Topics

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Moral Hazard in Monday Claim Filing: Evidence from Spanish Sick Leave Insurance

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Abstract: The Monday effect on workers' compensation insurance shows that there is a higher proportion of hard-to-diagnose injuries the first day of the week. The aim of this paper is to test whether the physiological hypothesis or the economic explanation is more satisfactory to understand this Monday effect and, if both are correct, to obtain an estimation of the magnitude of each of them. To do this, we exploit the singular legal regulation of Spanish sick leave benefits and use this country as a "laboratory". Our econometric analysis detects and measures a hard-to-diagnose reporting gap on Mondays by about 6.5 percentage points due to physiological reasons and up to 1.4 percentage points attributable to moral hazard for those injuries with a short recovery period.

Keywords: moral hazard, opportunistic behaviour, labour-law and economics, workers' compensation

1 Introduction

When analysing frequency of workplace accidents, an intriguing empirical regularity arises: there are more cases on Mondays than on the rest of the days. If work time were not evenly distributed along the working week, such an empirical observation might be the result of a greater number of workers performing their tasks on Mondays. In other words, if more employees were at work on Mondays than on the rest of the days, the exposure risk would increase on Mondays and, as a result, more accidents would be reported on the first day of the week.

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Nevertheless, what is more striking and difficult to justify with this sort of arguments is why there is a higher proportion of so-called soft-tissue¹ (Butler, Durbin, and Helvacian 1996) injuries on Mondays than on the other days. When using this kind of relative indicators (that is, the percentage of soft-tissue injuries conditional on having suffered an injury) we are implicitly controlling the possible differences among the days of the week with respect to the number of employees actually at work. For all of these reasons, it has been established that there exists a Monday effect on claims for accident insurance compensation.

The remainder of the paper is organized as follows. In Section 2, we present the state of the art. In Section 3, we outline the legislative and institutional framework of sick leave regulation in Spain. Section 4 deals with the basic theory to understand the empirical strategy employed in the following sections. Section 5 describes the database used in the empirical work. In Section 6, we explain the econometric methodology used in the article. Section 7 contains the basic findings of the paper. The final section summarizes our main conclusions.

2 State of the Art

Academic literature in economics has sought to explain the Monday effect. A good example of the relevance of this topic is the recent publication of the work of Butler, Gardner, and Kleinman (2013). In this survey, the authors review the economic effects and consequences of workers' compensation and devote a section to the Monday effect. Nevertheless, it is worth mentioning that they predominantly adopt a North American perspective. It is also worth pointing out that a documented Monday effect in workplace accident reporting already appears in a work published at the very beginning of the twentieth century (Vernon 1921). Nevertheless, it is a topic that keeps attracting researchers' attention as the articles published recently in top journals prove.

The more plausible justification for said effect is that individuals engage in opportunistic behaviour (moral hazard) because they report some injuries as work related on Mondays when they are really out-of-work injuries. This arises due to the economic incentives generated by the institutional settings in place in certain countries. In most countries, workers' compensation (WC) insurance pays for the cost of medical treatment and provides partial income replacement

¹ We use the terms *hard-to-diagnose*, *easy-to-conceal* and *soft-tissue* indistinctly throughout the paper. With them we refer to strains, sprains and lower back pains. In the literature, it has been quite common to use them virtually as synonyms.

for lost wages caused by work-related injury. Therefore, workers with no health insurance coverage can delay reporting out-of-work injuries suffered during the weekend to the Monday in order to obtain health care and compensation benefits from WC systems.

Nonetheless, it must be noted that there is a competing explanation provided from the field of Physiology. This alternative explanation simply states that after the rest over the weekend, workers become more prone to injuries when they come back to work on Monday. Thus, the key question is to find an adequate test to verify which of these two hypotheses – the physiological explanation or the economic justification – is more credible.

There have been some attempts of doing this in previous economic literature. The seminal work on this issue is that of Smith (1990), but this paper does not try to verify which of the two competing hypotheses above mentioned is more believable. Instead, this work takes for granted that the Monday effect is mainly driven by economic incentives. The empirical evidence, although simple, seems to be quite convincing especially if the reader is an economist.

A first attempt to truly discriminate between both explanations is the article by Card and McCall (1996). In such a work, the authors present a direct test to validate which of the hypotheses is better. Said authors seek differences in reporting behaviour between two groups of workers: those who are covered by health insurance and those who are not. Said authors are unable to identify any significant difference among them, so they conclude that the Monday effect could be explained by the physiological hypothesis.

In another paper, Campolieti and Hyatt (2006) try to find empirical evidence to support one of the two competing alternatives by comparing the United States and Canadian WC systems. These authors consider that in the United States there are two sources of moral hazard (obtaining medical care via WC insurance and getting at least partial income replacement for lost wages) while in Canada there is only one (collecting compensation benefits to replace lost labour income).² They find a fairly similar Monday effect in the case of both Canada (Ontario) and the United States (Minnesota).³ Thus, and in their own words, the main finding reached by Campolieti and Hyatt (2006) is that the results are not inconsistent with the strictly physiology-based hypothesis. Nonetheless, these authors recognise that although these arguments provide support for a physiological explanation, this is highly speculative and cannot be taken as a definitive argument against the economic (moral hazard) explanation.

2 In addition, the authors note that WC benefits in Canada are more generous than those in the United States.

3 The results for Minnesota are obtained from Card and McCall (1996).

A very recent work by Butler, Kleinman, and Gardner (2014) finds that neither the economic hypothesis nor the physiological explanation (the “ergonomic factors” in their own terminology) seems to be very important to understand the Monday effect in WC. A Monday effect that, on the other side, is very significant from a statistical point of view. The apparent puzzle is solved by considering three possible explanations, instead of two. The third one is what they call “work-aversion” and it is explained by the psychological reluctance of people to return to the workplace on Mondays. This third factor is the more important one in their empirical analysis. Whether this “work-aversion” is more than a mixture of both economic and ergonomic factors is out of the scope of this paper.

In this sense, a really appealing article, even more recent than the one by Butler, Kleinman, and Gardner (2014), is Hansen (2015). This work, by means of the diff-in-diff methodology, supports the view that the economic incentives play an important role in explaining the Monday effect in WC. The author carries out a thorough empirical analysis with several robustness checks to end up concluding that the reduction in the economic incentives generated by some legal reforms in California decreased the size of the Monday effect in that State (relative to other States in which such reforms did not take place). The importance of Hansen’s work (2015) is that it gives credit to economic hypothesis again. Although the author does not discard the physiological factors, because that is not the aim of his paper, he presents solid evidence in favour of individuals responding to economic incentives. From our point of view, neither the work of Card and McCall (1996) nor that of Campolieti and Hyatt (2006) presents a conclusive argument to reject the economic explanation. On the other hand, the article by Butler, Kleinman, and Gardner (2014) possesses some methodological differences that impede a strict comparison with our empirical outcomes.

It is also worth mentioning that from a pure empirical point of view, we consider here that a third effect (different from that of Butler, Kleinman, and Gardner 2014) could be operating (what we call statistical effect). This is a consequence of the fact that there are more accidents on Mondays, which implies that when we measure the Monday gap (following Campolieti and Hyatt 2006) the weight of what we could name “normal hard-to-diagnose” accidents would be reduced. This, in turn, would entail that the actual gap would be underestimated. Anyhow, this point will be explained in full detail in Section 4.

We believe that if we are looking for any proof of the strategic and opportunistic behaviour of the worker in the labour market, then the experiment carried out needs to be more theoretically guided. Moreover, this theoretical analysis should be able to admit that part of the gap might be due to medical reasons or to the above-mentioned statistical effect. This is one of the main aims of the present work. Here, we defend the notion that Spain is a good “laboratory” to check

whether the economic explanation is more likely than the physiological one or vice versa, as a result of the specific nature of legislation governing sick leave benefits. We use the fact that replacement rates differ uniquely across sick leave and WC programs in Spain in order to ascertain whether claimants filing difficult-to-diagnose injuries respond differentially to benefit generosity for Monday claims. Due to the dual regulation for work-related and non-work-related sick leave in Spanish law, a clear incentive mechanism is generated and this is what we aim to exploit when designing our experiment.⁴ More importantly, such an incentive mechanism depends on the expected duration of the injury recovery period that allows us to define a quite specific test for identifying the validity of the economic explanation of the Monday effect.

3 Legal Background

The Spanish social security system distinguishes between work-related and non-work-related injuries and illnesses as far as sick leave is concerned. The amount of income received as compensation by a worker differs if the accident (or illness) occurs at the workplace or outside the workplace.⁵ This singular legislative feature is exploited to test the economic explanation for the Monday effect.

In Spain, when a worker has to leave his/her job to recover from injury or illness, whether work-related or non-work-related, the employee is deemed to be in a situation of *temporary incapacity* (TI). When said contingency occurs, workers face two drawbacks. First, their costs increase as a result of health care expenses. Second, their labour income decreases because the labour contract relationship is suspended⁶ while employees are on sick leave (article 45.1.c. of the Workers' Statute), with employers under no obligation to remunerate their injured workers (article 45.2 of Workers' Statute). To mitigate this situation of need, the social security system in Spain covers medical expenses, on the one hand, and pays benefits that partially substitute lost wages, on the other. As is well known, medical expense coverage is practically universal in Spain. This is the case regardless of whether the injury is work related or not. Nonetheless, there are differences in TI payments depending on whether it is an occupational injury or not.

⁴ A general discussion on the effects of regulation on occupational safety in relation to worker behaviour, with some references to moral hazard problems, can be found in the works of Shapiro (2000) and Viscusi (2007).

⁵ In this paper, we focus on temporary incapacity. Injuries leading to permanent incapacity are less likely to be associated with moral hazard problems.

⁶ It should be mentioned, however, that this does not mean that the worker is dismissed.

The fundamental Spanish law in which TI benefits are regulated is the Social Security General Law (SSGL). Article 129 of SSGL establishes:

The economic benefit in the various situations that cause temporary incapacity to work will consist of a subsidy equivalent to a percentage of the contributory base to be determined, and effective in the terms established in this law and in the general regulations governing its application.

