents and thinners; g) handling or being in skin contact with chemical products or substances; or i) handling or being in direct contact with materials which can be infectious.
ISCO 1	6.3%	7.6%	Managers
ISCO 2	17.8%	28.0%	Professionals
ISCO 3	11.2%	15.5%	Technicians and associate professionals
ISCO 4	8.6%	8.0%	Clerical support workers
ISCO 5	21.7%	18.1%	Service and sales workers
ISCO 6	4.8%	2.2%	Skilled agricultural, forestry and fishery workers
ISCO 7	11.7%	10.4%	Craft and related trades workers
ISCO 8	6.7%	4.6%	Plant and machine operators, and assemblers
ISCO 9	10.4%	4.8%	Elementary occupations

Table 3.1. Variable description

Table 3.1 shows some interesting differences for the subsample of under-skilled workers. First, we find that the frequency of occupational accidents (3.3%) and the duration of sick leave are higher than the average (0.578). On the other hand, workers with skill deficits are characterized by being somewhat younger (40.80), working in slightly larger companies, and belonging to highly qualified professional groups (ISCO 1, 2, 3). Interestingly, we found a higher percentage of workers with a skills deficit among those with a permanent contract (67.3%). The lack of incentives for continuous training for those with a secure job and the fact that technology is advancing rapidly in high-skilled occupations may explain this initial evidence. Finally, we also observed that the intensity with which organizational practices aimed at compensating for the skill deficit is much higher in this group.

Table 3.2 shows the Pearson correlation coefficients between variables. As we expected, some variables present correlation; however, it is reasonably low in all cases.

	Correlations (Significance level)							
Variables	1	2	3	4	5	6	7	8
1. Occupational Accidents	1							
2. Days of absence	0.198** 0.000	1						
3. Under-skilling	0.013** 0.006	0.018** 0.000	1					
5. On-job-training	0.014** 0.003	0.046** 0.000	0.189** 0.000	1				
7. Teamwork	0.026** 0.000	0.046** 0.000	0.096** 0.000	0.213** 0.000	1			
6. Monitoring	0.039** 0.000	0.016** 0.000	0.031** 0.000	0.058** 0.000	0.138** 0.000	1		
8. Quality Standards	0.024** 0.000	0.031** 0.000	0.046** 0.000	0.097** 0.000	0.141** 0.000	0.120** 0.000	1	
4. OHS Information	-0.030** 0.000	-0.011* 0.024	0.020** 0.000	0.144** 0.000	0.116** 0.000	0.008 0.084	0.119** 0.000	1

**. The correlation is significant at the 0.01 level (bilateral).

*. The correlation is significant at the 0.05 level (bilateral).

Table 3.2. Pairwise Pearson's correlations for explanatory variables.

3.5.2. Dependent Variables

Occupational accidents: To measure the occupational injuries suffered by the worker, we use a dummy variable. It takes the value of 1 when the worker has sustained a sick leave due to an occupational accident and 0 if he has not suffered a sick leave or the job has not caused it.

Days of absence: We construct a discrete variable with the total number of days of absence from work due to illness to measure the days of absence.

3.5.3. Explanatory Variables

Under-skill: The workers' statement about if their need more training to perform their tasks well (12.1%) serves to construct the variable. Therefore, we constructed a dummy variable that takes the value one if the worker states that this statement best describes their job skills and takes the value 0 if it does not. The measure we use is based on the personal and subjective evaluation of workers on the adequacy of their skills to the needs of the job. There are other more objective measures, such as the realized matches method or job evaluation, but they are generally focused on measuring overeducation (McGuinness et al, 2018). In our case, the analysis is focused on skills deficits so that, for example, a Ph.D. working at McDonald's may find himself in this situation. Therefore, we believe that using a subjective measure of self-assessment is more appropriate in this case.

