Regulatory Protective Measures and Risky Behavior: Should We Be Saved From Ourselves?

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July 6, 2014

Abstract

We provide robust evidence on the long debated Peltzman effect, by which individuals required to wear protective gear end up taking additional risks potentially offsetting the intended aim of the device. We take advantage of the fact that wearing a visor, a protective device in Ice Hockey, has not always been mandatory throughout the career of professional players. We exploit within player variation in visor wearing induced by differences in league regulation to estimate the effect of mandatory visor wearing. We find that wearing a visor substantially increases risky behavior reflected in an additional 0.18 penalty in minutes per game, as compared to the average 0.8 penalty in minutes in our sample. Results are not driven by characteristics of players, playing style, or other league differences. We also find a small negative impact on performance.

JEL Classification: K32, K23, H40

Keywords: Peltzman Effect, Compensating Behavior, Regulation, Protection, Ice Hockey

1 Introduction

The effectiveness of safety and protective devices such as seatbelts in cars, helmets for bicycle riders, or hormonal injections to prevent pregnancies, hinges on the critical assumption that the behavior of individuals remains constant regardless of the use of such device. However, it is unclear whether this is indeed the case, or whether people will adapt in response to any additional protection so that the intended effect may end up being diluted or even negated. In particular, the use of protective devices may reduce the cost of risky behavior and thus increase aggressiveness and risk-taking. This behavioral response not only counters the observed effectiveness of the device, but also creates potential negative spillovers on others. The existence of this compensating behavior, widely known as the Peltzman Effect, may

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have vast implications in terms of government intervention and regulation in the economy (see Peltzman (1975)).

Despite of its relevance, the existing empirical evidence on compensating behavior remains inconclusive. Several researchers have tested for the Peltzman Effect by measuring the impact of seatbelt laws on fatalities among car occupants and pedestrians using a variety of approaches. While some studies document the presence of compensating behavior, others provide a much more nuanced picture. Harvey and Durbin (1986), Asch, Levy, Shea and Bodenhorn (1991) Garbacz (1992), Risa (1994), Loeb (1995), among others use time series techniques or cross sectional comparisons and find some evidence of compensatory behavior, measured by an increase in accidents or non-occupant fatalities. However, it is hard to take this evidence as causal given that only cross sectional or pure time series variation is exploited, raising concerns about omitted variables bias. In one notable exception Cohen and Einav (2003) use within state variation in seatbelt laws in the U.S. and find no evidence of compensatory behavior. In particular, they find a decrease in occupant fatalities and no significant effect on non-occupant deaths, providing no support for the Peltzman effect.

Besides unclear identification, the main shortcoming of this literature is that it focuses on aggregate, imprecise, and indirect proxies of behavior. This limitation is understandable given that we cannot directly measure how risky or careless an individual drives. With aggregate data it is impossible to identify which specific individuals are compliers, in the sense that the regulation was binding for them, and which ones are not. This is likely to attenuate the estimates as compensating behavior only arises from compliers. Moreover, aggregate outcomes may be contaminated by other policies. In the seatbelt case, for instance, safety awareness campaigns are typically implemented along with seatbelt regulation.

A more satisfactory way of isolating the Peltzman effect is to compare individual behavior before and after a change in regulation or perceived risk rather than just focus on aggregate outcomes. Some efforts along these lines are Pope and Tollison (2010) and Sobel and Nesbit (2007), who use data from competitive car racing where compliance and enforcement are automatic, and individual behavior can be observed. Even though these studies find evidence supporting the presence of compensating behavior, they typically lack a credible proxy to reflect risk taking or do not take into account trends in racing accidents that may compromise the interpretation of their results.

In this paper we take a different approach in order to test for the Peltzman Effect. We compare the behavior of individuals to whom a safety regulation is binding with that of individuals to whom such safety regulation is not binding. We do this in the context of professional Ice Hockey, by exploiting the fact that whereas wearing protective face shields or visors is optional in the National Hockey League (NHL), it is mandatory in many other hockey leagues where most, if not all players, had skated prior to or after coming to the NHL. We focus on the universe of players who skated in the NHL during the 2001 to 2006 regular seasons, for whom we obtained detailed individual data on visor wearing, personal characteristics, and playing information both while in the NHL 2001-2006 seasons and while in other hockey leagues. These leagues include professional European leagues as well as minor and junior leagues in the United States and Canada, which unlike the NHL, mandated players to wear a visor during the seasons we observe them. Players who willingly wear a visor in the NHL are not likely to be affected by regulation mandating visors in these other leagues, so we refer to them as *always wearers*. However, mandatory visor rules in other leagues are binding for players who do not wear a visor in the NHL. We refer to these players as *compliers*. We estimate the behavioral effect of requiring a player to wear a visor by comparing the differences in risky behavior between compliers and always wearers in the NHL 2001-2006 regular seasons–where only always wearers skate with a visor– with the difference in leagues that mandate both type of players to wear a visor. This empirical strategy identifies the effect of visor wearing from within player changes induced by differences in league regulation. The effect is identified from compliers –the group expected to change behavior, while always wearers help us take into account other league characteristics that affect both groups. We describe this strategy and the assumptions required in Section 2.

Peltzman's framework suggests that visor wearing provides players with additional protection. This reduces the cost of risk and translates into more aggressive skating, reflected in more frequent boarding, charging, checking, and related behavior that impose risk on others as well as on the players themselves. These specific actions are penalized using a measure called penalty in minutes, a commonly accepted variable in Ice Hockey that reflects aggressiveness and risky behavior (see Ashare, ed (2000)). Thus, we focus on penalty in minutes as our main proxy for behavior, but also present the effect of mandating a visor on several measures of performance.

In addition to our baseline estimates, we conduct an additional exercise using the 2004 NHL lockout, which led to an exogenous exodus of NHL players to European and minor pro leagues that mandated them to wear a visor. This narrower experiment has the advantage of exploiting a clear exogenous and temporal movement to leagues with mandatory visors, that is not related to player characteristics or their career path. We find that while compliers and always wearers behaved similarly during the 2001-2003 NHL seasons, compliers became significantly more aggressive during the lockout in 2004 when playing in other leagues with mandatory visors. More striking, when players returned to the NHL in 2005 and 2006 this difference disappeared. This provides further support for the existence of compensatory behavior created by mandatory visors.

Unlike most of the existing empirical evidence currently available, we find that there is significant compensating behavior among hockey players when required to wear visors. We estimate that whereas the average penalty in minutes per game is 0.8, mandatory visor wearing produces a substantial increase of 0.18 penalty in minutes per game. Our evidence supports the view advanced by Peltzman suggesting that when a player is required to wear a visor he will modify his behavior, imposing more risks for himself and others. We also find that wearing a visor has a small, negative effect on performance, measured by goals per game, which is consistent with players claiming that visors tend to reduce vision. However, the fact that these effects are not very robust and small suggests that some of these claims may be exaggerated. We provide evidence suggesting that our results are not driven by differential adaptation to other leagues' characteristics or sorting of players into different leagues with different regulations.

Overall, our results show that when a player is required to wear a visor he will take more risks and play more aggressively, partially offsetting the added protection and creating potential negative spillovers on other players. Contrary to common belief, the mandatory use of visors does not raise consciousness about safety.