From article 129 of SSGL, we can conclude that TI benefits can be assessed as the result of multiplying a coefficient times a contributory base. With regard to the contributory base, we should point out that there are few differences whether the injury or illness is of an occupational nature or not. In sum, the contributory base is a function of the previous wage (with upper and lower limits) earned by the worker before the sick leave takes place.⁷ As regards assessing the contributory base, the only significant difference between occupational and non-occupational contingencies deals with the overtime contribution. Whereas in the case of non-occupational sick leave, overtime is not taken into account to calculate the base, in the case of work-related sick leave, article 109.2.g of SSGL states that the annual average of overtime has to be calculated to assess the contributory base.

On the one hand, if TI is derived from an occupational accident or illness then the worker will receive a subsidy of 75% of the contributory base from the day after the physician issues the sick leave certificate. On the other hand, if TI is the result of a non-work related illness or injury then the benefit scheme has three parts. First, the worker perceives nothing from the first to the third day of the sick leave. Second, from the fourth day to the twentieth, the worker obtains 60% of the contributory base. Finally, from the twenty-first day onwards the employee receives 75% of the contributory base. Table 1 summarizes this information.

Table 1: Temporary incapacity payments by type of injury.

		Work-related (%)	Non-work-related (%)
% of contributory base (days)	From 1st to 3rd	75	0
	From 4th to 20th	75	60
	From 21st onwards	75	75

⁷ A reference where the interested reader can find a quite detailed discussion of the regulation of TI benefits in Spain is Galiana-Moreno and Camara-Botia (2005).

As can be seen, non-work related contingencies are covered less than occupational injuries and illnesses. For this reason, certain authors have pointed out that, on some occasions, workers try to conceal some non-work injuries so as to, later on, then report them as work related.⁸ In that case, the substitution moral hazard of Fortin and Lanoie (2000) would be present.⁹

4 Theory

In this section we construct a theoretical model so as to explain the Monday effect in WC in Spain. It is worth mentioning that out of the works previously discussed in the background section, only the one by Butler, Kleinman, and Gardner (2014) incorporates a theoretical model. These authors state: “(...) this simple illustrative model does not directly show that soft-tissue injuries are more likely to be reported on Monday. The Monday effect hypothesis rises naturally from the model above, coupled with the institutional fact that most workers work Monday through Friday and generally not on the weekend”. Notwithstanding this, we deem that the Spanish institutional setting is appropriate to build a formal model from a microeconomic standpoint.

With the aim of structuring the modelling process, we proceed in five stages. First, we define the main aggregates which constitute the starting point and, at the same time, are a key element to link the theory with the data. Then, we make use of microeconomics so as to model how an individual makes his/her choices, taking into account the central features of the Spanish insurance system, particularly its double regulation for work-related and non-work-related injuries. In the third stage, we present two theoretical effects of opposite sign that emerge from the model of stage 2. In the fourth place, we describe formally the aggregation process. Finally, we close the model and show how the Monday gap can be broken into its three components, according to our assumptions.

⁸ See Cisnal-Gredilla (2002, p. 21).

⁹ In Fortin and Lanoie (2000) up to four types of moral hazard linked to workplace accident insurance are described. The first type is called *ex ante injury hazard*. Since insurance covers financial and medical costs of accidents, workers have less incentive to take care of themselves than in a situation with no insurance. A second type of moral hazard is called *ex ante causality hazard*. This type occurs because sometimes it is hard to recognize which injuries are caused by work. For this reason, employees might file claims for off-the-job accidents. A third type could be named *ex post duration hazard*, which causes an increase in the length of the recovery period as a consequence of opportunistic worker behaviour. A fourth form might be termed *substitution hazard*, which arises because workplace accident insurance might prove more generous than other types of insurance, such as unemployment benefit for instance.

4.1 Stage 1: Definition of Main Aggregates

In order to link this theoretical section with the empirical work carried out later, first we define our variable of interest, which is the ratio of hard-to-diagnose injuries (HD) to total injuries, i.e. HD plus easy-to-diagnose injuries (ED), and we call it AR :

$$AR_j = \frac{HD_j}{HD_j + ED_j}; \forall j = M, R \quad (1)$$

where the subscript j refers to Monday (M) or to the rest of the days (R).¹⁰ At this point it is necessary to clarify that HD injuries have a triple nature and, for this reason, it is important to break them down into their three components. In formal terms: $HD_j = HD_j^1 + HD_j^2 + HD_j^3$.

The first component, HD_j^1 , captures those hard-to-diagnose injuries that a worker would suffer as a consequence of the performance of the normal routine in the workplace. Thus, there is no reason to expect any difference between Mondays and the rest of the days in this component and due to this $HD_M^1 = HD_R^1 = \overline{HD}^1$. The second element, HD_j^2 , encompasses precisely the excess of reporting of HD injuries on Mondays compared to the rest of the days and as a consequence of the inactivity period before starting to work. As it has been stated in the literature, since that period is much longer on Mondays (because of the weekend) than on the rest of the days, the proneness of experiencing an injury of this type is higher on Monday than from Tuesday through Friday. This is why we assume $HD_M^2 > 0$ but $HD_R^2 = 0$. With this formulation we try to incorporate to the model the idea of the “physiological Monday effect”.¹¹

However, the most important factor for the purposes of this article is the third one: HD_j^3 . This term captures the number of HD injuries reported for “economic reasons”. At the beginning of every working day, there are a number of potential cheating situations from an aggregate point of view, as a result of injuries out of the workplace. We denote them by the Greek letter capital eta, H_j . As the amount of outside-of-work time is much higher before the Monday workday than on the Tuesday through Friday workdays, we assume that

¹⁰ As we are working in relative terms, “the rest of the days” might be thought as a typical day in the working week from Tuesday through Friday, e.g. a Wednesday, or an average of the four days. There is no difference for the modelling process.

¹¹ It might be thought that before starting to work, there is always an inactivity period on every day of the week, not only on Mondays. However, those injuries caused by this normal inactivity period would be included in $\overline{HD}^1$, whereas $HD_M^2 > 0$ reflects the excess of reporting on Mondays (due to the weekend).

$H_M = \sigma H_R > H_R$, being $\sigma > 1$ an increasing factor responsible for the “economic Monday effect” following, for instance, the Smith’s (1990) way of reasoning.

Nonetheless, it is worth mentioning that not all of those potential cheating situations will become false on-the-job accidents. Only a proportion of them π will be reported. This proportion π will play a key role in our strategy to disentangle the “economic Monday effect” from the other components of the Monday gap. We consider it to be duration dependant, i.e. $\pi(d)$. Where d stands for the duration of the injury. In the following subsections we devote some additional effort to model such a proportion and to determine its specific functional form. The basic notion we need to have in mind for this introductory theoretical subsection is that we can write $HD_j^3 = \pi(d)H_j$.

As regards the easy-to-diagnose injuries, we treat them the same way as HD_j^1 , i.e. we consider them to be constant and evenly distributed throughout the working week. Putting it in mathematical terms: $ED_M = ED_R = \overline{ED}$.

From the previous discussion it is clear that AR_j is a function of duration because of $\pi(d)$. What is more, for a given duration, we might think that the ratio AR_j would depend on the distribution of the different types of injuries. Nevertheless, we discard this consideration as important for the modelling process under a realistic assumption. As it will be useful for the purposes of this article later, we formalize this idea.

Let $\zeta(d)$ be the likelihood that an injury has a given duration d . Furthermore, and for the sake of simplicity, let us assume that such likelihood is distributed similarly among easy-to-diagnose and hard-to-diagnose injuries, which seems to be a realistic assumption according to Figure 5 in Appendix A. In that case, we can write $AR_j(d)$ as:

$$AR_j(d) = \frac{\zeta(d)\overline{HD}^1 + \zeta(d)HD_j^2 + \zeta(d)H_j\pi(d)}{\zeta(d)HD_j + \zeta(d)\overline{ED}} = \frac{\overline{HD}^1 + HD_j^2 + H_j\pi(d)}{HD_j + \overline{ED}} \quad (2)$$

From eq. [2], it is evident that if we define the Monday gap (M) as the difference between the ratio of HD to total injuries on Mondays and on the rest of days, such a gap is also a function of duration:

$$M(d) = AR_M(d) - AR_R(d) \quad (3)$$

In eq. [2] there are some components that may be obtained easily from the data, e.g. $\overline{ED}$. It is also feasible to measure directly the total amount of HD injuries, both HD_M and HD_R . By means of econometric techniques that will be explained in a later section, we are able to estimate the total Monday gap defined in eq. [3] for every duration as well.

However, the aim of this article is not only to measure $M(d)$ but also to decompose it into its different components. If we knew $\overline{HD}^1$, HD_j^2 , H_j and $\pi(d)$, the task would be trivial. Unfortunately those components are unknown, at least from a strictly empirical point of view. In the rest of this theoretical section what we do is to develop a strategy to achieve the above-mentioned goal. First we “rationalize” $\pi(d)$ in the two following subsections with the help of a rather standard microeconomic model. Then, we break down HD injuries according to their triple nature by means of some theoretical assumptions and observed facts. Finally we decompose the Monday gap into three components, which we call economic Monday effect (M^E), physiological Monday effect (M^P) and statistical Monday effect (M^S).

4.2 Stage 2: Individual Decision Process

After having described the main features of the sick leave insurance system in Spain, it is easy to understand, from a theoretical point of view, why problems of moral hazard (mentioned in the introductory section) may arise. The differences in percentages shown in Table 1 may cause a potential situation of substitution moral hazard (in terms of Fortin and Lanoie’s classification). There is an incentive for the worker to substitute sick leave insurance by workers’ compensation insurance due to the differences in replacement rates. In other words, some individuals might try to conceal out-of-work accidents and report them as work related.

