Institute for Strategy and Business Economics

University of Zurich

Working Paper Series
ISSN 1660-1157

Working Paper No. 93

One for Sure or Maybe Three - Empirical Evidence

for Overtime Play from Swiss Ice Hockey

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October 2010

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This version: October 12, 2010

Abstract

In order to avoid too many tied games after playing the five-minute overtime period, the National Hockey League (NHL) introduced two rule changes in the 1999-2000 season. First, a team that loses in overtime receives one point instead of zero points. Second, the number of skaters in overtime is reduced from five to four. The theoretical literature analyzing these rule changes predicted that they would also produce the unintended side-effect that more games would reach overtime and recommended that a team that wins in regulation should receive three points (instead of two) in order to counterbalance the converse effect. We are the first to empirically support this theoretical prediction using NHL data and data from Swiss ice hockey, in which the rule changes of the NHL were copied in the 2006-2007 season and in which the three-point rule was also introduced.

JEL Classification: D23, L83

Keywords: NHL, Swiss Ice Hockey National League, overtime, incentive effects, three-point rule, rule-changes

*We are grateful to Jason Abrevaya, Leif Brandes, and seminar participants at the University of Zurich for helpful comments. Special thanks go to Christian Wassmer and Martin Merk for providing us with the data. Sabrina Büttler provided excellent research assistance. All remaining errors are our own. Corresponding author: Egon Franck, University of Zurich, Institute for Strategy and Business Economics, Plattenstrasse 14, CH-8032 Zurich, Switzerland; phone: +41 44 634 28 45; e-mail: egon.franck@isu.uzh.ch.

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1 Introduction

In the National Hockey League (NHL), North America's top professional hockey league, league officials came to the conclusion during the 1990s that too many games were ending in a tie after overtime.[1] Based on the assumption that sports fans like to see a winner after devoting two or three hours to watching a game, the NHL decided to change the rules prior to the 1999-2000 season in order to maintain and increase the demand for its product.

Starting with the 1999-2000 season, a team that loses in overtime receives one point instead of zero points. It was conjectured that the old rule rewarded defensive play in overtime. Instead of playing offensively and risking a loss (zero points), teams would prefer to play defensively and secure a tie (one point). By treating ties and overtime losses symmetrically, the new rule was expected to increase the incentives for offensive play in overtime. Moreover, the number of skaters in overtime was reduced from five to four (plus the goal keeper). Removing a skater was likewise expected to promote offense, since four-on-four play increases the speed of the game, making defensive strategies more difficult to implement.

As a result, the rule changes yielded the intended effect, when the percentage of overtime games ending in a tie fell. However, the rule change also had a measurable converse effect.[2] The percentage of games reaching overtime rose in the same time period. In order to mitigate this converse effect, alternatives to the rule changes implemented in the NHL have been proposed in the literature: Awarding three points for a win in the regulation time, the use of four-on-four play for a longer overtime period (e.g., from now 5 minutes to 10 minutes), and the introduction of a shootout after an undecided overtime have all been suggested. Most attention was given to the introduction of the three-point rule. Abrevaya (2004), Longley & Sankaran (2007), and Banerjee et al. (2007) all remark that awarding three points to the winner of a game after the 60 minutes of the regulation time would reduce the portion of games reaching overtime. Whereas Abrevaya's study solely suggests the three-point rule as a possible alternative, the latter two studies support their conclusions with their respective theoretical models.

At the simplest level, the intuition leading to fewer overtime games through the introduction of the three-point rule can be stated as follows: By awarding three points to the winner for a game decided in the regulation time, the rule change simply increases the total available payoff from two to three points. The larger "pie" transforms a win in the regulation time into a more desirable outcome.[3]

[1] See Abrevaya (2004), p 293.

[2] Abrevaya (2004) calls this effect "unintended", Banerjee, Swinnen & Weersink (2007) call it "perverse". Although these normative conjectures might be true, we do not know precisely which goals the league intended to reach with the rule changes. We call the effect "converse".