To control for the complexity and variety of the tasks performed, i.e., the skill levels required in each occupation, we use the different levels of the International Standard Classification of Occupations (ISCO) as dichotomous control variables. In addition, we introduced other control variables such as risk, enterprise size, age, and gender.

3.5.4. Moderator variables: HRM measures.

On-the-job training: We construct a dichotomous variable that adds a value of 1 if the worker has received training paid for by the firm in recent months to improve their skills, taking a value of 0 otherwise.

Teamwork: We measure this variable using a dichotomous variable with a value of one if workers work in a group or team in their everyday tasks, and can plan their work, otherwise, it takes 0.

Monitoring: We create a dichotomous variable. Value one indicates that the pace of work depends on the direct control of the boss or manager, and a value of 0 otherwise.

Quality Standards: To measure, we use a dichotomous variable. It takes a value of one of the work involves meeting precise quality standards in the performance of their task, and cero if not.

OHS Information: we create an ordinal variable that takes the value of three if it is very well informed, two if it is well informed, one if it is poorly informed, and 0 if it is not informed.

3.6. RESULTS

To test the hypotheses, we use the moderation model proposed by Baron and Kenny (1986), as shown in Figure 3.1, calculating the direct effects of the independent variable and the effects of the interactions on the dependent variable. In addition, the model takes into account the direct effects of moderating variables on the dependent variable, as these are essential in the analysis and interpretation of the results (Andersson et al., 2014).

The model presents two dependent variables, *Occupational injuries* and *Days of sick leave*. The first is a categorical variable (dichotomous), and the second is a discrete variable. Given this difference and the hypotheses to be demonstrated, we use two different statistical techniques: logistic regression and Cox survival analysis.

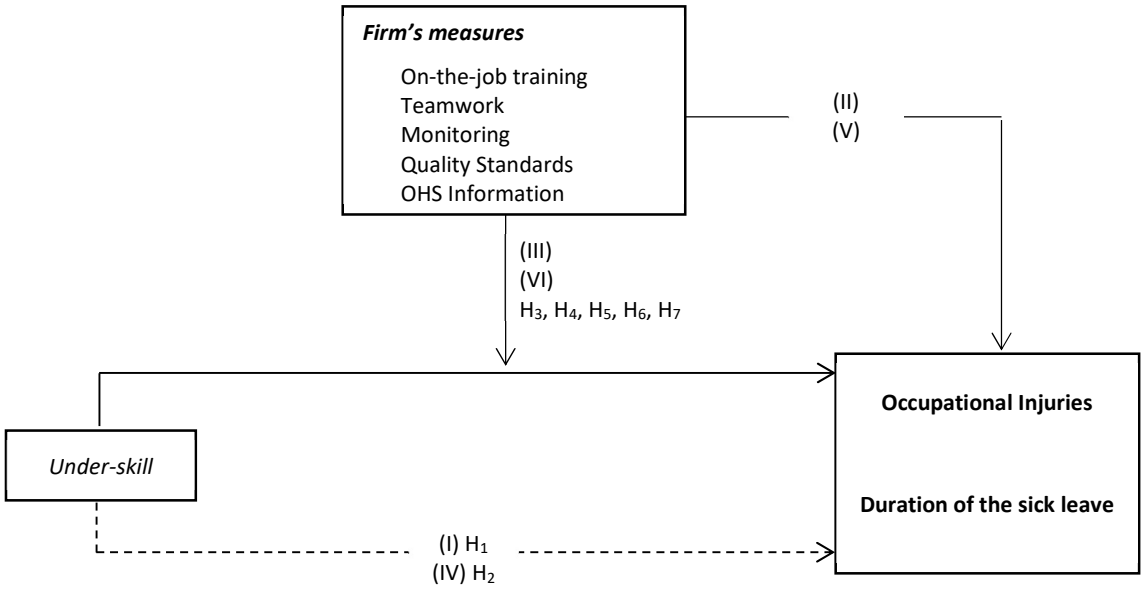

Figure 3.1. Theoretical model.