We believe that this paper provides compelling evidence on the presence of the Peltzman Effect with implications that extend beyond Ice Hockey. The presence of compensatory behavior of the type documented in this paper may be relevant when designing and implementing safety regulatory policies to "save us from ourselves". The additional risk created may render safety regulations welfare reducing even when there may be cognitive or social reasons (i.e., myopic behavior, stigma) that explain why people use less protection than what is individually optimal. Risky behavior also imposes negative spillovers on others that should be weighted against the potential gains in individual safety. Even in the absence of spillovers, individual gains may be lower or totally negated once compensating behavior is taken into account.

The rest of the paper is organized as follows. In section 2 we explain in detail the institutional features of Ice Hockey, describe our data and our identification strategy. In section 3 we present our results and provide evidence supporting our causal interpretation of the estimates. We conclude in section 4.

2 Empirical Strategy and Data

An on-going controversy in the National Hockey League (NHL), the top professional Ice Hockey league in the world, is related to the fact that the decision to wear a visor is voluntary. Visors are strong transparent fiber shields designed to protect a players' eyes and face. During our period of study, from 2001 to 2006, only one third of hockey players in the NHL chose to wear visors. This number appears to be exceedingly low taking into consideration the fact that year after year there are horrifying and high profile cases of players that become gravely injured for not wearing a visor. There are two reasons commonly associated to this behavior. First hockey players believe that their performance may be compromised, as sweat and dirt in the visor may interfere with the player's vision. Second, Ice Hockey is commonly associated with a macho subculture in which it is important to send the signal that one is courageous enough so much as not to wear a visor. The extent to which the lack of visor wearing has to do with a perceived reduction in performance or to peer pressure is unclear. Interestingly, it may be argued that wearing a visor can give a player a sense of additional security that may actually help him play better as, for instance, it may help him manage risk better.

Ice Hockey provides an ideal natural experiment to test for compensating behavior for two reasons. First, a particular feature that affects all players that end up in the NHL is that before, and sometimes after playing in the NHL, where the decision to wear a visor is optional, they participated in other North American or European leagues that mandated them to wear one. This provides a source of within player variation in visor wearing due to changes in league regulation and not arising from players' choice.

We are able to track individual playing careers for the different cohorts of NHL players active during the 2001-2006 regular playing seasons and collect their corresponding detailed playing statistics for regular seasons played at other leagues which mandated them to wear a visor. Henceforth we refer to these leagues as non-NHL leagues.[1] Our sample of players

[1]We exclude non-NHL leagues data for seasons in which it was not mandatory to wear a visor. We do so because in those cases we are unable to determine which players wore a visor. As an illustration, visor wearing became mandatory in the American Hockey League (AHL) in 2006. In this case we do not include any of the seasons in this league before 2006 as we do not have data that allow us to observe whether players

consists of 834 players, out of which 269 wore a visor regularly in the NHL 2001-2006 seasons, and 565 did not. As explained in the Introduction, we refer to the first group as always wearers, and to the second group as compliers. Always wearers use a visor in all leagues in our sample, while compliers only use one in non-NHL leagues.[2]

For each player we collect a broad set of personal characteristics including date of birth, birthplace, weight, height, the year of his first season in the NHL, position, experience, and several others. All the data comes from the official NHL website, related specialized websites, as well as hockey experts from such said websites.[3] A key feature in this paper is that we follow professional hockey players throughout their entire playing career prior to their arrival to the NHL. For each of the players in our sample we also collect data on playing statistics including position, goals, assists, games played, and penalty in minutes for each of the following: i) NHL regular seasons 2001, 2002, 2003, 2005 and 2006; and ii) seasons in non-NHL leagues with mandatory visors. Out of the 834 players in our sample, we were able to identify 784 who played at least one season in non-NHL leagues.

Our unit of observation are player/season cells. Among always wearers, we have 1012 player/seasons in the NHL, and 1139 player/seasons in non-NHL leagues. On the other hand, for compliers we observe 2315 player/seasons in the NHL, and 2620 player/seasons in non-NHL leagues. Table 1 summarizes the main variables of interest in this study. The table is divided in two panels presenting the data for both types of players, and then each panel breaks the data for the 2001-2006 NHL seasons and seasons in non-NHL leagues separately. The Table also presents the main time invariant characteristics of the players on the bottom panel.

As mentioned in the introduction, our primary focus is on the effect of mandatory visor wearing on risky behavior. We are able to measure it at the individual level using "Penalty Infraction Minutes" (PIM) or "Penalties in Minutes". This statistic represents the total amount of penalties measured in minutes accrued by a player. In our results we use penalty in minutes per game as a normalization. Penalty minutes are punishments for behavior that is deemed inappropriate. It is enforced by detaining the offending player within a penalty box for a set number of minutes. The offending team cannot replace the player on the ice, leaving them with one player short during the penalty period. This statistic is a reasonable proxy to measure compensating behavior, as it is widely accepted that this variable captures risky behavior and aggressiveness by the offending player (see Ashare, ed (2000)). Typical behavior that is penalized in the form of either a "minor" penalty or a "major" penalty, which are assigned a specific and pre-defined time of penalty in minutes, include charging, boarding, elbowing, kicking, head shots, attempt to injure other players, fighting, cross-

wore a visor or not. In addition, it is important to note that some leagues introduced mandatory visors with a "grandfather clause", which allowed some players to skate without wearing a visor. We do not include the corresponding data for the exempted players in these leagues, as we do not have information to determine whether they wore a visor or not. See Appendix 2 for a full description of the leagues in our sample.

[2]For the NHL, we only have visors' data for the 2001-2006 seasons and this is why we do not use playing statistics from other NHL seasons. Though some players start wearing a visor during the NHL 2001-2006 seasons, we do not exploit this variation. In fact, we code a player as a complier if he never used a visor during these seasons. This coding choice guarantees that we only exploit variation arising from changes in league regulation, which we regard as exogenous. The results in the paper are not affected by using alternative definitions of compliers and always wearers.

[3]We extracted the data from www.nhl.com, www.hockeydb.com, and www.tsn.ca

checking, abuse to officials, hitting an opponent with the head, and several others that are spelled out in the NHL rules, as described in Appendix 1. Importantly, we observe penalty in minutes at the individual level, allowing us to estimate the effect on compliers, which is the group that should exhibit a behavioral response to the increase in safety. Peltzman's theory suggests that by reducing the individual cost of engaging in most of these types of behavior, visor wearing causes an increase in risky, aggressive, and reckless skating, and will be reflected in an increase in penalty in minutes. This reaction imposes additional risks on the player forced to wear a visor and in other players, creating potential negative spillovers.

We exploit the fact that compliers must wear a visor in non-NHL leagues in our sample, while they do not wear one in the NHL 2001-2006 seasons. On the other hand, always wearers wear visors in all leagues in our sample. This variation is entirely driven by league differences and not by the choice of players to wear a visor. We argue below that this variation can be regarded as exogenous in our context. This allows us to estimate the effect of mandatory visor wearing by comparing the behavior of compliers in non-NHL leagues –where they are forced to wear a visor– relative to the 2001-2006 regular seasons in the NHL– where they are allowed to skate without one, using always takers as the control group to account for other league differences.

We exploit this variation by estimating the model

$$y_{isl} = \alpha_i + \theta_l + \kappa_s + \beta C_i \times M_l + \varepsilon_{isl}. \tag{1}$$

Here y_{isl} is any outcome variable for player i during regular season s at league l. C_i is a dummy that takes the value 1 for compliers and 0 for always takers. M_l is a dummy that takes the value 0 in leagues where visors are not mandatory (NHL) and 1 when they are (non-NHL leagues). Whenever we observe a player in a league with $M_l = 1$, we are certain that he was wearing a visor since enforcement is automatic, independently of his type. We estimate the model with a full set of player and season fixed effects (α_i, and κ_s), which control for player heterogeneity and trends in Ice Hockey. θ_l are league specific intercepts that control for all differences in leagues other than their visor regulation. ε_{isl} is a random error term orthogonal to the left hand side variables. Throughout, we compute standard errors robust against heteroskedasticity and serial correlation at the player level.