To better understand this idea, let us construct a simple microeconomic model which captures two basic features¹²: first, in the Spanish case WC is more generous than sick leave compensation (SC), but the difference between both coverage rates depends on the length of the recovery spell. For this reason a worker could try to substitute SC by the WC. But by doing this, and in the second place, the worker has to face reputational risk. This would mean that if the worker were caught performing this opportunistic behaviour, he/she would be penalized with a lower labour income in the future.¹³ This penalty will be

¹² A rather general discussion on the theoretical effects of the employment law with special attention to workplace safety can be found in Jolls (2007). A more specific analysis of the effects of social insurance (with an explicit treatment of worker’s compensation) is the work of Krueger and Meyer (2002).

¹³ There are a number of ways through which an employer might do this. The most obvious one is by dismissing the employee. However, without being so extreme, an employer could reduce promotion possibilities of an employee who behaves opportunistically.

imposed by the employer¹⁴ because there is a cost for the firm of reporting high rates of accidents and injuries.¹⁵

To rationalize the empirical findings obtained in this paper, we are going to use a utilitarian economic framework. Let us assume that individuals maximize their expected discounted utility. Their planning horizon consists of two periods.¹⁶ Period 1 comprises the present while period 2 refers to the future. Period 1 begins after the weekend in which an individual has suffered an accident out of the workplace. In that moment, the worker has to take the decision of reporting the accident as non-work related or, alternatively, of concealing the injury when arriving at the workplace on Monday and trying to notify the physical damage as work related. In the first case, the worker obtains SC and in the second he/she receives WC. Period 1 has a definite duration T and it is equal to the maximum work-related sick leave spell allowed by Spanish law. As a worker can be off work on sick leave for a maximum period of 18 months in Spain, period 1 would last a year and a half. On the other hand, period 2 would last since period 1 has finished until the worker reaches the retirement age. This means that period 2 has a variable size, depending on the workers' age.

With these theoretical assumptions, we can formalize the workers' decision as follows: if the worker chooses not to report a false work-related accident he or she will receive SC benefits in period 1 and a labour income in period 2, as it is established in expression [4]:

$$V_A = U(\alpha(d^e)w_1d^e + w_1(T - d^e)) + \delta U(w_2) \quad (4)$$

where $U(\cdot)$ is the utility function (with $U(0) = 0$, $U'(\cdot) > 0$ and $U''(\cdot) = 0$, for the sake of simplicity), δ is the discount factor, T is the number of days of which period 1 is composed, and d^e is the expected number of days in which the worker is off the job. We consider d^e as being an expectation because the decision has to be taken at the beginning of period 1. In any case, we will assume perfect foresight (i.e. $d^e = d$) in the empirical section, so in the rest of the paper we will use d^e and d interchangeably.

¹⁴ With this assumption, and for the sake of simplicity, we are leaving aside the role of the insurer (in Spain the mutual organizations of the Social Security). In any case, the consideration of the mutual organizations would only reinforce the effect described.

¹⁵ Besides reputational considerations, a firm with a high accident rate could be forced to assume higher costs because of the higher contributions to fund WC system and the fines imposed by the Labour and Social Security Inspectorate.

¹⁶ We omit any consideration about leisure and suppose that the unique argument of the utility function is consumption (or income). The inclusion of leisure within the theoretical framework only would complicate the model without shedding any valuable light on the reasoning.

Moreover, w_1 is the daily wage, which coincides with the daily contributory basis to assess the amount of both WC and SC in period 1, and w_2 is the labour income for period 2. So as to better understand the concepts of w_1 and w_2 , their order of magnitude and, in the end, the ultimate meaning of the periods 1 and 2 within our model, we construct Table 2. What Table 2 illustrates is that the amount of income related to period 2 is huge, so every little thing that could affect that period has a potentially very important effect within the model. This will be even clearer later.

Table 2: Examples of w_1 and w_2 .

w_1	w_2			
	Age 25	Age 35	Age 45	Age 55
33.3€	480,000€	360,000€	240,000€	120,000€
37.4€	538,752€	404,064€	269,376€	134,688€
50.0€	720,000€	540,000€	360,000€	180,000€
66.6€	960,000€	720,000€	480,000€	240,000€

Notes: In order to construct columns two through five, we considered 30-day months (or 360-day years) and a retirement age of 65 years. The second line is based on the average level measured in our database ($28.06€/0.75 = 37.41€$).

The parameter α refers to the percentage of the contributory basis received as SC, and evidently it is comprised between 0 and 1. Furthermore, it should be noted that α is a function of d^e . More precisely:

$$\alpha(d^e) = \begin{cases} 0 & \text{if } d^e \leq 3 \\ 0.6 \frac{(d^e - 3)}{d^e} & \text{if } 3 < d^e \leq 20 \\ \frac{(17 \cdot 0.6 + (d^e - 20) \cdot 0.75)}{d^e} & \text{if } d^e > 20 \end{cases}$$

On the other hand, if the worker chooses to report an out-of-the-work accident as work related, he/she will receive WC benefits in period 1 but in period 2 the worker will face a reputational risk. The employer may detect the opportunistic behaviour of the worker and in such a case the employer can take measures that lower the worker's labour income in retaliation. With probability p , the employee escapes from the monitoring of the employer and faces no penalty, and with probability $(1 - p)$ he/she is caught and, as a consequence, earns less in period 2. The discount expected utility for an opportunistic worker is:

$$V_B = U(\beta w_1 d^e + w_1(T - d^e)) + \delta[p(d^e)U(w_2) + (1 - p(d^e))U(\lambda w_2)] \quad (5)$$

In expression [5] β is the replacement rate of WC and λ is a parameter ($0 < \lambda < 1$) which reflects the fact that if the worker is caught shirking he/she will receive less income in period 2 than if he/she behaves non-opportunistically.¹⁷

It has to be noted that p is assumed to be a decreasing function of d^e ($p(d^e)$ with $\partial p / \partial d^e < 0$). The reason for that is not difficult to understand: if the worker suffers a minor injury, it will be easier for him/her to conceal it at the workplace than if he/she suffers a serious one. Minor injuries are related to short out-of-work spells and serious injuries are associated with long absences. Thus, the shorter the expected recovery period is the higher the probability of not being caught. In more formal terms, we make use in our model of the following probability function:

$$p(d^e) = \begin{cases} 1 & \text{if } d^e = 1 \\ 1 - \left(\frac{d^e - 1}{n} \right) & \text{if } 1 < d^e \leq n \\ 0 & \text{if } d^e > n \end{cases} \quad (6)$$

The function in expression [6] has three important properties that must be discussed in some detail. The first one is that $\lim_{d^e \rightarrow 1} p(d^e) = 1$. This assumption is crucial to obtain some theoretical results in our model, but, at the same time, we strongly believe that it reflects the Spanish labour market in a realistic way.¹⁸ In the second place, we assume a linear probability function (i.e. $\partial^2 p / \partial (d^e)^2 = 0$) for the sake of simplicity. Finally, and due to the linear form of $p(d^e)$, there will be an expected duration, which we call n , that makes zero the likelihood of concealing the injury. In other words, for $d^e \geq n$, it is impossible to perform an

¹⁷ As it has been mentioned before, period 2 comprises all the future. The worker could experience a spell of unemployment and later on could find a new job. When unemployed, the worker could be entitled for unemployment benefits (UB) or not. In any case, as UB does not cover the whole labour income the worker receives less income than if he or she is not caught carrying out an opportunistic behaviour. Alternatively the employer could not promote workers who behave opportunistically instead of dismissing them. That is the reason for supposing that the parameter λ runs between 0 and 1.

¹⁸ As a matter of fact, we held an informal talk with a representative of one of the mutual organizations of the Social Security (the insurers in Spain), and he told us that a minor hard-to-diagnose injury with an expected duration of only one day is practically undetectable at the workplace. For instance, an ankle sprain with a recovery period of only one day would not provoke even a slight limp. If it were the case, it would be easy for the worker to conceal the ankle swelling and then to pretend to have suffered the injury at the workplace. He also informed us that in the case of low-back injuries the situation would be similar.

opportunistic behaviour without being detected. Again, we deem that this is a rather realistic assumption.¹⁹

From the rationale described above we can conclude that if V_A is larger than V_B then the worker will choose to behave correctly and otherwise to behave opportunistically. To put it another way, if we define the indicator $Z(d^e) = V_A - V_B$, then the individual will perform an opportunistic behaviour when $Z < 0$ and will behave as a non-shirking worker when $Z > 0$. Consequently, $Z(d^e)$ may be written as follows:

$$\begin{aligned} Z(d^e) = & U(\alpha(d^e)w_1d^e + w_1(T - d^e)) - U(\beta w_1d^e + w_1(T - d^e)) \\ & + \delta[(1 - p(d^e))(U(w_2) - U(\lambda w_2))] \end{aligned} \quad (7)$$

4.3 Stage 3: Two Theoretical Effects at the Individual Level

The form and position of the Z function depend on the individual's preferences and on the above-mentioned parameters. To begin with, due to the supposition that $\lim_{d^e \rightarrow 1} p(d^e) = 1$, we obtain that Z is negative for the lower values of d^{e20} . For the purposes of this paper, we are also interested in analysing how Z varies when d^e varies. It is worth noting that Z is a piecewise function of d^e . The first section would be defined for those durations between 1 and 3 days, the second one for durations between 4 and 20 and the last one for sick leaves over 20 days. When the section changes the slope of Z will change.

It is important to bear in mind that we are interested in isolating two theoretical effects: one related to period 1 and another related to period 2. So as to identify both of them clearly, let's split Z into its two components Z_1 and Z_2 .

$$Z_1(d^e) = U(\alpha(d^e)w_1d^e + w_1(T - d^e)) - U(\beta w_1d^e + w_1(T - d^e)) \quad (8.1)$$

Making use of the linearity of the utility function, we have:

$$Z_1(d^e) = U_C w_1 d^e (\alpha(d^e) - \beta) \quad (8.2)$$

where U_C (the marginal utility) is a constant as a consequence of the assumption that $U''(\cdot) = 0$.