3.6.1. Estimation of the likelihood of an occupational injury: Logistic regression

Before pushing the hypotheses, we carry out some preliminary analyses on the robustness of the estimation. First, we checked whether there was a multicollinearity problem. To do so, we calculated the variance inflation factor (VIF), obtaining values lower than 3, which means that the possible existence of the multicollinearity problem was not relevant, even if, theoretically, the relationship between some variables is evident (Thompson et al., 2017). Furthermore, as a second analysis, we checked the variance bias of the common method (CMV). We performed Harman's single factor test on the data to be examined, calculating a PCA with a single factor and no rotation. The result showed an explained variance (8.41%) well below 50% (Chang et al., 2010), indicating no CMV bias.

When the dependent variable is categorical, researchers use logistic regressions (Jaccard, 2001) to estimate moderated regressions. In addition, the interaction effect is also applied using categorical moderators (Hayes, 2018), as in this research. Table 3.3 shows the obtained results.

	I	II	III
Independent Variables	Occupational Injuries	Occupational Injuries	Occupational Injuries
Under-skill	0.278 (0.093) **	0.211 (0.096) **	0.775 (0.259) **
Firm's measures			
On-job-training		0.181 (0.089) **	0.246 (0.099) **
Teamwork		0.152 (0.074) **	0.233 (0.071) ***
Monitoring		0.276 (0.075) ***	0.256 (0.083) **
Quality Standards		0.166 (0.085) **	0.127 (0.089)
OHS Information		-0.265 (0.050) ***	-0.244 (0.053) ***
Iterations			
On-job-training * under-skilling			-0.373 (0.188) **
Teamwork* under-skilling			-0.582 (0.160) ***
Monitoring* under-skilling			0.125 (0.176)
Quality Standards * under-skilling			0.245 (0.220)
OHS Information* under-skilling			-0.130 (0.063) **
Control Variables			
Age	-0.002 (0.002)	0.000 (0.002)	0.000 (0.002)
Enterprise size	0.190 (0.034) ***	0.156 (0.036) ***	0.152 (0.036) ***
Unlimited contract	0.301 (0.108) **	0.278 (0.102) **	0.276 (0.101) **
Gender (male)	0.215 (0.071) **	0.223 (0.072) **	0.217 (0.073) **
Risk	0.777 (0.081) ***	0.736 (0.084) ***	0.732 (0.083) ***
ISCO 1	-0.955 (0.185) ***	-0.878 (0.188) ***	-0.885 (0.188) ***
ISCO 2	-0.999 (0.085) ***	-0.968 (0.085) ***	-0.971 (0.084) ***
ISCO 3	-0.715 (0.107) ***	-0.691 (0.112) ***	-0.697 (0.113) ***
ISCO 4	-0.910 (0.148) ***	-0.905 (0.144) ***	-0.917 (0.143) ***
ISCO 5	-0.408 (0.086) ***	-0.370 (0.087) ***	-0.376 (0.088) ***
ISCO 6	0.097 (0.205)	0.136 (0.196)	0.142 (0.196)
ISCO 7	-0.113 (0.092)	-0.110 (0.094)	-0.111 (0.093)
ISCO 8	-0.235 (0.122)	-0.215 (0.124) *	-0.218 (0.125) *
ISCO 9	-	-	-
Log pseudolikelihood	-5,134.922	-5,091.922	-5,081.236
Pseudo R2	0.0407	0.0488	0.0508
Pseudo R2 with control variables only	0.0398	0.0398	0.0398
n	42,871	42,871	42,871

Notes: Table shows unstandardized Hazard Ratios. Robust standard errors for 35 clusters by country are in parentheses. All estimations include the control variables listed in Table 3.1.
*p≤ 0.1; **p ≤ 0.05; *** p ≤ 0.001

Table 3.3. Logistic regression. Dependent Variable: Occupational Injuries

First, we test hypothesis 1 by studying the direct effect of *Under-skill* on the dependent variable *Occupational Injuries*. Column I shows the results. We find that the coefficient of the independent variable is positive and significant (β_I = 0.278, $\rho \leq 0.05$); therefore, an underskilled worker is more likely to suffer an occupational injury. Hence, this supports hypothesis 1.