The interaction term $C_i \times M_l$ captures variation in visor wearing for compliers caused by differences in league regulation. Thus, we identify the effect of wearing a visor, β, entirely from its within player variation arising from differences in league regulation. Moreover, this is only identified from compliers. The specification underscores the importance of comparing compliers and always wearers, and putting together data for playing statistics in leagues with different visor regulations. By doing so, we are able to obtain within player variation in visor usage and use always wearers to control for other league specific effects.

A causal interpretation of β as the effect of mandatory visor wearing requires two key assumptions. First, it requires that other league characteristics do not differentially affect compliers and always wearers.[4] Second, since we are exploiting variation induced by changes in leagues, we require that players do not sort in leagues with different rules depending on their unobservable characteristics. When presenting our results in the next section we will

[4] This is analogous to the usual equal trends assumption used in difference in differences designs.

assume these requirements hold, and will interpret our results as causal. We fully discuss this assumption and provide evidence supporting it below.

3 Main Results

We start by estimating variations of the model in equation (1). Table 2 presents our results. The row "Complier × Mandatory league" presents our estimates for β, which we interpret as the causal effect of mandatory visor wearing. In column 1 we present results controlling for C_i, M_l and season effects. We estimate that mandatory visor wearing increases penalty in minutes by 0.158 (standard error=0.056). This is a sizable effect compared to the average 0.8 penalty in minutes per game in our sample. The coefficient on the compliers' dummy suggest that this group is on average more aggressive than always wearers independently of whether they wear a visor or not. Cross sectional estimates would mistakenly attribute this difference between compliers and always wearers to visors, underscoring the value of our approach. The coefficient on non-NHL leagues suggest that these leagues are either more aggressive or have tougher penalization standards. In column 2 we include additional player characteristics such as position, age, experience, birth year, birth region, weight, and height, and control for a full set of league effects (thus, we do not report the non-NHL leagues' coefficient). In column 3 we allow for different time trends in each Ice Hockey league category (NHL, minor pro, junior, major junior, college, and European leagues). Overall, the estimated effect of visors remains largely unchanged after the inclusion of these controls.

The last three columns include player fixed effects instead of individual characteristics that are fixed in time (thus, we do not report the compliers' dummy). This controls more flexibly for cross sectional differences between players, and guarantees that we identify the effect of visors only from within player variation. In column 4 we control for player fixed effects, season effects and the non-NHL leagues' dummy. In column 5 we add time-variant characteristics such as age and experience as controls, as well as league fixed effects. In column 6 we also allow for different time trends in each major category of leagues. Column 6, which presents the most demanding specification, suggests that visors increase penalty minutes by 0.182 (standard error=0.050). This effect is statistically significant at the 1% level, and it is fairly stable across specifications.

3.1 Robustness to Controlling for Other Differences Between Leagues

As mentioned above, there are two main threats to our identification assumption. We begin by discussing the first one, which represents the biggest challenge to our interpretation. As shown in column 1 in Table 2, there are marked differences between the NHL and non-NHL leagues and between treatment and control players in terms of penalty in minutes. This raises the possibility that our results may be driven by a differential impact of other leagues' characteristics on compliers and always wearers. Bias could arise if non-NHL leagues have stricter penalization standards, which may disproportionately affect compliers who are inherently more aggressive. If stricter penalization does not significantly modifies behavior, then compliers would mechanically have higher penalty in minutes in non-NHL leagues relative to the NHL, leading to an upward bias in our estimate. On the other hand, stricter penalization standards could have a stronger dissuasive effect on aggressive players, implying a downward bias in our estimates. Another possibility is that compliers and always wearers may differ in their adaptation to professional or North American leagues, as many of the leagues with mandatory visors are located in Europe or are minor leagues.

As a first strategy to deal with this issue we re-estimate equation 1, but we allow the effect of wearing a visor to vary by league type. In particular, we estimate the effect of mandatory visor wearing in college leagues, junior leagues, major junior, European, and minor-pro leagues, all of which require players to wear visors. Figure 1 shows the estimates graphically. We find a positive effect of mandatory visor wearing with similar point estimates in all leagues. The figure shows that our results are not driven by European leagues only, and thus they cannot be explained by different adaptation of compliers to European hockey. Furthermore, our results are not driven by minor leagues only, that is, they cannot be explained by different adaptation of compliers to more competitive leagues, either. In fact, European leagues are arguably the most competitive after the NHL, and we find a large effect of mandatory visor wearing in them.

In addition, the point estimates do not seem to reflect stricter penalization standards. For instance, junior leagues have an average penalty in minutes of 1.3 above the NHL while European leagues have an average of 0.75 penalty in minutes above the NHL. Yet, their point estimates are similar. Whereas European leagues tend to be regarded as less tolerant towards violence than the NHL, Canadian junior leagues tend to be regarded as more tolerant towards violence than the NHL. The fact that we obtain a positive effect of visor wearing on penalty in minutes using European or Canadian non-NHL leagues suggest that our main results are not driven by differences in penalization standards across leagues.

In order to provide further evidence on the robustness of our results, we extend the specification in equation (1). This extension controls for (potential) differential impacts of non-NHL leagues on players with different observable characteristics. In particular, we estimate the model

$$y_{isl} = \alpha_i + \theta_l + \kappa_s + \beta C_i \times M_l + \gamma X_i \times M_l + \varepsilon_{isl}. \tag{2}$$

The interaction $X_i \times M_l$, controls for differential impacts of league type depending on players' characteristics X_i.

Table 3 presents our estimates for this extended model. All models include a full set of player fixed effects, season and league effects. The first row presents the estimated effect of visors, and the bottom rows presents the interactions. The first column in Table 3 shows estimates controlling for interactions with birth year and year of first NHL season. Column 2 shows estimates controlling for interactions with position. This is particularly important, given that visor wearing is not balanced across positions. Column 3 shows estimates controlling for interactions with weight and height, which are relevant because bigger players are less likely to wear visors, and could adapt to the NHL differently. Column 4 shows estimates controlling for interactions with birthplace, which is relevant given that players born in Europe are more likely to wear visors. This column controls explicitly for the possibility that they could adapt differently to the NHL. Column 5 presents estimates controlling for interactions with a measure of players' aggressiveness.[5] This specification controls for the

[5]This measure is obtained as the predicted individual effect in a specification like the one in equation 1,

possibility that non-NHL leagues with stricter penalization standards may have a different impact on more aggressive players, who are also more likely to be compliers. Finally, Column 6 introduces all interactions simultaneously.

The estimated effect of visor wearing on penalty in minutes drops to a half of its original value but remains statistically significant at the 5% level when including all the interactions in column 6. The interactions of the dummy for non-NHL leagues with both the dummy for players born in Europe and with the measure of aggressiveness explain most of the drop. Players born in Europe, who are more likely to be always wearers, tend to get less penalty in minutes in leagues requiring visors. Likewise, more aggressive players, who are more likely to be compliers, tend to get more penalty in minutes when playing in leagues with stricter penalization standards, like European leagues or minor leagues in North America, which also require them to wear a visor. These two forces combined imply that our original estimate has an upward bias.