[3] See Abrevaya (2004), p. 296.

No empirical evidence is available at the time, since the NHL did not introduce this rule. However, the Swiss Ice Hockey National League (Swiss NL) went through a major rule change prior to the 2006-2007 season, which included the introduction of the three-point rule. Compared to the rules that the NHL introduced in the 1999-2000 and 2005-2006 seasons, the rules that the Swiss NL introduced in the 2006-2007 season are different only in terms of the three-point rule. It follows that, by defining adequately observed pre-change periods and post-change periods for the NHL and the Swiss NL, the only remaining difference concerning the point awarding system between the two can be reduced to the three-point rule.

Although supportive theoretical models are presented in the literature, the question whether the three-point rule really mitigates the converse effect finally remains an empirical one. We are able to provide the first empirical support for the theoretical predictions made in the literature concerning the effect of the three-point rule. It seems that the three-point rule contributes to damp the converse effect that more games reach overtime. Matched data from both leagues' regular seasons allow us to empirically compare and examine the two incentive schemes and to draw our conclusions.

One point requires more consideration: the objective function of the league. Abrevaya (2004) discusses the objective functions of the different agents and states that more games reaching the overtime do not have to be a bad state for the league. In this sense, we do not know whether the indicated converse effect is really unintended from the perspective of the NHL. Independent of whether the effect was intended, the focus of this work lies in the analysis of the reasons for the behavior of the teams after the rule changes in the respective leagues and whether the theoretical predictions about this behavior were correct or not.

The paper is organized as follows. In the next section, we briefly review related studies. Thereafter, the rule changes in the NHL and the Swiss NL with their basic incentive effects are briefly explained. We then turn to the data comparison by presenting some descriptive findings of the different leagues, which we then supplement with the results of a probit regression analysis controlling for other factors that might influence the occurrence of an overtime. The final section concludes and reflects on the potential limitations of our approach.

2 Literature

Abrevaya (2004) was the first to study the incentive effects of the rule changes in the NHL in 1999.[4] He analyzed these effects by identifying different scenarios and payoff distributions and applying decision theory. As a result, he showed that the rule changes yielded the

[4]The next section explains the changed elements in the relevant point awarding scheme in the NHL in more detail.

intended effect, since the percentage of overtime games ending in a tie fell. However, the rule change also had a converse effect: the percentage of overtime games rose in the same period. Longley & Sankaran (2007) proposed a general formal model of strategic behavior for the NHL. They added the insight that the decision to adopt an offensive or a defensive on-ice strategy crucially depends on a team's perception of its own strengths relative to those of its opponent. Their model shows that not all teams find it beneficial to adopt a defensive playing style during the regulation time after the rule change. However, they agree that more games reach overtime after the rule change, based on their theoretical model. Banerjee et al. (2007) developed a game-theoretic model that determines optimal team strategies under alternative overtime point awarding systems for the NHL. All three publications finally come to the conclusion that awarding three points to a winner in the regulation time could mitigate the above mentioned converse effect. However, none of these works presents empirical evidence to support the theoretical conclusions.