Second, to test Hypothesis 3.a, Hypothesis 4.a, Hypothesis 5.a, Hypothesis 6.a, and Hypothesis 7.a, we calculate the direct effects of moderators by collecting the results in column II, and the iterations effects by column III.

The result for the *under-skill* variable (β_{III} = 0.775, $\rho \leq 0.05$) corroborates our conclusion about the Hiphotesys I; as Aguinis et al. (2017) indicate, the direct effects are to be interpreted "from full models including the predictor, the moderator, and the product terms." Also, the increase in the coefficient β is justified because "in the additive model the coefficients estimate the average or main effect, whereas in the moderator model they estimate simple effects of one variable when the other variable is fixed at 0" (Whisman and McClelland, 2005).

The iterations *teamwork*under-skill* and *on-job-training*under-skill*, shown in column III, indicate that the impact of the under-skill variable on workplace injuries is weakened when it occurs in teamwork environments (β_{III} = - 0.582, $\rho \leq 0.001$) or when the company trains workers (β_{III} = -0.373, $\rho \leq 0.05$). Conversely, the direct effects of the teamwork and training variables are positive and significant (β_{II} = 0.233, $\rho \leq 0.001$; β_{II} = 0.246, $\rho \leq 0.05$), being relevant when the under-skill variable takes the value 0. Then, Hypothesis $H_{3.a}$ and $H_{4.a}$ are supported.

Similarly, hypothesis H_{7}.a. is also satisfied. Again, the iteration of OHS information and under-skill is significant and negative (β_{III} = -0.130, $\rho \leq 0.05$), with specific information on prevention being the only measure adopted by the company whose direct effect decreases the probability of suffering an injury at work (β_{III} = -0.244, $\rho \leq 0.001$).

On the contrary, the iterations of *Monitoring* and *Quality Standards* variables are not significant. They, therefore, do not moderate the effect of the underskilling variable on the dependent variable. Thus, hypotheses $H_{5.a}$ and $H_{6.a}$ are not validated.

Although McFadden's pseudo-R squares obtained in all three regressions are too low (pseudo-R^2 < 0.2-0.4), this only confirms that occupational injuries depend on multiple and random variables, so we consider it a reasonable fit for our explanatory model. Furthermore, pseudo-R^2 based on log-pseudolikelihood represent the improvement in model likelihood

over a null model (Hemmert et al., 2018), indicating an increase in the likelihood of our final model by 23,81% (regression I pseudo R2 = 0.0407 and regression III pseudo R2 = 0.0508).

In order to guarantee the validity of the model, we have estimated the confusion matrix.

Classified Occupational injures	True		Total	Real Injury rate by predicted categories
	Yes	No		
Predicted Yes	787	16,326	17,113	4.59%
Predicted No	379	25,379	25,758	1.47%
Total	1,166	41,705	42,871	
Sensitivity			67.50%	
Specificity			60.85%	
Classified + if predicted Pr(D) > 0.027				

Table 3.4. Confusion Matrix: Injury rate by predicted categories.

The results show that the predictive capacity of the model is moderate. The sensitivity (ability to predict the occurrence of an accident) reaches 67.50%, while the specificity (ability to predict the absence of an accident) reaches 60.85%. The model, therefore, slightly overestimates the occurrence of accidents. The moderate predictive ability of the model is not a surprising result. On the one hand, the probability of suffering an accident is relatively low (2.7%) and, therefore, more difficult to predict. On the other hand, occupational accidents are rare events that depend, to a large extent, on a powerful random component.