All the same, after directly controlling for these potential confounding effects, we still find a positive and statistically significant effect of mandatory visor wearing on penalty in minutes. This suggests that our estimates are not entirely driven by violations of our first requirement, and we are capturing in part a causal effect of visors. The estimates in Column 6 make our causal interpretation quiet plausible, as this is a very challenging specification controlling simultaneously for several potential confounders. Overall, this table suggests that the causal effect of mandatory visor wearing is to increase penalty in minutes by 0.09 (standard error=0.039), which is still a 10% increase relative to the average penalty in minutes in our sample.

Table 4 explores some additional generalizations of equation (1) designed to show that league observable characteristics do not have a differential impact on compliers. In all cases we present results with a full set of players, league and season fixed effects. Even columns add time-variant controls (age and experience).

In the first extension we calculate the average penalty in minutes for each league relative to the NHL, as a proxy for its penalization standards and playing style.[6] Columns 1 and 2 show estimates controlling for an interaction of this measure with the complier's dummy C_i. This interaction controls for a differential effect of a league's penalization standards or overall aggressive style on compliers, which could potentially bias our estimates. Our estimate remains roughly the same and the interaction indicates that, as hinted in Figure 1, there is no clear differential effect of leagues' characteristics related to their average penalty in minutes on the compliers other than the effect of visor rules.[7]

In Columns 3 and 4 we control for an interaction between a discrete variable that ranks leagues according to how competitive they are and the complier's dummy C_i. This interaction controls for different adaptation of compliers to more competitive hockey. Following the view of most hockey experts, we rank the NHL as the most competitive league, followed

which is essentially the average penalty in minutes for a player during his career after partialling out other determinants.

[6]This is estimated using league dummies in a specification similar to equation (1). By doing this we isolate the leagues measure from season effects, time trends, and player effects.

[7]This is different from column 5 in Table 3. In that table, we showed that a player's observable aggressiveness was associated with more penalty minutes in leagues with mandatory visors. The result in Table 4 suggest that this must occur through channels unrelated to average penalty minutes.

by European leagues, minor pro-leagues, major junior leagues, junior leagues, and finally college leagues, in that order. Our measure is an integer ranging from zero –reflecting the least competitive league– to 5– for the most competitive one. We find that as compliers move to more competitive hockey leagues, they tend to become more aggressive, which may induce a negative bias in our estimates because leagues with mandatory visors are less competitive than the NHL. Though the interaction is not precisely estimated, it is consistent with the idea that players specialize as they advance in their professional careers. As expected, the estimated impact of visors on penalty in minutes becomes larger and remains statistically significant at conventional levels once we add this interaction.

In the last two columns of Table 4 we exclude European leagues and college hockey. The remaining leagues with mandatory visors are junior and major junior leagues in Canada, and minor pro leagues in the United States, which are considered to be more similar to the NHL. We still find that compliers are more violent in these leagues with mandatory visor relative to the NHL as compared with always wearers. In particular, in column 6 we identify the effect of mandatory visor wearing from within player variation induced by the usual movement from junior and minor leagues in Canada, and minor leagues in the U.S. to the NHL.

Our first requirement for identification implies that compliers should not behave differently (relative to always wearers) when moving across leagues with mandatory visors. We find no evidence of the opposite. In particular, we estimate no difference in behavior between compliers and always wearers as they move from junior leagues to other leagues with mandatory visors: compliers receive -0.07 less penalty minutes in college than in junior leagues relative to always wearers (standard error=0.17); 0.08 more penalty minutes in minor leagues than in junior leagues relative to always wearers (standard error=0.14); and 0.08 more penalty minutes in European leagues than in junior leagues relative to always wearers (standard error=0.17). None of these effects are significant, suggesting no evidence of different behavior between compliers and always wearers in leagues with mandatory visors. Not only are these differences in behavior not significant, but also small when compared to our baseline estimates in Table 2. In particular, the difference in penalty minutes received by compliers in minor leagues and European leagues – two types of leagues with mandatory visors, and yet some differences in playing style and penalization standards – relative to always wearers is 0.01 (standard error=0.17). Differences in behavior between compliers and always wearers only appear in the NHL – where visor usage is mandatory, relative to other leagues – where it is not, consisting with the interpretation of our findings as the causal effect of visors.

To summarize, the evidence in this section suggests that our results are not driven by differential effects of league characteristics on players. We presented four main arguments to support this point: First, we find a positive and similar point estimate of mandatory visor wearing on compliers for all groups of leagues with mandatory visor wearing in our sample. This suggests that despite differences across these leagues, it is their common characteristic of having mandatory visor requirements that is driving our estimates. Second, although we find that players that differ in observable characteristics may adapt differently to non-NHL leagues, we still find an effect of visor wearing on compliers after explicitly controlling for these differences. Third, non-NHL leagues' location, how competitive they are, or differences in penalization standards are not driving our results, as controlling directly for the differential impact of these characteristics on compliers did not change our results. Finally, we find no evidence of differential changes in behavior between compliers when observed in different leagues with mandatory visor requirements (College, Junior, Minor Pro and European leagues).

3.2 Exogenous League Changes

The second requirement for identification is that the variation in league regulation must be exogenous to player characteristics. In other words, it should be the case that players do not sort in leagues with different visor wearing regulations. We believe that this is not the case in our context for two reasons. First, players switch leagues at high frequencies while leagues' rules and characteristics remain largely unchanged, suggesting there is not much sorting, and other factors drive movements across leagues. For instance, players change leagues 37.5% of the time at the end of the current season in our sample. Second, conditional on playing on the NHL during the 2001-2006 seasons, players must have skated in minor leagues mandating visors with very few exceptions. In particular, only 50 out of 834 players in our sample are missing playing statistics corresponding to seasons in leagues with mandatory visors. These exceptions are probably caused by lack of data availability rather than players avoiding these leagues strategically.

To further substantiate this point, we focus on a more narrow experiment. We look at the effects of the 2004 NHL lockout, which led to an exogenous change in leagues for NHL players. The lockout, which started due to salary disagreements between the NHL and the players' union (NHLPA), led to the cancellation of the 2004 regular season. As a result, a large number of players decided to play in other professional leagues that season, many in Europe. Out of the 690 players in our sample who played in the NHL in 2003, we obtained data on 338 that played the 2004 season in some European league. Out of these 338 players, 211 skated in leagues for which we were able to find detailed rules on whether visor wearing was mandatory that season (that is, leagues with $M_l = 1$).[8] Other 67 players for whom we have data on visor wearing stayed in leagues in North America that mandated the wearing of visors, including the ECHL, and other minor leagues.[9] Throughout this section, we focus on the subsample of 277 players that were in the NHL during the 2003 season, and played in some league with mandatory visor during the 2004 lockout, and the 2001-2006 NHL seasons as well as the 2004 seasons is non-NHL leagues. Thus, by construction, all players wore a visor during the 2004 lockout.

Figure 2 previews the effects of the lockout. The figure plots for each season the estimated difference in penalty in minutes between compliers and always wearers, $E[y_{isl}|C_i = 1] - E[y_{isl}|C_i = 0]$. We pool together the data for all leagues with mandatory visors to which players migrated in 2004. We control for age, experience, birth region dummies, position,

[8] For instance, the Russian league (KHL) has a special clause allowing players born before 1974 to skate without wearing a visor. Therefore, when considering the players who moved to Russia, we only focus on the set of players born after this year.