3 The Leagues and their Changes

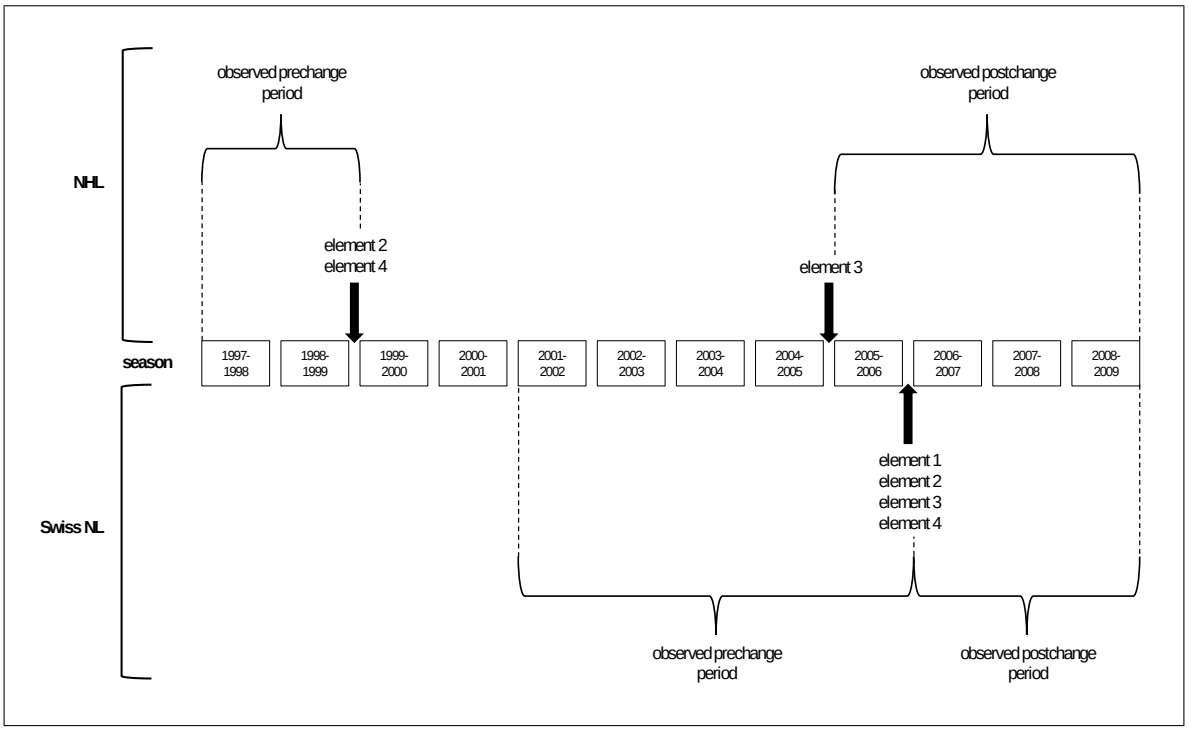
The NHL is North America's major professional ice hockey league. It is divided into two conferences, each with three divisions. Each division consists of five teams. The points gained during the regular season determine the standings of the teams. The best eight teams of each conference according to the respective standings enter the post-season (the playoffs) and compete with each other to win the Stanley Cup. Additionally, the league standings influence the seeding of teams in the playoffs. Our sample period for the NHL consists of the regular seasons 1997-1998, 1998-1999 and 2005-2006 to 2008-2009.[5]

The Swiss Ice Hockey National League (Swiss NL) is the major (semi-)professional ice hockey league in Switzerland. It is divided into National League A (NLA) and National League B (NLB). There are no conferences within the NLA or the NLB. Whereas the NLA is the top division of the Swiss NL, the NLB is the minor division, where most players are semi-professionals. Clubs are allocated between the two divisions at the end of every season based on sportive merit. Though these divisions are linked through promotion and relegation at the end of every season, their teams play a completely independent regular season and playoffs. As in the NHL, the points gained during the regular season determine the division standings of the teams, and the best eight teams according to the division standings enter their respective playoffs at the end of the regular season. The division standings dictate the seeding of teams in the playoffs. Teams compete directly with each other in their division for a slot in the playoffs. Therefore, every game has the same ex-ante importance for reaching the playoffs. We have data from the 2001-2002 through 2008-2009 regular seasons for the NLA and the NLB.

[5]The NHL seasons from 1999-2000 to 2003-2004 are not relevant here, because during this period the shootout rule was not implemented (see Figure 1 and explanation below). Additionally, a lock-out "spoiled" the 2004-2005 season.