In any case, we observe interesting differences if we look at the actual incidence rate for the two groups. Individuals for whom the model predicts an accident have an actual incidence rate of 4.59% versus the 1.47% for the group where the model does not predict an accident. separates the sample into two groups where the risk of suffering an accident is very different. We believe the model can be a handy tool for differentiating workers based on occupational risk. By simply analyzing individual responses to a survey, a risk analyst can ex-ante identify workers with a three times higher incidence rate.

3.6.2. Estimation of the likelihood of the sick leave duration: Cox survival analysis.

First, as was done in the previous section, we checked compliance with the requirements related to multicollinearity and CMV bias. The variance inflation factors (VIF) are values below 3, which means the multicollinearity problem is irrelevant. We performed Harman's single factor test on the data to be examined with the same assumptions and obtained a similar result of explained variance (8.47%<50), indicating no CMV bias.

We turn to the Cox proportional hazards regression model to analyze the likelihood that the sick duration is affected by the under-skill variable and the proposed moderations (Cox, 1972), which enables us to calculate a particular form of rate ratios known as hazard ratios.

Hazard ratios allow us to analyze the association of the time to occurrence of an event with one or more predictor variables. In our case, we define the event as the medical discharge of the disease, and the discrete variable is the time until the event occurs as the *Days of absence* variable. The elements (workers) that have not suffered the event (medical discharge) during the analysis period are censored, either because they have not sustained accidents or because they have not yet received ill leave. Therefore, the sample studied is reduced to 15,345 workers. Table 3.5 shows the results.

The covariate under-skill has a significant hazard ratio of 0.813 (ρ ≤0.001, 95% CI: 0.729-0.907). Hence, this means that underskilled workers are 18.7% less likely to be discharged than workers who are not skill-deficient. In other words, the duration of sick leave for underskilled workers is likely to be longer. There is a statistically significant difference in the duration of sick leave in the two groups (1 not included in 95% C.I.: 0.729-0.907); under-skilled workers and those with no skill deficiencies. Hypothesis 2 is therefore not supported.

The iteration between underskilled workers and teamwork is the only significant one in the moderation model (HR= 1.104, ρ ≤0.05, 95% CI: 1.001-1.199), indicating a shorter duration of sick leave. $H_{4.b}$ is validated. On the contrary, the results for the remaining iterations, not being significant, indicate that the variables do not influence the relationship

between workers' under-skilling and sick leave duration. $H_{3.b}$, $H_{5.b}$, $H_{6.b}$ and $H_{7.b}$ are not confirmed.

The only moderating variable that maintains direct effects in the moderated regression is on-job-training, (HR= 1.041, ρ ≤0.1, 95% CI: 0.998-1.085), whose result indicates that training increases the probability of shorter discharges by 4.1% relative to those not trained workers. Regarding the control variables introduced in the model, it is worth noting that age, company size, permanent contracts, and risk are associated with higher probabilities of having a longer duration of sick leave. In contrast, men and jobs related to ISCO 1, ISCO 2, ISCO 3, ISCO 4, ISCO5, and ISCO 6 are more likely to be discharged earlier