[9] Yet a third group went to play in the AHL, which did not mandate visor wearing at the time. We do not include this group in any of our exercises, as we cannot identify which players wore visors during the lockout. Assuming same visor wearing from previous NHL seasons would be misleading as players could have started using one while in the AHL, only.

height and weight, birth year dummies and cohort dummies when estimating these mean differences, and plot confidence intervals for each difference. As can be seen in the figure, compliers are slightly more violent during the 2001, 2002, 2003 and 2005 seasons, and equally violent during the 2006 season. Moreover, these differences are only significant for 2001. Thus, until the 2003 season, both groups of players were comparable in the penalty minutes they were obtaining. However, during the 2004 lockout, when compliers were required to wear a visor, they became significantly more violent than before by about .3 penalty in minutes per game relative to always wearers. Once the players moved back to the NHL, and compliers stopped wearing visors this difference disappeared. This is exactly the pattern one would expect if mandatory visor rules made compliers more violent during the 2004 lockout. The figure also shows that once we control for covariates, and focus on players that were on the NHL during the 2003 season, there is no significant difference in penalty minutes in the NHL between compliers and always wearers. This increases our confidence in using always wearers as a control group providing the right counterfactual for compliers.

To study the evidence in this figure more systematically, we move to a regression framework. We estimate variations of the following specification for the NHL 2001-2006 seasons and the 2004 lockout, for our subsample of players:

$$y_{isl} = \alpha_i + \theta_l + \kappa_s + \beta C_i \times L_s + \varepsilon_{isl}, \tag{3}$$

with all the variables as explained above and L_s a dummy for the lockout season 2004. The key advantage in this specification is that due to an exogenous temporal shock, players moved to other leagues, especially European ones, where compliers were required to wear a visor. always wearers were unlikely to be affected by the change in visor wearing rules, which provides a counter factual that allow us to control for other differences between the NHL and non-NHL leagues to which players migrated in 2004 and season effects. The effect of mandatory visor wearing due to the exogenous change in leagues is captured by the coefficient on the interaction $C_i \times L_s$.

Table 5 presents our estimates exploiting this narrower source of variation. In all models we control for a full set of player and season fixed effects. In even columns we add league fixed effects, rather than just a dummy for the lockout season (L_s).

Columns 1 and 2 presents our estimates of equation (3). The estimate in column 2 shows that mandatory visor wearing causes 0.382 additional penalty minutes per game (standard error=0.152). This is larger than our baseline estimates (though less precisely estimated), and supports our main qualitative conclusion.

In Columns 3 and 4 we restrict our analysis to players who returned to the NHL in 2005 immediately after the lockout year. One may argue that these are the players to whom the lockout induced a purely exogenous change in leagues Again, the results are similar, though less precisely estimated because of the smaller sample size.

In the last four columns we present results using the same specifications as in columns 1-4 but controlling for interactions of the form $X_i \times L_s$. Here, X_i is a vector of player characteristics including birth year, first year in the NHL, position, height, weight and birthplace. Importantly, we also control for an interaction with average penalty in minutes before 2003 as a proxy of aggressiveness, based on the idea that more aggressive players, which are more likely to skate without wearing a visor, could be affected differently by other rules in the leagues to which they migrated during the lockout. Column 6, which is our preferred specification shows that, even after controlling for differential adaptation to non-NHL leagues during the lockout (based on the observable characteristics X_i), mandatory visor wearing increases penalty in minutes by 0.294 (standard error=0.134). Column 8 presents similar estimates which are slightly less precisely estimated.

Overall, these estimates confirm our conclusion that mandatory visor wearing increases aggressive behavior. The estimates in this subsection have the advantage that they exploit the narrower more exogenous variation caused by the 2004 lockout. This suggests that sorting across leagues, which is not an issue during the lockout, is not driving our estimates. An additional advantage of this narrower experiment is that it does not exploit changes in leagues related to players' career paths. This was the bulk of the variation used in our baseline estimates. Thus, these additional estimates exploit a very different source of variation in leagues from our baseline estimates.

There are also two important advantages of these estimates: first, we have shown that both groups were receiving a similar number of penalty in minutes before the lockout and after it. This suggests that once we condition on observable covariates, always wearers provide a good counter factual for the behavior of compliers during the lockout. Second, the lack of difference in behavior before the lockout implies that our results are not driven by the particular linear structure imposed by our regression or interactions between league characteristics and players' behavior. These alternative explanations require behavior among compliers to differ from that of always wearers before the lockout.

3.3 Does Visor Wearing Reduce Performance?

In this section we test whether mandatory visor wearing has an impact on performance, measured by assists and goals per game. Table 6 presents our estimates. We find a negative effect of wearing a visor on performance, although it is only statistically significant at traditional levels in the case of goals per game. Our estimates suggest that mandatory visor wearing reduces assists per game by 0.019, and goals per game by 0.022. These effects are not as big as our effects on penalty minutes once we compare them to an average of 0.35 assists and 0.25 goals per game in our sample. Moreover, our confidence intervals do not rule out very small (or zero) effects. We view these results as consistent, but not entirely supportive, of claims of player complaints about the fact that visor wearing reduces performance, as visors may become fogged or may be uncomfortable to wear.

In Columns 1 and 4, the corresponding coefficients on the dummy that accounts for compliers imply that they tend to have a lower performance on average, independently of the visor, suggesting there is self selection when it comes to whether wearing a visor or not. Cross-sectional estimates of the effect of visor wearing on performance would be upward biased and would give the wrong impression that visor wearing are associated with better performance, since this is entirely driven by the fact that better performing players tend to be more likely to wear a visor.

While our discussion has focused on the existence of compensating behavior and related spillover effects, the results in this section show that visor wearing may also produce additional behavioral changes. Some players may not wear visors willingly precisely because they may not want to sacrifice performance, not necessarily because of the presence of a macho subculture. This finding is relevant as it suggests that mandating protective gear may not only increase risky behavior, but may impact the performance of individuals, as well.[10]

4 Conclusions

In this paper we provide empirical evidence of the Peltzman effect by following the professional path of hockey players active in the National Hockey League between 2001 and 2006, for whom we know wether they wore a visor or not during these seasons. We take advantage of the fact that during the full playing career of a typical professional player wearing a visor has not always been voluntary as it is in the NHL. In particular, this provides us with a plausible exogenous source of variation in within player use of visors induced entirely by league regulation differences. By exploiting this variation in league regulation regarding mandatory visors, we are able to estimate the behavioral impact of forcing a player to wear a visor. We are able to control for league effects using players that always wear visors, independently of the regulation.

Controlling for season and player effects, as well as for league effects that absorb the common effect of other league characteristics on compliers and always wearers, we find that mandatory visor wearing is associated with an increase in aggressiveness, recklessness, and risk taking, as measured by an increase of 0.18 penalty in minutes per game. Our results suggest that once a player is required to wear a visor, its added protection will be partially offset by his change in behavior and potentially impose negative spillovers on others, as reflected in the increase of his penalty in minutes. We also find smaller and less robust effects on performance.

We are confident that our results can be interpreted causally for several reasons described in the text. In particular, we show that our results are not driven by differences in league characteristics that affect compliers differentially. Furthermore, our results hold even if we focus in the variation in visor wearing induced by the 2004 NHL lockout, when for exogenous reasons, players had to move to leagues with mandatory visors and compliers had to play with a visor.

In the presence of compensatory behavior of the type documented in this paper, protective measures may be less effective once implemented. Additionally, compensatory behavior potentially creates negative spillovers on others. In the case of Hockey, many of the actions accruing penalty minutes involve situations in which the player does not only puts himself in a risky situation, but imposes risks on others. This change in behavior and its consequences should be taken into account in any cost benefit calculation of policies mandating safety regulations.