In both leagues, the NHL and the Swiss NL, a regular season game lasts 60 minutes, divided into three periods of 20 minutes. A five-minute overtime period is played if regulation time ends in a tie.

Figure 1: Rule Changes over Time in the NHL and the Swiss NL



The four rule changes addressed in this paper are as follows:

Element 1: The winner in the regulation time receives three points (instead of two).

Element 2: The winner in overtime receives two points, but the loser receives one point (instead of zero).

Element 3: The winner in the shootout, which now follows a tied five-minute overtime period, receives two points and the loser one point.

Element 4: The number of skaters in overtime is reduced from five to four (plus the goal keeper).

Elements 2 and 4 were introduced by the NHL prior to the 1999-2000 season. Element 3 was introduced by the NHL prior to the 2005-2006 season. Elements 1, 2, 3, and 4 were introduced by the Swiss NL prior to the 2006-2007 season. Figure 1 depicts the exact introduction time-line of the rule changes in the NHL and Swiss NL.

Table 1 sums up the different point awarding systems resulting from the rule changes in the NHL and the Swiss NL. It is important to notice that both organizations had the same point awarding system before their respective rule changes (1999 in the NHL and 2006 in the Swiss NL). After all of these changes (since 2005 in the NHL and since 2006 in the Swiss NL), both organizations again have the same point awarding system with one exception: in the Swiss NL, the winner in the regulation time is awarded three points instead of two.

Table 1: Point Awarding System in the NHL and in the Swiss NL

	Old Rules	New Rules	
	NHL (until 1998) &	NHL	Swiss NL
Points awarded for	Swiss NL (until 2005)	(since 2005)	(since 2006)
Win in regulation time	2	2	3
Defeat in regulation time	0	0	0
Win in overtime	2	2	2
Defeat in overtime	0	1	1
Tie	1	-	-
Win in the shootout	-	2	2
Defeat in the shootout	-	1	1

The incentive effect of element 1, the three-point rule, is linked to the increase of the total payoff for a game decided in the regulation time from two to three points. As a result, the potential "pie" available for the two teams in regulation time and in overtime is identical. However, in regulation time, this entire "pie" will be awarded to the winner. In terms of net points (relative to the opponent), a win in regulation time gives the winner three points to make a difference to his opponent. A win in overtime or after the shootout only makes a net difference of one point between the winner and the loser. While element 2, the overtime-loss rule, makes losing in overtime more attractive than losing in regulation time, element 1 makes winning in regulation time more desirable than winning in overtime. According to Longley & Sankaran (2007), it is not beneficial for all teams to adopt an offensive strategy. The choice of the strategy depends on the team's own perception of its playing strength relative to the opponent. Teams perceiving themselves as weak may try to play defensively in order to reach overtime and obtain one "secure" point. However, as the authors show, even with only two points awarded to the winner during regulation time, teams perceiving themselves as strong may have incentives to play an offensive style in overtime. These incentives to play offensively in regulation time may become even more pronounced with the introduction of the three-point rule. Whereas element 2 tends to encourage defensive strategies in regulation time for teams perceiving themselves as weak in order to avoid the zero-point payoff, element 1 sets incentives for an even more offensive playing style for teams perceiving themselves as strong.

Element 2, called the overtime-loss rule, was changed because it was conjectured that the old rules rewarded defensive play in overtime. Instead of playing offensively and risking a loss (zero points), teams would prefer to play defensively and secure a tie (one point).[6] With the introduction of element 3, ties are no longer possible. One team has to win, and the realized point difference will now be one point only, regardless of whether the decision is reached during overtime or through a shootout. This smaller point difference together with the absence of a possible tie is expected to increase the incentives for offensive play in overtime. Removing a skater during the overtime (element 4) is expected to produce a similar effect, since four-on-four play increases the speed of the game, making defensive strategies more difficult to implement.[7]