¹⁹ If we now suppose an ankle sprain with an expected duration of 60 days, for instance, it is easy to imagine that the worker would not even be able to walk, so the likelihood that a weekend injury migrates to a work-related Monday injury (in the Butler, Kleinman, and Gardner (2014) terminology) without being discovered could be assumed to be zero.

On the other hand, for period 2 we have:

$$Z_2(d^e) = \delta[(1 - p(d^e))(U(w_2) - U(\lambda w_2))] = \delta[(1 - p(d^e))(U_C w_2(1 - \lambda))] \quad (9)$$

From expression [8.2], it is easy to calculate the slope of $Z_1(d^e)$ in the space Z_1, d^e :

$$\frac{\partial Z_1}{\partial d^e} = \begin{cases} U_C w_1(-0.75) < 0 & \text{if } d^e \leq 3 \\ U_C w_1(-0.15) < 0 & \text{if } 3 < d^e \leq 20 \\ 0 & \text{if } d^e > 20 \end{cases} \quad (10)$$

Regarding the slope of Z_2 , it can be expressed in formal terms by means of the following expression:

$$\frac{\partial Z_2}{\partial d^e} = \begin{cases} \frac{\delta}{n}(U_C w_2(1 - \lambda)) > 0 & \text{if } d^e \leq n \\ 0 & \text{if } d^e > n \end{cases} \quad (11)$$

As it is clear from such a Figure 1, the theoretical effect related to period 1 (and captured by Z_1) would make the individual behave opportunistically as a consequence of the greater generosity of WC payments as compared to SC benefits. The theoretical effect associated with period 2 is a reputational effect that makes the individual behaves non-opportunistically. Putting together Z_1 and Z_2 we

Figure 1: Z , Z_1 and Z_2 as functions of the expected duration of the sick leave.

obtain Z , which is negative for low values of d^e . Nonetheless, if the reputational effect of period 2 is strong enough, Z will eventually become positive. This is what we represent in Figure 1 from d_R^e onwards, where d_R^e stands for “reservation duration” and it is a threshold from which the individual stops behaving opportunistically and begins to behave non-opportunistically. This is due to that Z_1 is flat from day 20 onwards and we assume that the reputational effect would finally offset the economic incentives to behave opportunistically.

Table 3: Potential costs and benefits of cheating.

w_1	Benefits	Costs			
		Age 25	Age 35	Age 45	Age 55
33.333€	160€	120,000€	90,000€	60,000€	30,000€
37.413€	180€	134,688€	101,016€	67,344€	33,672€
50.000€	240€	180,000€	135,000€	90,000€	45,000€
66.667€	320€	240,000€	180,000€	120,000€	60,000€

Notes: The first column shows four alternative contributory bases. The second column reflects the maximum amount of money that an individual can obtain if he/she is not detected when cheating. Columns three to six show the lost earnings if the worker is caught cheating and is penalized with a 25% of his/her life-cycle labour income (i.e. $\lambda = 0.75$) for four alternative ages.

Why do we suppose that the reputational effect is strong enough to eventually offset period 1 effect? Based on Table 2 figures, we construct Table 3, in which we compare the potential monetary costs and benefits of cheating. Those figures (and their order of magnitude) make us think that assuming that eventually Z becomes positive is not unrealistic. The monetary amounts for period 2 are so huge that it is difficult to imagine a reasonable parameterization that makes Z not to be positive sooner or later.²⁰ In addition, this implies that there exists a d_R^e for every individual and the key point is to analyse how they are distributed from a statistical point of view.

4.4 Stage 4: The Aggregation Process

It is worth mentioning that the graphical representation showed in Figure 1 is only a particular case. It would be easy to prove that, depending on worker’s

²⁰ From Table 3, we can also infer that the older the worker is, the less likely he/she behaves non-opportunistically. This prediction will be used as robustness check to empirically verify the model in a later section (see Table 7).

preferences and characteristics, the critical value d_R^e could be below 20 days. What is more, for those extremely job-committed workers the value of d_R^e could perfectly be lower than 3 days. To be more accurate, the reservation duration would be a function of individual's preferences and characteristics for each worker. In more formal terms²¹:

$$d_R^e = \psi(w_1, w_2, \delta, \lambda, n) \quad (12)$$

Expression [12] reveals that, in order to reach valuable conclusions at the aggregate level, it is necessary to make some assumptions regarding the distribution of d_R^{e23} . Consistent with our microeconomic model, as d increases, the number of individuals carrying out an opportunistic behaviour reduces. This means that if the proportion of “well-behaved” workers follows a cumulative distribution function (CDF) $\Phi(d_R^e)$, the proportion of “bad-behaved” workers is distributed according to $1 - \Phi(d_R^e)$. At this point, it should be already clear that $\pi(d) = 1 - \Phi(d_R^e)$. In principle, and from a theoretical standpoint, it is not critical to impose a specific CDF for $\Phi(d_R^e)$, and consequently for $\pi(d)$, as long as the right tail of the distribution is decreasing and asymptotic to zero.

4.5 Stage 5: The Monday Gap

Once we have described the individual's behaviour and the aggregation process, let us come back to expression [2]. If we now use small letters to denote a specific realization for a determined duration (e.g. $\overline{hd}^1(d) = \zeta(d)\overline{HD}^1$ or $\eta_j(d) = \zeta(d)H_j$), we may rewrite the expression [2] in the following way:

$$AR_j(d) = \frac{hd_j(d)}{hd_j(d) + \overline{ed}(d)} = \frac{\overline{hd}^1(d) + hd_j^2(d) + \eta_j(d) \cdot \pi(d)}{\overline{hd}^1(d) + hd_j^2(d) + \eta_j(d) \cdot \pi(d) + \overline{ed}(d)} \quad (13)$$

With this compact notation we may define the statistical Monday effect $M^S(d)$ as:

$$M^S(d) = \frac{\overline{hd}^1(d)}{\overline{hd}^1(d) + hd_M^2(d) + \sigma \cdot \eta_R(d) \cdot \pi(d) + \overline{ed}(d)} - \frac{\overline{hd}^1(d)}{\overline{hd}^1(d) + \eta_R(d) \cdot \pi(d) + \overline{ed}(d)} \quad (14)$$

²¹ It could be also noted that w_2 is a function of w_1 and the worker's age.

As it is evident from expression [14], the statistical Monday effect is a consequence of the fact that in the denominator of the Monday ratios there are more injuries. Although it has no clear meaningful economic interpretation, if we did not consider this effect, we would be underestimating the other two effects. This is so because the excess of reporting is calculated as a ratio and on Mondays there are more injuries, independently of the underlying cause. In the top left-hand panel of Figure 2, we depict M^S as a function of d . If letter s represents short durations (i.e. $\pi(s) \approx 1$) $M^S(s)$ is negative for two reasons: (1) because $hd_M^2(s) > 0$ and (2) $\sigma > 1$. As d increases $\pi(d)$ becomes smaller and $M^S(d)$ increases. However, even for very long durations expression [14] is still negative. Putting it another way, if letter l represents long durations (i.e. $\pi(l) \approx 0$), $M^S(l)$ is negative because of the term $hd_M^2(l) > 0$ in the denominator of the minuend in the right-hand side of the expression [14]. Furthermore, expression [14] has an asymptote due to the fact that is the difference between two asymptotic terms, as a consequence of $\pi(d) = 1 - \Phi(d_R^e)$.

On the other hand, the formal expression that allows us to measure physiological Monday effect, that is eq. [15], is simpler because of our assumption of $hd_R^2(d) = 0$:

$$M^P(d) = \frac{hd_M^2(d)}{\overline{hd}^1(d) + hd_M^2(d) + \sigma \cdot \eta_R(d) \cdot \pi(d) + \overline{ed}(d)} \quad (15)$$

The graphical representation of $M^P(d)$ is shown in the top right-hand panel of Figure 2. From eq. [15], it is clear that it is an increasing function of d with an asymptote at $\left[hd_M^2(l) / (\overline{hd}^1(l) + hd_M^2(l) + \overline{ed}(l))\right] > 0$ for long durations.

Finally, following the same line of reasoning and consistent with our modelling layout, the corresponding expression for the economic Monday effect might be summarized through eq. [16]:

$$M^E(d) = \frac{\sigma \cdot \eta_R(d) \cdot \pi(d)}{\overline{hd}^1(d) + hd_M^2(d) + \sigma \cdot \eta_R(d) \cdot \pi(d) + \overline{ed}(d)} - \frac{\eta_R(d) \cdot \pi(d)}{\overline{hd}^1(d) + \eta_R(d) \cdot \pi(d) + \overline{ed}(d)} \quad (16)$$

The behaviour of $M^E(d)$, which is represented in the bottom left-hand corner of Figure 2, is more complex. First of all, it would be positive if and only if the excess of reporting for strictly economic reasons is strong enough to compensate the higher number of Monday injuries due to strictly physiological motives. In other words, expression [16] would be positive whether $\sigma > 1$ is big enough to offset

Figure 2: Monday effect as a function of the expected duration of the sick leave.

$hd_M^2(d) > 0$ in the denominator of the first right-hand side term in eq. [16] above.²² Anyhow, this is not the main concern because it is relatively easy to check out this point by inspecting our database, and as it will be shown later, this is the case. The main difficulty would emerge because $\pi(d)$ appears both in the numerator and in the denominator of both the minuend and the subtrahend of the right-hand side of expression [16]. However, it is relatively easy to verify that eq. [16] has an asymptote at zero since both terms of the right-hand side tend to zero as duration increases. This is so because the numerators in both the first and the second terms of the right hand-side of eq. [16] tend to zero as duration expands, whereas the denominators tend to a positive value.