We believe that these insights apply more generally, as abundant anecdotal evidence in the media argue for the presence of the Peltzman Effect in a broad variety of situations. For instance, in the case of condom use it may be the case that free availability may increase the number of sexual partners as the cost of risky sex goes down, which may result in an increase in STDs. This would increase the individuals' utility if it were not for the potential

[10] A different view is that the decision to wear a visor may involve strategic considerations analogous to the prisoner's dilemma since it affects performance relative to other players. In this specific case, mandating the use of a protective measure may improve the well-being of individuals (see Schelling (1978)).

of spillovers, which can create a detrimental effect as a whole. This is particularly true in the case of activities that involve regular interaction.

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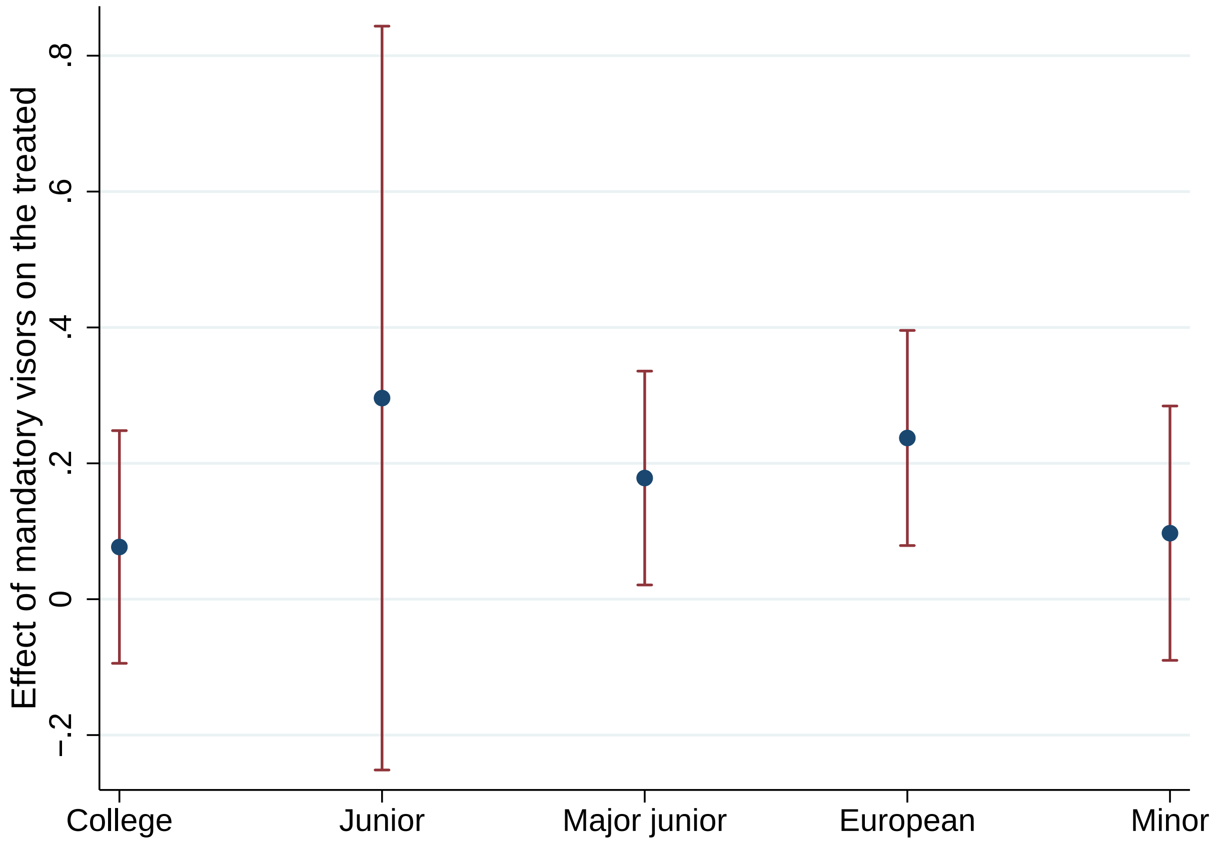

FIGURE 1: EFFECT ON MANDATORY VISOR WEARING IN DIFFERENT LEAGUES. The figure reports the league-specific effect of mandatory visors, for the five broad types of leagues with mandatory visors described in the horizontal axis.

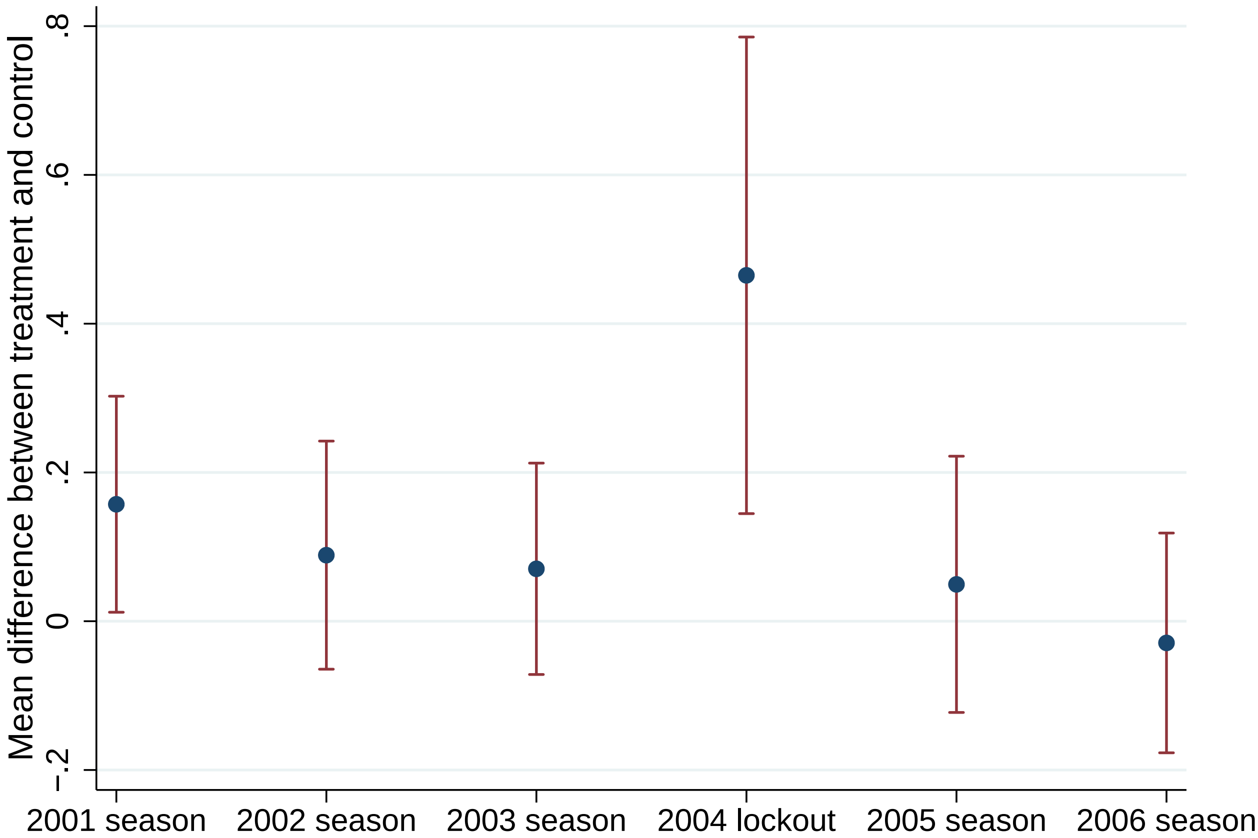

FIGURE 2: COMPLIERS' BEHAVIOR RELATIVE TO ALWAYS WEARERS DURING THE 2004 LOCKOUT AND IN THE 2001-2006 SEASONS. The figure uses the sample of players that were active in the NHL during the 2003 season and moved to a league with mandatory visors during the 2004 lockout. The figure reports the mean difference in penalty in minutes per game between compliers and always wearers for each season, controlling for observable characteristics described in the text.