The introduction of element 3, the shootout, simply excludes the possibility of two teams earning one point each. It is clear that one team will win and improve its relative position compared to its opponent in the standings after the shootout. On the one hand, the teams perceiving themselves as strong should try harder to win the game during overtime as the shootout decision could be more stochastic. On the other hand, teams perceiving themselves as weak compared to the actual opponent during overtime could try to reach the shootout because their chance of winning could be higher in the more stochastic setting than in normal play during the overtime.[8] This inclination could even be enhanced by the perception that the weaker team has a high-performing shootout goal keeper or excellent shooters. These overtime team incentives induced by element 3 may be effective during the regulation time as well. Strong perceiving teams may reduce the likelihood of an overtime and the possible "lucky" shootout and try harder to play an offensive style in order to win in the regulation time. Weak perceiving teams instead may already start playing defensively during the regulation time, hoping for the assured point in the overtime and a possible win in the overtime or shootout where they may perceive to have more chances to win.

The considerations from above give reason to conclude that the introduction of all four elements together have the incentive effects the literature predicts: More games will be decided during the five-minute overtime period while the portion of games reaching overtime will stay stable.

[6] See Abrevaya (2004), p. 295.

[7] In the NHL and the Swiss NL, both elements were introduced simultaneously. Abrevaya (2004), p. 298, examined the effects of the separate introduction of element 2 and 4 in the American Hockey League (AHL). He figured out that the introduction of the overtime-loss rule as the only changed element increased the number of games going into overtime in that league.

[8] Match data from the NHL combined with the match betting odds show that the probability that the ex-ante better team wins the shootout is lower than a win during the five minute overtime period. Albeit this difference is not big, it is an indication that the incentive effects might be effective for the teams.

4 After the Changes

The rule changes in the NHL caused the effect that the percentage of overtime games ending in a tie[9] fell from 73.98% in the pre-change period (1997-1998 to 1998-1999) to 55.91% in the post-change period (2005-2006 to 2008-2009).[10] However, the rule changes also had the discussed converse effect: namely, the percentage of games reaching overtime rose from 20.34% to 22.68% in the same period.[11] Because of the rule changes, the percentage of total games reaching overtime and ending in a tie after overtime dropped from 15.05% to 12.68% after the rule change. This decrease would be higher if not counter-balanced by the described converse effect. The first rows in Table 2 summarize the mentioned numbers for the NHL. Despite the fact that we differ in the observation periods, these numbers are quite similar to those provided by Abrevaya (2004).

One could argue that the statistic "percentage of OT games ending in a tie" from Table 2 is superfluous to indicate after the introduction of the shootout as there is always a winner now. In the pre-shootout era, the statistic "percentage of OT games ending in a tie" was meaningful, because it showed the league the extent to which it was still not getting its preferred result - i.e., no ties. Although this argument is true, this statistic is meaningful here as it is a good measure to compare the effectiveness of the two different point awarding schemes on the originally intended effect.

The rule change in the Swiss NL mimics all mentioned rule changes in the NHL and additionally introduces the three-point rule. Theoretically, element 1 should counter-balance the effect that more games reach overtime. This is exactly what can be found in the data of the two divisions of the Swiss NL. Table 2 summarizes the figures for the NLA and the NLB.[12]

In the NLA, the percentage of games reaching overtime insignificantly decreased from 18.65% to 18.63% after the rule change. Therefore, the probability of a game reaching overtime has not been affected by the rule change. In this sense, the given numbers support

[9]Note that in the post-change period (2005-2006 to 2008-2009) the shootout rule became effective in the NHL. There are no tied games anymore. But here we look at the game status before the shootout. So games ending in a tie after the five-minute overtime play are still possible.

[10]The difference is statistically significant with a two-sided p-value of 0.0000.

[11]The difference is statistically significant with a two-sided p-value of 0.0257.