	IV		V		VI	
	Haz. R. (Rob. Std. Err.)	95%CI	Haz. R. (Rob. Std. Err.)	95%CI	Haz. R. (Rob. Std. Err.)	95%CI
Under-skill	0.947 (0.023) **	0.903-.0994	0.942 (0.024) **	0.895-0.992	0.813 (0.045) ***	0.729-0.907
Firm's measures						
On-job-training			1.049 (0.022) **	1.006-1.095	1.041 (0.022) *	0.998-1.085
Teamwork			1.013 (0.022)	0.970-1.057	1.000 (0.023)	0.956-1.046
Monitoring			0.979 (0.018)	0.943-1.016	0.983 (0.018)	0.948-1.019
Quality Standards			0.958 (0.023) *	0.913-1.005	0.960 (0.026)	0.910-1.013
OHS Information			1.020 (0.015)	0.989-1.052	1.016 (0.016)	0.984-1.049
Iterations						
On-job-training * under-skilling					1.058 (0.061)	0.943-1.186
Teamwork* under-skilling					1.104 (0.046) **	1.001-1.199
Monitoring* under-skilling					0.973 (0.038)	0.900-1.052
Quality Standards* under-skilling					0.996 (0.047)	0.907-1.093
OHS Information* under-skilling					1.028 (0.035)	0.961-1.100
Control Variables						
Age	0.990 (0.000) ***	0.988-0.992	0.990 (0.000) ***	0.988-0.992	0.990 (0.000) ***	0.988-0.992
Enterprise size	0.976 (0.010) *	0.956-0.997	0.973 (0.009) **	0.954-0.992	0.973 (0.009) **	0.954-0.992
Unlimited Contract	0.903 (0.022) ***	0.860-0.949	0.895 (0.022) ***	0.852-0.941	0.895 (0.022) ***	0.851-0.941
Gender (male)	1.169 (0.023) ***	1.124-1.216	1.169 (0.023) ***	1.124-1.217	1.170 (0.023) ***	1.124-1.218
Risk	0.907 (0.020) ***	0.868-0.947	0.909 (0.020) ***	0.869-0.950	0.910 (0.020) ***	0.870-0.951
ISCO 1	1.375 (0.091) ***	1.207-1.567	1.354 (0.086) ***	1.194-1.535	1.358 (0.087) ***	1.197-1.541
ISCO 2	1.364 (0.042) ***	1.283-1.450	1.339 (0.042) ***	1.259-1.424	1.342 (0.041) ***	1.262-1.426
ISCO 3	1.186 (0.031) ***	1.126-1.251	1.172 (0.031) ***	1.112-1.235	1.175 (0.030) ***	1.116-1.237
ISCO 4	1.188 (0.039) ***	1.113-1.268	1.178 (0.039) ***	1.103-1.258	1.182 (0.039) ***	1.108-1.261
ISCO 5	1.173 (0.039) ***	1.098-1.252	1.161 (0.040) ***	1.085-1.242	1.163 (0.039) ***	1.088-1.244
ISCO 6	0.957 (0.053)	0.856-1.068	0.956 (0.055)	0.853-1.071	0.955 (0.054)	0.854-1.069
ISCO 7	0.965 (0.032)	0.903-1.031	0.969 (0.032)	0.907-1.035	0.969 (0.032)	0.908-1.034
ISCO 8	0.979 (0.031)	0.919-1.043	0.981 (0.031)	0.922-1.045	0.980 (0.031)	0.921-1.043
ISCO 9	-					
Wald chi^2	774.74		794.37		1,614.92	
Wald chi^2 with control variables only	736.58		736.58		736.58	
Log pseudolikelihood	-133,623.84		-133,614.45		-133.610.69	
n	15,345		15,345		15,345	

Notes: Table shows unstandardized Hazard Ratios. Robust standard errors for 35 clusters by country are in parentheses. All estimations include the control variables listed in Table II. *p≤ 0.1; **p ≤ 0.05; *** p ≤ 0.001

Table 3.5. Cox proportional hazard model. Dependent Variable: days of absence

3.7. DISCUSSION AND CONCLUSIONS.

The results of this study only partially validate the hypotheses we have put forward. Let us start with the issues we demonstrated. Our analysis shows that skill deficits increase the risk of an accident. Consequently, the technical qualification for the performance of a task should be incorporated as a factor affecting OHS risks. Our analysis also provides some possible solutions for the OHS risk linked to the under-skilling. When a company identifies workers without sufficient skills to perform their tasks, our results show that this risk can be reduced by working in a team, intensifying training, or informing more precisely of the OHS risks.