TABLE 1: SUMMARY STATISTICS.

	Always users ($C_i = 0$)		Compliers ($C_i = 1$)	
	NHL	Other leagues	NHL	Other leagues
Games played	56.84	40.55	47.16	41.43
	(25.28)	(19.28)	(28.26)	(20.32)
Goals per game	0.18	0.33	0.11	0.28
	(0.14)	(0.26)	(0.12)	(0.24)
Assists per game	0.31	0.50	0.19	0.44
	(0.20)	(0.34)	(0.16)	(0.31)
Penalty minutes per game	0.63	1.13	0.94	1.59
	(0.49)	(0.93)	(0.87)	(1.36)
Number of players	269	246	565	538

	Always users ($C_i = 0$)	Compliers ($C_i = 1$)
Birth year	1976.27	1976.48
	(4.29)	(4.12)
Born in Canada	0.42	0.62
	(0.49)	(0.49)
Born in Europe	0.46	0.20
	(0.50)	(0.40)
Born in U.S.	0.12	0.18
	(0.32)	(0.38)
First season	1997.31	1997.89
	(4.47)	(4.43)
Weight	200.09	204.72
	(13.31)	(15.51)
Height	5.80	5.83
	(0.39)	(0.37)

Notes: The table shows summary statistics of the main variables used in the paper. Standard deviation is reported in parentheses. The columns labeled "NHL" include game statistics for the NHL regular seasons 2001,2002, 2003, 2005 and 2006, while the columns labeled "Non-NHL leagues" include game statistics for the same players when they played in non-NHL leagues with mandatory visors.

TABLE 2: EFFECT OF MANDATORY VISORS ON PENALTY MINUTES.

	Player characteristics			Player fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Complier × Mandatory league	0.158***	0.193***	0.177***	0.171***	0.194***	0.182***
	(0.056)	(0.060)	(0.059)	(0.046)	(0.051)	(0.050)
Complier	0.310***	0.166***	0.167***			
	(0.039)	(0.043)	(0.043)			
Mandatory league	0.477***			0.609***		
	(0.068)			(0.051)		
R-squared	0.114	0.291	0.293	0.160	0.193	0.197
Observations	8047	8034	8034	8047	8047	8047
Season effects	Y	Y	Y	Y	Y	Y
League effects	N	Y	Y	N	Y	Y
Player attributes	N	Y	Y	N	Y	Y
League trends	N	N	Y	N	N	Y

Notes: This table shows estimates of the effect of mandatory visor wearing on penalty in minutes per game. In the first three columns we control for player characteristics and the dummy C_i. In the last three columns we include player fixed effects as well as time-variant player characteristics, and league time trends. Player attributes include age, experience, date of birth, draft year, weight and height. Additional covariates are specified in the bottom rows. Robust standard errors clustered at the player level are shown in parentheses below each point estimate. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

TABLE 3: EFFECT OF MANDATORY VISORS ON PENALTY MINUTES (ROBUSTNESS TO DIFFERENTIAL EFFECTS OF LEAGUES' DIFFERENCES).

	(1)	(2)	(3)	(4)	(5)	(6)
Complier × Mandatory league	0.199***	0.184***	0.142***	0.146***	0.081*	0.090**
	(0.050)	(0.050)	(0.049)	(0.048)	(0.042)	(0.039)
M_l interacted with:						
First season	-0.043**					-0.148***
	(0.017)					(0.018)
Age	-0.009					0.082***
	(0.017)					(0.016)
Defender		0.228***				0.089*
		(0.051)				(0.050)
Left Wing		0.150**				0.003
		(0.073)				(0.060)
Right Wing		0.329***				0.183***
		(0.070)				(0.054)
Height			-0.089			-0.076
			(0.067)			(0.054)
Weight			0.009***			-0.001
			(0.002)			(0.002)
European				-0.275***		-0.108*
				(0.077)		(0.064)
Aggressiveness					0.324***	0.464***
					(0.052)	(0.056)
R-squared	0.203	0.202	0.202	0.199	0.223	0.248
Observations	8047	8047	8034	8047	8047	8034

Notes: This table shows estimates of the effect of mandatory visor wearing on penalty in minutes per game. All estimates include players fixed effects. We include interactions between a dummy that captures leagues with mandatory visor wearing (non-NHL leagues), M_l, and different characteristics of the players listed on the left of the table. Robust standard errors clustered at player level are shown in parentheses below each point estimate. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

TABLE 4: EFFECT OF MANDATORY VISORS ON PENALTY MINUTES (ROBUSTNESS TO SPECIFIC LEAGUE CHARACTERISTICS).

	Differential effect by leagues:					
	Average PIM		Competitiveness		North American Leagues	
	(1)	(2)	(3)	(4)	(5)	(6)
Complier × Mandatory league	0.237**	0.236**	0.291***	0.291***	0.175**	0.174**
	(0.114)	(0.114)	(0.095)	(0.095)	(0.072)	(0.072)
Complier in stricter league	-0.051	-0.049				
	(0.149)	(0.149)				
Complier in competitive leagues			0.038	0.038		
			(0.030)	(0.030)		
R-squared	0.190	0.191	0.193	0.194	0.180	0.181
Observations	7913	7913	8047	8047	5824	5824
Time-varying controls	N	Y	N	Y	N	Y

Notes: This table shows estimates of the effect of mandatory visor wearing on penalty in minutes per game. All the specifications include a full set of controls, including league effects, season effects and player fixed effects. Age and experience are added in even columns. Robust standard errors clustered by player are shown in parentheses below each point estimate. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

TABLE 5: EFFECT OF MANDATORY VISORS ON PENALTY MINUTES (ROBUSTNESS USING THE 2004 LOCKOUT).

					Controlling for interactions			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Complier × 2004 Lockout	0.350^{**}	0.382^{**}	0.293^{*}	0.368^{**}	0.224^{*}	0.294^{**}	0.193	0.257
	(0.145)	(0.152)	(0.174)	(0.178)	(0.135)	(0.134)	(0.158)	(0.157)
R-squared	0.300	0.339	0.261	0.309	0.342	0.389	0.305	0.367
Observations	1316	1316	1096	1096	1309	1309	1089	1089
League effects	N	Y	N	Y	N	Y	N	Y

Notes: The table shows estimates of the effect of mandatory visor wearing on penalty in minutes per game using variation induced by changes in league regulation during the 2004 lockout. All specifications include a full set of player, league, and season fixed effects, as well as time varying characteristics such as age and experience. Even columns include league effects instead of a dummy for the 2004 lockout. Columns 1,2 and 5,6 use the sample of players that were in the NHL during the 2003 season and moved to a league with mandatory visors during the 2004 lockout. Columns 3,4 and 7,8 restrict the sample to players that returned to the NHL in 2005 after the lockout ended. Robust standard errors clustered by player are shown in parentheses below each point estimate. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

TABLE 6: EFFECT OF MANDATORY VISORS ON PERFORMANCE.