[12]The NHL data is available on the NHL's webpage (www.nhl.com). Match data for the NLA and NLB was provided by Christian Wassmer and Martin Merk (www.hockeystats.ch). One game was excluded due to missing data in the NLA and no games were excluded in the NLB and NHL for this statistic. A comment is needed concerning the observed data from the Swiss NL during the 2004-2005 season. Between 30 to 40 NHL players played several games or that whole season in the Swiss NL due to the NHL lockout in 2004-2005. Among them, there have been several who could be considered "NHL stars" (e.g., Joe Thornton, Rick Nash, Martin St. Louis, Danny Heatley, Daniel Brière, Olli Jokinen, Niklas Hagman, Alex Tanguay, Rod Brind'Amour, Jean-Pierre Dumont). Despite the fact that this situation was uncommon, it has not changed the studied issues. The stated results and conclusions based on the descriptive statistics and the probit estimations do not change when season 2004-2005 is excluded from the analysis the NLA and NLB.

the theoretical predictions that the introduction of the three-point rule let the portion of overtime games be stable. At the same time, the percentage of overtime games ending in a tie decreased from 69.41% before the rule change to 53.42% afterwards. This corresponds to a relative decline of more than 23%, which is statistically significant (with a two-sided p-value of 0.0012). There is a significant difference in the probability that an overtime game would end in a tie before and after the rule change.

Table 2: Game Statistics for the NHL, the NLA and the NLB

	Old Rules	New Rules	Absolute Change	Relative Change
NHL				
Observed games	2173	4920		
% of games going into OT	20.34%	22.68%	+2.34% pt.	+11.50%
% of OT games ending in a tie	73.98%	55.91%	−18.07% pt.	−24.43%
NLA				
Observed games	1367	864		
% of games going into OT	18.65%	18.63%	−0.02% pt.	−0.11%
% of OT games ending in a tie	69.41%	53.42%	−15.99% pt.	−23.04%
NLB				
Observed games	1101	864		
% of games going into OT	15.62%	15.86%	+0.24% pt.	+1.54%
% of OT games ending in a tie	62.21%	47.83%	−14.38% pt.	−23.12%

Table 2 also shows the percentages of games reaching overtime and games ending in a tie after overtime for the minor division of the Swiss NL, the NLB, before and after its rule change. The results are comparable to those in the NLA. The percentage of games reaching overtime after the rule change (2006-2007 to 2008-2009 seasons) slightly rose from 15.62% to 15.86%. However, this change is not statistically significant (with a two-sided p value of 0.8875). Again, the numbers indicate what the theoretical models predict. The percentage of games ending in a tie after overtime shows a strong decline from 62.21% to 47.83% after the rule change in the NLB. This corresponds to a relative decline of more than 23%. This decline is statistically significant (with a two-sided p value of 0.0115). In the seasons after the rule change, significantly fewer games were tied after overtime in the NLB.

5 Probit Estimation Analysis

So far, we have taken a descriptive look at the percentages of games reaching overtime or ending in a tie after overtime, conditional on the described rule changes in the NHL and in

the Swiss NL. Importantly, the statistics of the Swiss NL show that the portion of games reaching overtime has not changed and that more games were decided during overtime after the rule change. We will now proceed with probit estimations to investigate whether the rule changes in the NHL and in the Swiss NL have had an influence on these percentages when controlling for other factors that might affect whether games reach overtime or the overtime decision. Following our reflections and findings from above, we expect that the rule change in the Swiss NL should have no influence on the proportion of games reaching overtime (the main focus of our analysis), while it should be influential on the portion of games decided in overtime. For the NHL, we expect the rule change to alter both the portion of games reaching overtime and the portion of games decided in overtime.

Model 1 is designed to reflect our main focus of analysis and regresses the percentage of games reaching overtime on the implementation of the new rules. In Model 2, the overtime games are analyzed concerning the effects of the implementation of the new rules on the decision during the overtime.[13] We estimate the two models based on the data from the NHL, the NLA, and the NLB. All variables are explained in Table 3.