As a result of the previous discussion, and with eqs [14]–[16] in mind, it is now convenient to rewrite expression [3] in terms of $M^S(d)$, $M^P(d)$ and $M^E(d)$:

$$M(d) = AR_M(d) - AR_R(d) = M^S(d) + M^P(d) + M^E(d) \quad (17)$$

From eq. [17] it follows that the total Monday gap is the aggregation of its three components. That is what we represent in the bottom right-hand panel of Figure 2. It is worth noting that it does not have to be a decreasing and convex function of

²² It can be proved that the exact condition for $M^E(d) > 0$ is: $\sigma > \frac{hd_M^2(d)}{hd(d) + ed(d)} + 1$.

duration unambiguously, as it is shown in Figure 2. It could be an increasing and concave function or even show and mixed concave–convex profile. It all depends on the magnitude of $M^S(d)$, $M^P(d)$ and $M^E(d)$. However, $M(d)$ has unambiguously an asymptote, which is the result of adding those of the statistical Monday effect and the physiological Monday effect. The reason for having depicted $M(d)$ as a decreasing and convex function of duration is because this profile fits what we find in our data, as it will be shown later.

Interestingly, our model is able to provide values analytically for the statistical Monday effect and the physiological Monday effect for long durations (i.e. for $M^S(l)$ and $M^P(l)$). They can be obtained by making use of the assumptions of the model and taking into account that we can easily measure (in our database) $\overline{ed}(d)$ at any duration and the aggregate $M^S(l) + M^P(l)$ for long durations,²³ due to the fact that $M^E(l) = 0$. Taking advantage of this information, then we can decompose, also analytically, the total Monday gap into its three components $M^S(s)$, $M^P(s)$ and $M^E(s)$ for short durations by just doing an additional assumption about the size of the parameter σ . On the other hand, we can also assess the total Monday gap for every duration by means of econometric techniques that will be explained in a following section. Finally, putting all this together, and by means of a calibration procedure, with an appropriate CDF for $\pi(d)$, it is possible to break down the total Monday gap into its three components for every duration in line with expression [17], which in the end is the final objective of this research.

5 Database

The data used in the empirical analysis come from the administrative data of the Statistic of Accidents at Work (SAW) for the year 2002. In 2003 there was a methodological change in these statistics such that we opt to employ 2002 data because of the better codification (for our purposes) of the type of injury in the old methodology. In other words, in our view it is easier to identify so-called hard-to-diagnose injuries, which are similar to those considered in the works of Card and McCall (1996) or Campolieti and Hyatt (2006), in pre-2003 data codification.

²³ It should be noted that it is required to define what we consider as “long durations” and “short durations”. It can be deemed as an additional assumption, but, as we will clarify later, we make this conjecture based on well-founded empirical grounds.

Data have been checked in order to avoid errors in the recording process. In this regard, we have removed those observations that exceed the limits of the contributory base. We have also deleted from our database individuals for whom we have no information concerning the date on which they returned to work. Given the objective of the present work, it is very important to control likely calendar effects accurately. In this regard, and following previous literature on this topic, we first eliminated those accidents occurring at the weekend.²⁴ Secondly, to avoid distortions caused by bank holidays and other public holidays on the observed phenomenon,²⁵ we decided to delete from our database those weeks in which there was a national or regional public holiday. In this way, we only have regular five-day workweeks in our database. In our view, this kind of week is more appropriate for analysing the Monday effect accurately because of the absence of any public holidays which might distort the observed behaviour of the worker in a number of ways. We also corrected other evident errors in the record. After data cleansing, the analysis is carried out with 458,256 observations corresponding to workers suffering injury due to a work-related accident which causes at least one day of sick leave.

Table 4 shows that a quarter of all accidents that occur during a regular five-day workweek (from Monday to Friday) take place on Monday. Evidently, this figure exceeds the 20% associated with an even distribution of accidents along the week and could be understood as a sign of the existence of the Monday effect. However, it is somewhat risky to conclude this too quickly as this result may be due to a higher level of economic activity on Mondays. We also observe in Table 4 that the duration of sick leave is one day shorter when the accident occurs on Monday than if it happens on any other day, which could indicate that accidents on Mondays are different. With regard to the type of injury, it can be seen that on the first day of the week there is a greater concentration of easy-to-conceal or hard-to-diagnose injuries such as sprains, strains and lower back pains. Table 4 only includes seven types of injury; specifically the most common (the database contains a total of 20). For this reason, the percentages do not add up to 100.

²⁴ The reason for doing this is explained in Campolieti and Hyatt (2006), for instance.

²⁵ It must be taken into account that a public holiday may fall on any day of the week. This might impact the behaviour of opportunistic workers in a complex way and could partially mask the Monday effect.

Table 4: Mean characteristics by day of injury.

Day of the week	%		95% Conf. Interval	
Monday	25.1		(24.9–25.2%)	
Tuesday	20.5		(20.4–20.6%)	
Wednesday	19.5		(19.4–19.6%)	
Thursday	17.9		(17.7–18.0%)	
Friday	17.1		(17.0–17.2%)	
Type of injury	Monday		Non-Monday	
	%	95% CI	%	95% CI
Lower back injuries	14.2	(14.0–14.4%)	11.2	(11.1–11.3%)
Sprains and strains	35.3	(35.0–35.6%)	34.0	(33.9–34.2%)
Fractures	5.5	(5.4–5.6%)	6.0	(5.9–6.1%)
Burns	1.3	(1.2–1.3%)	1.6	(1.5–1.6%)
Contusions	15.5	(15.3–15.7%)	16.1	(16.0–16.2%)
Cuts and lacerations	14.4	(14.2–14.6%)	16.0	(15.9–16.1%)
Traumatisms	4.3	(4.12–4.4%)	4.5	(4.5–4.6%)
Other injury characteristics		95% CI	95% CI	
Days out of work	16.89	(16.75–17.03)	17.85	(17.76–17.93)
Daily benefits	28.04	(27.98–28.11)	28.07	(28.03–28.11)
Demographic characteristics		95% CI	95% CI	
Age	34.60	(34.53–34.66)	34.63	(34.59–34.66)
Male	82.7	(82.5–82.9%)	81.0	(80.9–81.1%)
Seniority (months)	42.81	(42.36–43.25)	42.29	(42.03–42.54)
Observations	114,853		343,403	

Source: Authors’ own from SAW.

6 Methodology

The empirical strategy employed in this paper seeks to answer two questions: Is there a Monday effect? And if so, what is the nature of this effect? In order to do this, we begin by estimating a probit model with the following specification:

$$L_j^i = f\left(\rho^i \cdot \text{Monday}_j + \gamma^i \cdot X_j + \mu_j^i\right) \tag{18}$$

In expression [18], L_j^i is a dichotomous variable which takes the value 1 if the worker j has suffered a type- i injury and 0 otherwise. γ^i is a vector of coefficients

associated with type- i injuries, X_j is a vector of covariates which are included to control for certain characteristics²⁶ that may affect accident occurrence and μ_j^i is a random disturbance related to the type- i injury. Finally, ρ^i is the coefficient of the Monday variable. Its sign and size indicate the existence and magnitude of the Monday gap in different types of injuries. This sort of analysis closely follows previous literature on this topic.

One aspect that should be clarified is that the paper estimates the probability of each type of injury conditional to having suffered an accident. This is because the database used is composed of microdata referring to injured workers and we do not have any information on non-injured workers. Thus, we follow the same empirical strategy as Campolieti and Hyatt (2006) and a relative frequency index is obtained.

The second part of the methodological analysis is far more original and, to the best of our knowledge, has never been used to analyse the Monday effect. It is based on a generalization of the Oaxaca–Blinder decomposition for non-linear models. The literature has developed several decompositions of this type. Even and Macpherson (1990) and Fairlie (1999) perform decompositions to probit models. Nielsen (1998) makes an approach for logit models. Fairlie (2005) develops another application where both logit and probit models are used, and Ham, Svejnar, and Terrel (1998) decompose expected durations. Finally, Yun (2004) proposes a generalization of the Oaxaca–Blinder decomposition for any type of functional relation.

According to Yun (2004), if a variable Y depends on a linear combination of independent variables through a non-linear function φ , the difference in Y at the first moment between different groups 1 and 2 can be decomposed according to the following expression:

$$\overline{Y_1} - \overline{Y_2} = \left[\overline{\varphi(y_1 \cdot X_1)} - \overline{\varphi(y_1 \cdot X_2)} \right] + \left[\overline{\varphi(y_1 \cdot X_2)} - \overline{\varphi(y_2 \cdot X_2)} \right] \quad (19)$$

The first addend of the right-hand side indicates that part of the whole difference is explained by the fact that groups 1 and 2 have different characteristics. The second addend shows how the same characteristics affect differently depending on which group is considered. In the vast economic literature on wage discrimination, the unjustified (by characteristics) part of the difference in the

²⁶ We consider up to five alternative models depending on the controls used. Specifically, we have included personal characteristics such as age, seniority or gender, accident characteristics such as the time or the shift as well as other aspects such as the actual activity, the occupation, or the autonomous community.

Oaxaca–Blinder decomposition has usually been interpreted as a measure of wage discrimination. In our case, the second addend of eq. [19] is interpreted as being an indicator of the relative intensity of moral hazard problems between the two groups. In this regard, we follow previous works on this topic such as Corrales, Martín-Román, and Moral (2008) and Martín-Román and Moral (2008).

Assuming this, and following the guidelines obtained from the theoretical model, we study such an unjustified component. We thus split the group of lesions into two. The first group corresponds to the accidents that occurred on Monday (subscript M) and the second to those occurring from Tuesday to Friday (subscript R). To delve more deeply into this analysis, we build the counterfactual distribution for the hard-to-diagnose injuries using the characteristics of those accidents occurring from Tuesday to Friday and the estimated coefficients for Monday accidents.

From that counterfactual distribution, the unjustified component of the non-linear decomposition associated with different sick leave durations is built. The method of calculation is as follows. For each value taken by the sick leave duration (d), the difference between the average values of two predictions is constructed. One is the percentage of hard-to-diagnose injuries that would be expected if we applied the Monday coefficients to accidents occurring from Tuesday to Friday. The other is obtained directly from the estimation made with the accidents occurring from Tuesday to Friday. Such a component is expressed as follows:

$$M_d = \overline{(f(y_M \cdot X_R))}_d - \overline{(f(y_R \cdot X_R))}_d \quad (20)$$

where M is the unjustified component and d is the actual number of sick leave days. By studying that component, we can break the Monday gap down into its three components. More precisely, we can evaluate whether the economic explanation of the Monday effect is likely or not, and, if so, its relative size within the total Monday gap.