	(1)	(2)	(3)	(4)	(5)	(6)
	Assists per game			Goals per game		
Complier × Mandatory league	-0.011	-0.018	-0.019	-0.016	-0.024**	-0.022*
	(0.013)	(0.014)	(0.014)	(0.011)	(0.011)	(0.012)
Complier	-0.082***			-0.037***		
	(0.011)			(0.008)		
R-squared		0.436	0.437		0.363	0.366
Observations	8034	8047	8047	8034	8047	8047
Player effects	N	Y	Y	N	Y	Y
League trends	N	N	Y	N	N	Y

Notes: This table shows estimates of the effect of mandatory visor wearing on performance. The first three columns show estimates on assists per game, the last three columns show estimates on goals per game. All models include a full set of controls, including league effects, season effects, player characteristics and league specific trends. Additional covariates are listed in the bottom row. Robust standard errors clustered by player are shown in parentheses below each point estimate. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

Appendix 1: Infractions that result in penalty in minutes

- Abuse of officials: Arguing with, insulting, using obscene gestures or language directed at or in reference to, or deliberately making violent contact with any on or off-ice official.
- Aggressor penalty: Assessed to the player involved in a fight who was the more aggressive during the fight. This is independent of the instigator penalty, but both are usually not assessed to the same player (in that case the player's penalty for fighting is usually escalated to deliberate injury of opponents, which carries a match penalty).
- Attempt to injure: Deliberately trying to harm an opponent.
- Boarding: Pushing an opponent violently into the boards while the player is facing the boards.
- Butt-ending: Jabbing an opponent with the end of the shaft of the stick. It carries an automatic misconduct.
- Charging: Taking more than three strides or jumping before hitting an opponent.
- Checking from behind: Hitting an opponent from behind. It carries an automatic minor penalty and misconduct, or a major penalty and game misconduct if it results in injury. Illegal check to the head: Lateral or blind side hit to an opponent, where the player's head is targeted and/or the principal point of contact
- Clipping: Delivering a check below the knees of an opponent. If injury results, a major penalty and a game misconduct will result.
- Cross-checking: Hitting an opponent with the stick when it is held with two hands and no part of the stick is on the ice. Delay of game: Stalling the game.
- Diving: Falling to the ice in an attempt to draw a penalty.
- Elbowing: Hitting an opponent with the elbow.
- Fighting: Engaging in a physical altercation with an opposing player, usually involving the throwing of punches with gloves removed or worse.
- Goaltender Interference: Physically impeding or checking the goalie.
- Head-butting: Hitting an opponent with the head. A match penalty is called for doing so.
- High-sticking: Touching an opponent with the stick above shoulder level. A minor penalty is assessed to the player. If blood is drawn, a double-minor is usually called. Referees may use their discretion to assess only a minor penalty even though blood was drawn. They may also assess a double-minor when blood is not drawn, but he believes

that the player was sufficiently injured or that the offending player used excessively reckless action with his stick.

- Holding: Grabbing the body, equipment, or clothing of opponent with hands or stick.
- Holding the stick: Grabbing and holding an opponent's stick, also called when a player deliberately wrenches a stick from the hands of an opposing player or forces the opponent to drop it by any means that is not any other penalty such as Slashing.
- Hooking: Using a stick as a hook to slow an opponent, no contact is required.
- Instigator penalty: Being the obvious instigator in a fight. Called in addition to the five minute major for fighting.
- Interference: Impeding an opponent who does not have the puck, or impeding any player from the bench.
- Joining a fight: Also called the "3rd man in" rule, the first person who was not part of a fight when it broke out but participates in said fight once it has started for any reason (even to pull the players apart) is charged with an automatic game misconduct in addition to any other penalties they receive for fighting.
- Kicking: Kicking an opponent with the skate or skate blade. Kicking carries a match penalty if done with intent to injure, but otherwise carries a major penalty and a game misconduct.
- Kneeing: Hitting an opponent with the knee.
- Roughing: Pushing and shoving after the whistle has been blown or checking an opponent with the hands in his face.
- Slashing: Swinging a stick at an opponent, no contact is required.
- Slew Footing: Tripping an opponent by using your feet.
- Spearing: Stabbing an opponent with the stick blade.
- Starting the wrong lineup: When offending team fails to put the starting lineup on the ice at the beginning of each period.
- Substitution infraction: When a substitution or addition is attempted during a stoppage of play after the linesmen have signaled no more substitutions or if a team pulls its goalie and then attempts to have the goalie re-enter play at any time other than during a stoppage of play.
- Too many men on the ice: Having more than six players (including the goalie) on the ice involved in the play at any given time.
- Tripping: Using a stick or one's body to trip an opponent.

- Unsportsmanlike conduct Arguing with a referee; using slurs against an opponent or teammate; playing with illegal equipment; making obscene gestures or abusing an official.

Appendix 2: Leagues in Ice Hockey

TABLE A1: HOCKEY LEAGUES AND VISOR WEARING REGULATION.

Name	Short name	League type	Face protection
National Hockey League	NHL	Pro	Visors are non-mandatory
United Hockey League	UHL	Minor pro	Mandatory since 2004
American Hockey League	AHL	Minor pro	Mandatory since 2006
East Coast Hockey League	ECHL	Minor pro	Mandatory since 2003
Central Hockey League	CHL	Minor pro	Mandatory since 2004
Western hockey league	WHL	Major junior (CA)	Mandatory since 1976
Ontario hockey league	OHL	Major junior (CA)	Mandatory since 1976
Quebec Major junior hockey league	QMJHL	Major junior (CA)	Mandatory since 1976
British Columbia Junior Hockey League	BCJHL	Junior (CA)	Mandatory since 1981
Ontario Provincial Junior A Hockey League	OPJHL	Junior (CA)	Mandatory since 1981
British Columbia Hockey League	BCHL	Junior (CA)	Mandatory since 1981
Saskatchewan Junior Hockey League	SJHL	Junior (CA)	Mandatory since 1981
Atlantic Junior Hockey League	AJHL	Junior (CA)	Mandatory since 1981
Metropolitan Junior Hockey League	MetJHL	Junior (CA)	Mandatory since 1981
Ontario Junior Hockey League	OJHL	Junior (CA)	Mandatory since 1981
Canadian Junior Hockey League	CJAHL	Junior (CA)	Mandatory since 1981
United States Hockey League	USHL	Junior (U.S.)	Always been mandatory
North American Hockey League	NAHL	Junior (U.S.)	Always been mandatory
Western Collegiate Hockey Association	WCHA	College (NCAA)	Mandatory since 1980
Central Collegiate Hockey Association	CCHA	College (NCAA)	Mandatory since 1980
NCAA East Division	H-East	College (NCAA)	Mandatory since 1980
Eastern College Athletic Conference	ECAC	College (NCAA)	Mandatory since 1980
National Collegiate Athletic Association	NCAA	College (NCAA)	Mandatory since 1980
College Hockey Association	CHA	College (NCAA)	Mandatory since 1980
Sweden Elitserien	SEL	European elite	Mandatory since 1969
Finland SM-liiga	FNL	European elite	Mandatory since 1988
Russian Elite League	KHL	European elite	Mandatory since 1994
Switzerland National League A	Swiss-A	European elite	Mandatory by 2004
Deutsche Eishockey League	DEL	European elite	Mandatory since 1998

Notes: This table shows the different leagues used in our study, as well as their respective regulation regarding facial protection. In college leagues, players are required to use a full cage if they are under 18, and may choose between full cage or a visor if they are older. Mandatory visor wearing was introduced in European and international leagues with a "grandfather clause" which exempted some players from wearing a visor. We take that into account when coding the variable M_l.