Table 3: Variable Description

Variable	Description
overtime	1: game reaches overtime, 0: otherwise (dependent variable)
otwinner	1: a team scores and wins the overtime, 0: otherwise (dependent variable)
newrule	1: seasons after the rule changes, 0: seasons before the rule changes
winprobdiff	Indicating the team's difference in playing strength measured in the absolute value of the difference between the winning probability of the home team and the winning probability of the away team.
teamdifference	Indicating the team's difference in playing strength measured in the absolute value of the difference in the seasonal average goal difference: |(goals scored by the home team - goals allowed by the home team) - (goals scored by the away team - goals allowed by the away team)|
matchday	Indicates the day in the season the game takes place
indivision	1: opponents belong to the same division in the NHL, 0: otherwise

The dependent variables of the two models, *overtime* and *otwinner*, indicate whether a game reaches overtime and whether the game is won by a team in overtime, respectively. Whether the game was played prior to or after the rule change is indicated by another dummy variable, *newrule*. According to our expectations, *newrule* should have a positive

[13] In this model specification, the games reaching overtime directly represent the population and not a special sample of all games. Therefore, no problem with sample selection arises.

influence in Model 1 for the NHL but no influence for the NLA and the NLB. This means that the probability of a game reaching overtime should be positively affected by the rule change in the NHL when controlling for other factors. For the NLA and the NLB, the probability of a game reaching overtime should be unchanged after the rule change due to the incentive effects of the three-point rule. In Model 2, we expect a significant positive influence of *newrule* on *otwinner* in all three leagues. Since we talk about the outcome of a sportive contest, the most obvious factor determining a game reaching overtime or not is the relative playing strength of the opponents. It seems reasonable to assume that overtime is more likely in a game in which the opponents have similar playing strengths compared to a game in which there is a clear favorite and a clear under-dog. In order to model the relative playing strength we include the variable *teamdifference* which is the absolute value of the seasonal average goal difference of the two opponents.[14]

To check for the robustness of the estimations results, we perform a similar estimation but with the variable *winprobdiff* as the measure for the competing teams' playing strengths. The *winprobdiff* is the absolute value of the difference in the winning probability of the home and the away team. Betting odds are used due to the feature of inhering all relevant information about the quality of the two teams in a game. We derive the winning probabilities from ex-ante betting odds that have been published for each game.[15] Unfortunately, the betting odds for the first observed NHL season (1997-1998) and for all seasons in the NLB could not be obtained. Therefore, *winprobdiff* could not be calculated for all these games.

As outlined above, we assume that the greater the difference in the teams' playing strengths, the smaller the probability that this game reaches overtime. We therefore expect a negative sign for the coefficient of *teamdifference* and *winprobdiff* in Model 1 for all leagues. In Model 2, however, we do not expect any influence of *teamdifference* or *winprobdiff*. The very short period of five minutes, the reduced number of skaters leading to increased speed of play, and the immediate end of the game in the case of a goal scored ("sudden death") all contribute to the introduction of random effects into the contest success function. Coincidence and luck mitigate the importance of relative playing strength and make the outcome more comparable to the result of a lottery.

Furthermore, *matchday* controls for a time trend within a season as matches may be more important when held late in the season. For the NHL, the dummy variable *indivision* indicates whether the two opponents belong to the same division. The relative point difference between the teams of the same division is important for the conference standings (and therefore for the play-off seeding). Therefore, teams may adopt a different playing style when playing against a team from the same division compared to a team from a different division. The regression results of Model 1 are shown in Table 4.[16]

[14]This measure has already been proposed by Abrevaya (2004), p. 302f.

[15]The used odds are extracted from www.betexplorer.com and were transferred into the market's "implicit probabilities" of the three possible events (win home team, win away team, tie).