As it was explained in the theoretical section, according to our model, the Monday gap is a function of the sick leave duration, $M = M(d)$. The specific form of $M(d)$ depends on those factors previously discussed in Section 4 (and Appendix B). Nonetheless, we know with total certainty that $\lim_{d \rightarrow \infty} M = M^S + M^P$.

In other words, for long durations the Monday gap equals the sum of the asymptotic values of the statistical Monday gap and the physiological Monday gap.

Anyhow, after a first inspection of our data, we detected a clear decreasing and convex profile for $M(d)$. This profile is compatible with our theoretical model

of Section 4. In order to connect this empirical part with the previous theoretical discussion, we decided to adjust econometrically an equation such as²⁷:

$$M_d = \kappa_0 + \kappa_1 \frac{1}{d^\theta} + \varepsilon \quad (21)$$

where d is the above-mentioned number of sick leave days. On the other hand, κ_0 and κ_1 are two parameters to be estimated and θ is a parameter of shape to be calibrated, $\theta \in (0, 1)$, so as to obtain the best econometric adjustment. Finally, ε stands for an error term. It is obvious that eq. [21] represents a hyperbolic relation between M and d , and that when d increases and tends to infinite, M tends to κ_0 , which constitutes a lower asymptote. As a matter of fact, according to our theoretical explanation of Section 4, κ_0 could be considered a measurement of the size of the aggregation of the statistical Monday gap and the physiological Monday gap for long durations. To put it in more formal terms, $\kappa_0 = \lim_{d \rightarrow \infty} M(d) = M^S(d) + M^P(d)$.

7 Results

7.1 Monday Gap Estimation

Table 5 shows the results of the probit estimation of eq. [18]. In such a table, the coefficients and the Z -statistics associated with the Monday covariate are included. The Z -statistics were calculated from the standard errors of the Observed Information Matrix (robust and cluster methods have been used to obtain the standard errors, with the results proving quite similar). Those coefficients are obtained for six separate regressions²⁸ and for five econometric specifications. Model I only includes the Monday dummy as a covariate, taking value 1 if the accident occurs on Monday and 0 otherwise. Model II adds age, job tenure, sex, region and the time of the accident as control variables. Model III also includes which sector of industry the firm is involved in. Model IV takes into account covariates that describe the worker occupation. Model V includes sick leave duration as a proxy of expected duration. Finally, model VI uses model specification V, but takes into account potential endogeneity problems

²⁷ As it will be shown in the next section, we are able to calibrate a theoretical Monday gap that totally resembles to this empirical Monday gap by just assuming a Weibull CDF for $\pi(d)$.

²⁸ All of them are probit estimations where the dependent variable takes the value 1 for each type of injury and zero otherwise.

Table 5: Probit estimation of the “Monday effect” from different models and injuries (Marginal effects).

	I	II	III	IV	V	VI
Dependent variable (Nature of injury)						
Lower back injuries	0.030 (26.85)	0.028 (25.03)	0.027 (24.87)	0.027 (24.85)	0.026 (23.93)	0.025 (22.70)
Sprains and strains	0.013 (7.87)	0.015 (8.87)	0.015 (9.30)	0.015 (9.36)	0.015 (9.52)	0.011 (6.57)
Fractures	−0.005 (−6.04)	−0.005 (−5.92)	−0.005 (−5.95)	−0.005 (−5.92)	−0.002 (−2.81)	−0.003 (−3.44)
Burns	−0.003 (−7.22)	−0.003 (−6.79)	−0.003 (−6.55)	−0.002 (−6.40)	−0.003 (−6.64)	−0.002 (−6.04)
Contusions	−0.006 (−5.01)	−0.006 (−4.75)	−0.006 (−4.87)	−0.006 (−4.95)	−0.007 (−5.50)	−0.007 (−5.87)
Wounds	−0.016 (−13.04)	−0.016 (−13.08)	−0.016 (−12.91)	−0.016 (−12.82)	−0.016 (−13.54)	−0.016 (−13.25)
Superficial traumatism	−0.002 (−3.49)	−0.002 (−3.50)	−0.002 (−3.63)	−0.002 (−3.65)	−0.003 (−3.92)	−0.003 (−4.31)
Observable characteristics		*	*	*	*	*
Industry			*	*	*	*
Occupation				*	*	*
Duration					*	*
Observations	458,256	458,256	458,256	458,256	458,256	458,256

Notes: The table reports coefficient estimates for the Monday reporting changes in probability. The dependent variable takes the value 1 for each type of injury and zero otherwise. Z-statistics in parenthesis. The coefficients do not add up to zero since only a sample of the more common injuries is included.

caused by including sick leave duration as an explanatory variable. According to the Wald and Hausman tests, there is an endogeneity problem in the model when the duration variable is included. To correct this problem, a two-step estimation is carried out where duration is instrumented by dummy variables related to the severity of the injury (two dummy variables that indicate whether the accident was serious or very serious, and another variable that takes 1 if primary care is provided by a hospital).²⁹ Finally, the Amemiya–Lee–Newey test shows the absence of over-identification in the instrumented model.³⁰

²⁹ As a robust measure, we repeated the estimation using 10 variables as instruments to show how the accident took place, with the results proving similar (see Table 8).

³⁰ Test results are not included in the paper, but are available from the authors upon request.

With regard to the endogeneity of the duration variable, an additional consideration needs to be taken into account. Although hard-to-diagnose injuries might always appear to be only slight and of a short duration, this is not the case for Spain. The mean duration of injuries of this nature is close to that of all sick leave periods (and indeed above it in the case of accidents entailing less than 60 days off).³¹ Moreover, if we analyse the distribution of accidents in terms of their duration, these injuries can be seen to under-represented in the shortest durations.³²

From the high significance of the coefficients related to the Monday covariate appearing in Table 5, we can conclude that there is an important Monday effect. However, it is necessary to clarify that a positive sign on such a variable can only be found for lower back injuries as well as strains and sprains. In other words, these two types of injuries are overrepresented on the first day of the week. Researchers agree that it is in this kind of injuries where the problems of moral hazard are more acute. A good example of this research is the work of Campolieti (2006) which finds *ex ante* causality moral hazard in reports of back pain.

More specifically, the likelihood of suffering a lower back injury on Monday is 3 percentage points higher than during the rest of the week. For the case of strains and sprains, the gap is about 1.5 percentage points higher. Another aspect that might be stressed is that there are no sizeable differences in the estimated coefficients for different specifications. The only significant effects are those of the covariates included to control for observable worker characteristics on lower back injuries and strains and sprains, on the one hand, and the effect of sick leave duration on fractures, on the other hand.³³

As previously discussed, model VI seeks to correct the endogeneity problem of model V. Results failed to reveal any major differences. Only a slight reduction in the Monday variable coefficient was observed when analysing sprains and strains.

7.2 Sensitivity and Robustness Analysis

The above results show differences in the composition of the injuries reported on Monday. However, prior to decomposing the Monday gap, it seems appropriate

³¹ See Table 10 in Appendix 1.

³² See Figure 5 in Appendix 1.

³³ These findings are consistent with previous research on the Monday effect in the United States and Canada (Campolieti and Hyatt 2006).

to perform a sensitivity analysis to check the stability of the results and the conclusions. To this end, different strategies may be adopted. First, we estimate an additional model which complements those already shown in Table 5. In this case, the duration variable in model V is replaced by a group of dummy variables that indicate changes in the replacement rates associated with non-work-related injuries (from 1 to 3 days, from 4 to 20 days, and 21 or more). In light of the results presented in Table 6, it is found that the failure to include a set of dummy variables related to changes in replacement rates does not alter the results. Coefficients maintain the magnitude, sign and the signification already observed in Table 5 (Model V).

Table 6: Model V estimation with dummy variables of duration.

Dependent variable: type of injury	Monday effect	Z-statistics
Lower back injuries	0.026	24.03
Sprains and strains	0.016	9.65
Fractures	−0.001	−2.43
Burns	−0.003	−6.61
Contusions	−0.007	−5.35
Wounds	−0.016	−13.39
Superficial traumatism	−0.003	−3.88

Notes: The table reports changes in probability for the first day of the week. Z-statistics are obtained using the Observed Information Matrix.

Second, using an indicator of whether the worker reports a hard-to-diagnose injury as a dependent variable, model V in Table 5 is re-estimated for different worker characteristics. We can thus measure the sensitivity of the Monday effect to changes in occupation, age, or type of contract. Table 7 presents estimates

Table 7: Sensitivity analyses of the “Monday effect” by worker characteristics.

		Monday effect	Z-statistics
Occupation	White collar	0.045	17.66
	Blue collar	0.031	13.15
Age	55 or less	0.036	20.58
	Over 55	0.052	7.56
Contract	Open-ended	0.049	19.91
	Temporary	0.028	12.75

Notes: Dependent variable: hard-to-diagnose injuries. The table reports changes in probability for the first day of the week. Z-statistics are obtained using the Observed Information Matrix.

where the Monday variable includes multiplying dummies that reflect different worker characteristics. Results show a greater effect among workers in occupations requiring greater skill. This is because they are more difficult to replace and therefore less exposed to a reputation effect. Another important conclusion is that the Monday effect is greater in older workers. This suggests a lower reputation effect (in terms of lost income) when retirement is closer. Finally, the higher coefficient observed for workers with open-ended contracts indicates greater protection against employer retaliation resulting from the cost of dismissal.

Table 8: Robustness analysis and placebo test.

Robustness analysis to test endogeneity		
Instruments	Monday effect	Z-statistics
Severity	0.037	21.61
How the accident occurred	0.041	23.70
Placebo test		
	Tuesday effect	Z-statistics
Estimation from Tuesday to Friday	0.002	1.21

Notes: The table reports changes in probability for the first day of the week. Dependent variable: hard-to-diagnose injuries. Z-statistics are obtained using the Observed Information Matrix.