We can also draw conclusions from the issues we have not been able to demonstrate. On the one hand, we did not observe that the standardization of processes and the monitoring of jobs reduce the under-skilled occupational risk. The results suggest that the under-skilled are better protected by measures directed at the individual (training, information, and equipment) than by systemic measures (standardization and monitoring). On the other hand, we observed that under-skilled workers have longer sick leaves. They may suffer more severe accidents and therefore have longer recovery times. However, if we assume that the severity of their pathologies is similar to that of skilled workers, the longer duration of sick leave may be related to the lower incentive (pressure) to return to work for under-skilled workers. Interestingly, descriptive statistics show that the contract of low-skilled workers is more often permanent. This safer contractual relationship may suggest low-skilled workers' motivation to return to work may be lower.

Moreover, our study leaves open some questions that could be investigated in the future. One relevant question is the point in the professional career at which the skills deficit occurs. Our initial approach suggested that such a deficit occurs mainly during the entry into a new job, and it may disappear through training and experience. However, the descriptions of the under-skilled group suggest that the skills deficit also occur in workers with permanent contracts in skilled occupations. This evidence suggests that some workers may lose the incentive to upgrade their skills, so that they become obsolete. Our results therefore indicate that the lack of incentives and motivation for continuing education may constitute an

occupational risk. The motivation to train, the factors that influence it and the consequences of this lack of motivation constitute an interesting line of research that can contribute to the prolific literature on the subject (Colquitt, LePine & Raymond, 2000).

From our study, we can also draw some implications for the design of OHS systems. Traditional OHS management systems are based on preventing occupational accidents by controlling the working conditions and the risk associated with the tasks, independently of the individual factors of each worker (García-Herrero et al., 2012). Therefore, from this perspective, an effective OHS system should be sufficient to curb the accident rate. However, our results show that workers' abilities to perform their tasks will significantly alter the risk of accident and the period of sick leave.

In recent decades, the consideration of the human factor in the occupational risk prevention system has undergone significant advances in the control of psychosocial risks. However, technical training for task execution is not a psychosocial risk and, therefore, is not among the objectives of the OHS system. At present, and in general, the regulations establish general protocols in situations such as the incorporation to a new job or the modification of the production process, where the deficit of skills may be more likely. However, this deficit can occur in today's dynamic and changing environment in many other circumstances.

Our study also opens the door to the analysis of incentives to invest in OHS. Since their human capital is less valuable, companies may have less incentive to protect under-skilled workers. However, if they do not take adequate measures to protect them, companies may incur in higher costs, as, our paper shows, they are more likely to suffer an accident and more extended sick leave. Due to this situation of risk, the regulation should include aspects not previously considered. Firstly, in addition to providing OHS training and information, it should be considered an obligation for the employer to provide regular technical training for all staff. In sectors where subcontracting is a common practice, an increase in the cost per accident of a subcontracted worker could be imposed on the contracting company if it has not been provided technical-preventive training to that worker. This measure would encourage companies, which know the job characteristics, facilities, and internal organization, to extend their training scope and investment.

Secondly, encouraging teamwork in high-risk activities could be a step forward in reducing mortality rates in some sectors. The risk assessment could establish, for example, a minimum level of experience to be able to perform a task autonomously. In those tasks where the risk is high, and the worker's experience is low, periods could be established in which the work is carried out in teams. In this way, the inexperienced worker will be accompanied by more experienced workers and will never assume the final responsibility in executing the task.

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GENERAL CONCLUSION

The three chapters of this thesis attempt to bring an innovative and fundamental perspective to occupational safety and health (OSH) management; they place human capital at the heart of the discipline. As markets evolve and companies adopt similar technologies, human capital becomes the primary source of competitive advantage. This thesis attempts to contribute to a paradigm shift in OSH, where workers are recognized as valuable assets for companies and, as such, must be protected and cared for in the same way that other strategic assets are protected.

Furthermore, this study emphasizes the need for a proactive approach to OSH. Rather than reacting to irregularities, incidents, and regulations, organizations should actively anticipate and mitigate risks by extending their actions to other aspects that are not initially related to safety, such as training, fostering work teams, and reducing individual incentives to produce or link them to safe performance. In doing so, they not only improve the well-being of their workers but also optimize the company's overall performance.

This research's implications are relevant for policy-making and business practice. Policymakers can use these findings to refine OSH regulations and monitoring, while organizations can implement the outcome of each chapter to develop more effective safety management strategies. To make significant progress in accident prevention, organizations, workers, and regulators must work together toward a common safety goal. An integrated approach, which fosters collaboration, becomes the key to addressing OSH challenges.

In summary, this thesis proposes a revolutionary approach to OSH that places workers at the center of occupational safety and health management. It recognizes that a company's human capital is as valuable as its physical and technological assets and argues that protecting and caring for workers is fundamental to the long-term success of organizations. By adopting this paradigm, companies will reduce workplace accidents, improve worker health, ensure a safer and healthier work environment, and strengthen their competitive advantage in an ever-changing world. This thesis does not represent the end but intends to begin a transformation in OSH. This thesis does not represent the end but intends to begin a transformation in OSH, a revolution where caring for human capital is the key to a safer and more prosperous future.

CONCLUSIÓN GENERAL

Los tres capítulos de esta tesis intentan aportar una perspectiva innovadora y fundamental en la gestión de la seguridad y salud en el trabajo (SST) al poner el capital humano en el centro neurálgico de esta disciplina. A medida que los mercados evolucionan y las empresas adoptan tecnologías similares, el capital humano se convierte en la fuente principal de ventaja competitiva. Esta tesis intenta contribuir a un cambio de paradigma en la SST, donde se reconoce que los trabajadores son activos valiosos para las empresas y, como tales, deben ser protegidos y cuidados de la misma manera que se protegen otros activos estratégicos.

Además, este estudio enfatiza la necesidad de un enfoque proactivo en la SST. En lugar de reaccionar ante irregularidades, incidentes y regulaciones, las organizaciones deben anticipar y mitigar activamente los riesgos ampliando sus acciones a otros aspectos que inicialmente no están relacionados con la seguridad, como son la capacitación, fomentar los equipos de trabajo y reducir los incentivos individuales a la producción o ligarlos a las actuaciones seguras. Al hacerlo, no solo mejoran el bienestar de sus trabajadores, sino que posiblemente también optimizarán el rendimiento general de la empresa.

Las implicaciones de esta investigación son de relevancia tanto para la formulación de políticas como para la práctica empresarial. Los responsables de políticas pueden utilizar estos hallazgos para perfeccionar las regulaciones y la supervisión de la SST, mientras que las organizaciones pueden implementar el resultado de cada capítulo para desarrollar estrategias de gestión de seguridad más efectivas. Para lograr avances significativos en la prevención de accidentes, es esencial que las organizaciones, los trabajadores y los organismos reguladores trabajen juntos hacia un objetivo común de seguridad. Un enfoque integrado, que fomente la colaboración, se convierte en la clave para enfrentar los desafíos en SST.

En resumen, esta tesis propone un enfoque revolucionario para la SST, que coloca a los trabajadores en el centro de la gestión de la seguridad y salud laboral. Reconoce que el capital humano de una empresa es tan valioso como sus activos físicos y tecnológicos, y argumenta que proteger y cuidar a los trabajadores es fundamental para el éxito a largo plazo de las organizaciones. Al adoptar este paradigma, las empresas no solo reducirán los accidentes laborales, mejorarán la salud de los trabajadores y garantizarán un ambiente laboral más seguro y saludable, sino que también fortalecerán su ventaja competitiva en un mundo en constante evolución. Esta tesis no representa el fin, sino que pretende ser el inicio de una transformación en la SST, una revolución donde el cuidado del capital humano es la clave para un futuro más seguro y próspero.