Table 8 summarizes the last two steps of the analysis. First, we estimate model VI using two different groups of instruments to correct for endogeneity of the duration variable, how the accident came about and the severity. The second is a placebo test where Monday accidents are removed and Tuesday becomes the first day of the week.

The first part examines whether model VI is robust to changes in the instruments used to correct endogeneity. Results are seen to be very similar regardless of whether the instrument used is severity or how the accident occurred. We can therefore say that the instrument used is correct. The placebo test checks the uniqueness of the first day of the week. In this case, it is estimated whether Tuesday has a significant effect on the likelihood of a reported injury being categorized as hard-to-diagnose. Results show that, in this case, the coefficient associated with the first day of the week is not significant and thus has no differential effect on the dependent variable.

7.3 Monday Gap Decomposition

Having seen that there are significant differences in the types of injuries reported on Mondays, we move on to the next stage of the analysis. Here we group all the hard-to-diagnose injuries (that is, strains, sprains and lower back pains) into one category and the remaining injuries into another. We then carry out two different econometric regressions, one for accidents occurring on Mondays and another for accidents occurring from Tuesday to Friday. In both cases the chosen specifications correspond to model VI, which takes into account the possible endogeneity problem, and is therefore performed using variables related to accident severity. The above-mentioned econometric regressions are also the basis for elaborating the counterfactual distribution used in the last part of our empirical analysis.

Table 9: Probit estimation for hard-to-diagnose injuries by day of the week (Marginal effects).

	Monday		Non-Monday	
	Coefficient	Z-statistics	Coefficient	Z-statistics
Duration	−0.0075	−20.05	−0.0068	−35.33
Age	0.0116	13.60	0.0124	25.18
Squared age	−0.0001	−12.31	−0.0001	−22.92
Seniority	0.0005	8.91	0.0004	12.53
Squared seniority	−1.10E-6	−6.32	−8.74E-07	−8.73
Daily benefits	0.0015	9.42	0.0013	14.25
Male	−0.0979	−21.62	−0.1157	−45.84
Shift (ref: morning)				
Evening	−0.0259	−6.54	−0.0099	−4.50
Night	0.0063	1.10	−0.0006	0.19
Time worked (ref: first 2 hours)				
Between 2 and 6 hours	−0.0338	−9.91	−0.0193	−9.62
After the first 6 hours	−0.0555	−12.62	−0.0291	−11.73
Observations	114,853		343,403	

Notes: Standard errors used in Z-statistics are calculated with the Observed Information Matrix. The econometric specification includes controls of region, industry and occupation.

Table 9 reports the results of the estimates of the likelihood that a reported injury was categorized as “hard-to-diagnose” depending on the day the accident was reported (Monday or the rest of the week). The main conclusions to emerge from Table 9 are that the probability of reporting a hard-to-diagnose injury increases with age, with job tenure, with the amount of benefits, during the

first working hours and in the morning shifts. Nonetheless, the probability is lower for males and for the longest sick leaves. We can also detect in Table 9 some differences in the magnitudes of the coefficients for Monday accidents and for Tuesday to Friday accidents which are responsible for the observed gap. Thus, an increase in sick leave duration reduces further the probability of reporting a soft-tissue injury if the accident occurs on Monday.

Nevertheless, we must not forget that one of the main aims of this paper is to identify traces of moral hazard in the Spanish workplace accident insurance system. With this objective in mind, we study the different effect of similar characteristics depending on which day of the week the accident takes place. At the same time, we analyse how such differences evolve while sick leave duration increases. With the estimated coefficients for Monday and for Tuesday through Friday accidents and the characteristics referring to the latter, we build the counterfactual distribution and the unjustified component described in expression [20]. By assessing this unjustified component for a number of sick leave spells we depict what we label the “actual Monday gap” in Figure 3. In this figure, we also represent the best econometric fit according to expression [21] and name it “adjusted Monday gap”. The length of the sick leave (expressed in days) is plotted in abscissas,³⁴ whereas the magnitudes of the “Monday gaps” are shown in ordinates.

Figure 3: Actual and adjusted Monday gap.

³⁴ Figure 3 only presents the unjustified component for those injuries with recovery periods of less than 60 days. This is because over 95% of recorded accidents fall within these limits and because the longer the sick leave duration, the lower the number of observations. As a result, predictions become less accurate and fluctuate more.

To give a better sense of the order of magnitude of the relative importance of the alternative explanations, we focus on the results associated with the econometric adjustment of eq. [21], whose graphical representation is the “adjusted Monday gap” in Figure 3. The best result was obtained for $\theta = 0.1$ and the estimated values of $\kappa_0 = 0.0263$ (t -statistic = 23.48) and $\kappa_1 = 0.0181$ (t -statistic = 11.93). The R -squared of the regression was 0.7105.

The shape of the estimated unjustified component or “actual Monday gap” is strongly consistent with the model developed in Section 4. As a matter of fact, the “theoretical” Monday gap in Figure 3 was depicted that way since our “empirical” Monday gap shows a negative slope and a convex profile. Theoretically other profiles were possible, but once we have measured empirically the total Monday gap it is easy to decompose it into its three components according to the procedure described in Section 4.5 and Appendix B. First of all, we must define what short and long durations are. We made the decision of considering short durations those lasting only one day (the minimum possible) and long durations those with recovery periods over 90 days.³⁵ Taking into account these limits and proceeding in the manner described in Section 4.5 and Appendix B, we obtain the following figures: $a^l = 0.431$; $a^s = 0.436$; $b^l = 0.468$; $b^s = 0.481$; $\overline{ed}(s) = 2,309$; $\overline{ed}(l) = 1,507$; $\overline{hd}^l(l) = 1,143$; $\overline{hd}^l(s) = 1,572$; $hd_M^2(l) = 184$, $hd_M^2(s) = 283$, and $\eta_R(s) = 36$.

Another important decision is to provide a value for the parameter σ . Within the calibration process, a value for such a parameter that yielded good results was $\sigma = 3$. This means that the number of potential situations causing the report of a false on-the-job accident is three times higher on Mondays than on the rest of the working days, which appears to be a quite reasonable order of magnitude. Finally, we need to choose a CDF for $\Phi(d_R^e)$, so as to compute $\pi(d) = 1 - \Phi(d_R^e)$. Although we tried several alternatives, due to the type of phenomenon we are studying (duration analysis), the Weibull distribution seemed to us an appropriate option. After the calibration process, our choice was a Weibull with parameters 1 and 10, which produced good outcomes.

As a result of all this calibration work, we may depict Figure 4. In this figure we show our calibrated Monday gap (purple line) together the adjusted Monday gap from Figure 3 (black dotted line). As can be observed, the two curves resemble each other remarkably well. To be more precise, the correlation coefficient is about 97%. Once we are confident that the calibrated curve captures reasonably well the reality measured through econometric techniques, we apply

³⁵ We made this decision because after our informal talk with the representative of one of the mutual organizations of the Social Security (previously mentioned), it was undoubtedly clear that for these values that $\pi(d=1) = 1$ and $\pi(d > 90) = 0$. Anyhow, we carried out some sensibility analysis around these values and the results proved to be robust.

Figure 4: Calibrated and adjusted Monday gap.

the theoretical reasoning pointed out in Section 4.5 and Appendix B so as to decompose the total Monday gap into its three components. Such components are also displayed in Figure 4.

There are several comments to be made about Figure 4. Firstly, we would like to highlight the importance of the statistical Monday gap, which is an effect neglected in previous research. For asymptotic values, it equals 2.8 (negative) percentage points. Although it does not have a meaningful economic interpretation and it is just a consequence of the fact that there are proportionally more accidents on Mondays, we need to take it into account in order to make accurate measures of the other two types of Monday gaps. Without taking the statistical Monday gap into consideration, we would be underestimating the other two effects.

Regarding the economic Monday gap, it reaches a value of 1.4 percentage points for those durations lasting only one day. As long as the duration increases this effect eventually vanishes, accordingly to our theoretical assumptions. For example, for a duration of 5 days, it represents 0.95 percentage points, and for a sick leave lasting 14 days it still remains at a level of 0.39 percentage points. From one month onwards, this effect is practically non-existent (less than 0.1 percentage points). Although, it is necessary to bear in mind that the bulk of the accidents have an associated duration much shorter than one month (see Appendix A), so it would be a mistake to discard the economic Monday gap as an important component to understand the whole phenomenon.

However, and without a doubt, the order of magnitude of the physiological Monday gap is outstanding. For durations of one day, it reaches a value of 6.37

percentage points, but rapidly converges to its asymptotic level of about 6.51 percentage points. With this size, it is uncontroversial to state that the physiological Monday gap is the most important factor to understand the Monday effect, and this result should be kept in mind when designing policy actions to cope with this fact.

As a result of all this, we might conclude this section by answering the two main questions posed in this paper. Firstly, it seems clear that there is a Monday effect in the Spanish WC. Secondly, to better understand such a Monday gap, it is necessary to take into consideration both the economic and physiological hypotheses, together with the statistical effect identified and explained in this research. Although the physiological explanation undoubtedly dominates from a quantitative standpoint, the economic view still plays a role.

8 Concluding Remarks

A simple observation of the data reveals that there are not only more accidents on Mondays but also a higher concentration of the so-called hard-to-diagnose, easy-to-conceal or soft-tissue injuries. Nonetheless, the interesting fact is to find a credible justification that explains such regularity. Two main hypotheses have arisen to rationalize the Monday effect. The first one, the physiological hypothesis, simply states that after two days off work (that is, after a weekend) an employee has a higher probability of suffering this type of accidents due to physiological reasons. The second form of rationalizing this fact involves the strategic or opportunistic behaviour, which characterises microeconomics. Anyhow, it is worth mentioning that from a pure empirical point of view, we add a third effect that plays a role when measuring the Monday gap.

We develop a microeconomic model which, despite its simplicity, sheds valuable light on the analysed phenomenon. This model is a guide to interpret the empirical results. Two main insights are obtained from the theoretical analysis. First, the legal framework creates an incentive scheme for substituting two different types of accident insurance (non-work related versus work related) that tends to disappear as long as sick leave extends over time. Second, taking advantage of this assumption, we are able to break down the total Monday gap into three components: statistical Monday gap, physiological Monday gap and economic Monday gap.

By using the over-reporting rates obtained in our empirical work, together with the average compensation paid and the overall number of accidents on Monday, we can give a rough estimation of total costs linked to the Monday

effect. If we express the costs in 2014 Euros, the total amount adds up to 9,876,885€ for the year 2002. This figure might be break down into 9,517,055€ associated with the physiological Monday effect and 359,830€ with the economic Monday effect. If we took into account the period from 2002 to 2013, and assuming that the over-reporting rates approximately follow the same pattern identified for the year 2002, the total cost would add up to 71,643,649€. In the same way as before, this amount could be broken down into 69,033,563€ as a result of the physiological Monday effect and 2,610,086€ as a consequence of the economic Monday effect (or moral hazard).

The implications for the economic policy are evident. In the first place, we have found evidence of a Monday effect in the Spanish insurance for workplace accidents which should be addressed when designing measures in order to make the system more efficient. This means that Mondays should be treated as a very special working day so as to prevent the excess of reporting of workplace accidents in Spain. Thus, the first policy recommendation is to design what we could be termed as Monday-specific measures both from a physiological and an economic point of view. Some examples of them are given below.

As the bulk of the total gap is estimated to have a physiological nature, some measures and practices regarding the avoidance of this phenomenon might be promoted when passing health and safety at work legislation. Perhaps, the most obvious recommendation is to make compulsory the performance of some warming-up exercises before starting working, especially in those physically demanding jobs. Although it might not be possible in some industries, another line of action would be to arrange the tasks along the working week in a more efficient way from an ergonomic standpoint. To put it another way, the HR department could organise working tasks starting with those less physically demanding on Mondays and leaving the hardest ones for the last days of the working week.

Finally, it should not be forgotten that despite the fact that the physiological explanation dominates from a quantitative standpoint, the economic hypothesis is also relevant. Our microeconomic model and our microeconometric evidence show some guidance for policy makers. From the results obtained in our research three lines of action are proposed. The first one would be to equalize the SC and WC parameters or, more precisely, to apply to WC the same replacement rates as in SC. This would eliminate the economic incentives to substitute SC by WC.

The second measure would be to monitor carefully, ex-ante and ex-post, those short duration injuries in WC system. It is in this kind of claims where the economic incentives are stronger. Therefore, our proposal for the policy makers at this point is to increase control procedures for those hard-to-diagnose filings on Monday. At the same time, if a false claim were detected, a deterrent penalty should be imposed in order to discourage others from committing the same offence.

Finally, our microeconomic model predicts that the older the worker, the higher the moral hazard level (in average terms). This is due to the fact that economic incentives of cheating increase as the worker gets older, because the expected economic loss decreases. At the same time, our microeconomic evidence supports this view. As a consequence, the previous two economic policy suggestions are also valid here. That is, our advice is to reinforce the monitoring procedures when a suspicious Monday claim from an older worker is filed and, if a fraud is discovered, to enhance the penalty to deter potential cheaters.

Appendix A

Table 10: Average duration by type of injury.

		Average duration	Number of accidents
Full sample	Hard-to-diagnose	16.60	212,307
	Total	17.61	458,256
Less than 61 days off work	Hard-to-diagnose	13.23	204,105
	Total	13.20	436,092

Figure 5: Accident distribution by days off work and type of injury.

Appendix B

In this appendix we prove some analytical results that will prove useful for our empirical strategy.

We know that for every workday (i.e. Monday or Tuesday through Friday) and for every duration:

$$\frac{\overline{hd}^1(d)}{\overline{hd}^1(d) + \overline{ed}(d)} = a = \text{constant} \quad (22)$$

If we now take into consideration those very long durations, for which $\pi(l) = 0$, we can write the following two relations:

$$AR_M(l) = \frac{\overline{hd}^1(l) + hd_M^2(l)}{\overline{hd}^1(l) + hd_M^2(l) + \overline{ed}(l)} = b^l \quad (23)$$

$$AR_R(l) = \frac{\overline{hd}^1(l)}{\overline{hd}^1(l) + \overline{ed}(l)} = a^l = a \quad (24)$$

Thus, the exact value of $a = a^l$ can be computed from our database with simply making a reasonable assumption of what a very long duration is. Then, with this number it is possible to obtain a relation between $\overline{hd}^1(l)$ and $\overline{ed}(l)$:

$$\overline{hd}^1(l) = \frac{a^l \cdot \overline{ed}(l)}{(1 - a^l)} \quad (25)$$

On the other hand, if we now focus on very short durations, for which $\pi(s) = 1$, and taking into account that $\eta_M(s) = \sigma \cdot \eta_R(s)$ with $(\sigma > 1)$, we have:

$$AR_M(s) = \frac{\overline{hd}^1(s) + hd_M^2(s) + \sigma \cdot \eta_R(s)}{\overline{hd}^1(s) + hd_M^2(s) + \sigma \cdot \eta_R(s) + \overline{ed}(s)} = b^s \quad (26)$$

$$AR_R(s) = \frac{\overline{hd}^1(s) + \eta_R(s)}{\overline{hd}^1(s) + \eta_R(s) + \overline{ed}(s)} = a^s \quad (27)$$

Again, it is feasible to establish the exact value for a^s from our database with simply defining what a very short duration is. Then, taking into consideration eqs [22], [25] and [27], it is also possible to assess the value of $\eta_R(s)$. From eq. [27]:

$$\eta_R(s) = \frac{\overline{hd}^1(s) \cdot (a^s - 1) + a^s \cdot \overline{ed}(s)}{(1 - a^s)} \quad (28)$$

Rewriting eq. [22] in order to make clearer the underlying relations:

$$\frac{\overline{hd}^1(d)}{\overline{hd}^1(d) + \overline{ed}(d)} = \frac{\overline{hd}^1(l)}{\overline{hd}^1(l) + \overline{ed}(l)} = \frac{\overline{hd}^1(s)}{\overline{hd}^1(s) + \overline{ed}(s)} = a^l \quad (29)$$

This produces a new version of eq. [25] that we call eq. [30]:

$$\overline{hd}^1(s) = \frac{a^l \cdot \overline{ed}(s)}{(1 - a^l)} \quad (30)$$

Then, substituting eq. [30] into eq. [28] we have:

$$\eta_R(s) = \frac{\frac{a^l \cdot \overline{ed}(s)}{(1 - a^l)} (a^s - 1) + a^s \cdot \overline{ed}(s)}{(1 - a^s)} = \frac{\left[\frac{a^l \cdot (a^s - 1)}{(1 - a^l)} + a^s \right] \overline{ed}(s)}{(1 - a^s)} \quad [31]$$

At the same time, it is possible to assess $\overline{hd}^1(s)$, because from Tuesday through Friday the following relation occurs:

$$\overline{hd}^1(s) = hd_R(s) - \eta_R(s) \quad (32)$$

Moreover, and due to the fact that b^s is a percentage directly measured from the data, rearranging expression [26] yields a value for $hd_M^2(s)$:

$$hd_M^2(s) = \frac{(\overline{hd}^1(s) + \sigma \cdot \eta_R(s)) \cdot (b^s - 1) + b^s \cdot \overline{ed}(s)}{(1 - b^s)} \quad (33)$$

To sum up it is feasible to obtain empirically (from our database) exact values for $\overline{ed}(s)$ and $\overline{ed}(l)$. With our econometric work we are able to estimate $a^l = a$, a^s , b^l and b^s . Finally, with all this information we can set out a system of equations that can be solved by just making an assumption about the size of σ . From this system, we obtain analytically the figures for $\overline{hd}^1(s)$, $\overline{hd}^1(l)$, $hd_M^2(l)$, $hd_M^2(s)$, and $\eta_R(s)$. With all these numbers, it is possible to compute:

$$M^S(s) = \frac{\overline{hd}^1(s)}{\overline{hd}^1(s) + hd_M^2(s) + \sigma \cdot \eta_R(s) + \overline{ed}(s)} - \frac{\overline{hd}^1(s)}{\overline{hd}^1(s) + \eta_R(s) + \overline{ed}(s)} \quad (34)$$

$$M^S(l) = \frac{\overline{hd}^1(l)}{\overline{hd}^1(l) + hd_M^2(l) + \overline{ed}(l)} - \frac{\overline{hd}^1(l)}{\overline{hd}^1(l) + \overline{ed}(l)} \quad (35)$$

$$M^P(s) = \frac{hd_M^2(s)}{\overline{hd}^1(s) + hd_M^2(s) + \sigma \cdot \eta_R(s) + \overline{ed}(s)} \quad (36)$$

$$M^P(l) = \frac{hd_M^2(l)}{\overline{hd}^1(l) + hd_M^2(l) + \overline{ed}(l)} \quad (37)$$

$$M^E(s) = \frac{\overline{hd}^1(s)}{\overline{hd}^1(s) + hd_M^2(s) + \sigma \cdot \eta_R(s) + \overline{ed}(s)} - \frac{\overline{hd}^1(s)}{\overline{hd}^1(s) + \eta_R(s) + \overline{ed}(s)} \quad (38)$$

$$M^E(l) = 0 \quad (39)$$

In other terms, we are capable of breaking down the Monday gap into its three effects both for short durations and long durations. And we do this without making use of econometrics. However, statistical procedures play a crucial role when we decompose the Monday gap into its three effects for every duration. This is so since econometrics allows us to measure and quantify the total gap for every duration. Then, taking into account the idea behind eq. [2], the definitions of eqs [14] through [16] and the reference points obtained in eqs [34] through [39] are easy to simulate the three effects. Finally, we calibrate the theoretical effects to match them with the real Monday gap calculated via econometric techniques in order to achieve a high correlation. To carry out such a calibration exercise, we only need a specific distribution for $\pi(d)$.

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