[16]Due to missing betting odds data, 1089 matches in the NHL and 20 matches in the NLA were excluded

Table 4: Regression Results Model 1

COEFFICIENT	(1) NHL	(2) NLA	(3) NLB	(4) NHL-odds	(5) NLA-odds
newrule	0.06991*	0.01186	0.03981	0.09057*	0.00771
	(0.03661)	(0.06348)	(0.06996)	(0.04771)	(0.06353)
teamdifference	-0.16016***	-0.06707	-0.13825***		
	(0.03855)	(0.04320)	(0.03593)		
winprobdiff				-0.22599	-0.58307***
				(0.16716)	(0.20934)
matchday	0.00070**	-0.00067	-0.00238		
	(0.00032)	(0.00229)	(0.00262)		
indivision	0.00893				
	(0.03511)				
Constant	-0.80159***	-0.81658***	-0.78869***	-0.80787***	-0.78957***
	(0.04975)	(0.07548)	(0.08386)	(0.04966)	(0.05313)
Observations	7093	2231	1965	6004	2211
Wald χ^2	26.66***	2.539	15.57***	5.432*	7.761**
log likelihood	-3720.73	-1072.04	-846.71	-3174.80	-1059.17

Dependant Variable: *overtime*
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results are in line with our expectations. In Model 1 for the NHL, *newrule* is statistically significant. This indicates that there is a statistically measurable effect of the rule change on the probability that a game reaches overtime. This fact holds for the estimation with *teamdifference* (column 1) and *winbprobdiff* (column 4). For the NLA and the NLB, there seems to be no statistically significant effect that more games reach overtime after the rule changes. For all three leagues, the control variables *winprobdiff* and *teamdifference* have the expected negative signs when they are statistically significant.

The estimations results of Model 2 are shown in Table 5.[17] In Model 2, all estimations for

for the estimation of Model 1 (see columns 4 and 5). There is the possibility of correlation of outcomes across games due to team or even pair of team clusters (match opponents). We controlled for this possible correlation with clustered standard errors (home team and away team cluster and pair of team cluster). The stated results do not change for all estimations listed here.

[17]Due to missing betting odds data, 226 overtime matches in the NHL and 4 overtime matches in the NLA were excluded for the estimation of Model 2 (see columns 4 and 5). There is the possibility of correlation of outcomes across games due to team or even pair of team clusters (match opponents). We controlled for this possible correlation with clustered standard errors (team cluster and pair of team

Table 5: Regression Results Model 2

COEFFICIENT	(1) NHL	(2) NLA	(3) NLB	(4) NHL-odds	(5) NLA-odds
newrule	0.49269***	0.43438***	0.36266**	0.47161***	0.43177***
	(0.07491)	(0.13050)	(0.14570)	(0.09890)	(0.12947)
teamdifference	-0.03027	-0.06248	0.06675		
	(0.07810)	(0.09599)	(0.07677)		
winprobdiff				-0.15112	0.39657
				(0.33218)	(0.42972)
matchday	0.00063	0.00077	-0.00716		
	(0.00063)	(0.00458)	(0.00546)		
indivision	-0.04454				
	(0.06872)				
Constant	-0.67010***	-0.47416***	-0.23108	-0.59818***	-0.58386***
	(0.09763)	(0.15994)	(0.17787)	(0.10426)	(0.10931)
Observations	1558	416	310	1332	412
Wald χ^2	45.17***	11.21**	8.830**	23.14***	12.02***
log likelihood	-1018.37	-268.01	-208.26	-891.02	-264.71

Dependant Variable: *otwinner*
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

all three leagues speak the same language: As *newrule* is statistically significant, the rule changes induced a higher probability that a game is decided during the five-minute overtime period higher in all three leagues. The variables *teamdiff* and *winprobdiff* both are never statistically significant in Model 2. As we expected, it seems that the relative team quality is not determining whether an overtime game gets decided during the five-minute overtime period or not.

Most importantly, the results of Model 1 and Model 2 support the theoretical predictions concerning the three-point rule. In the two Swiss Leagues where the three-point rule is active together with the other changed elements, more overtime games get decided without more game reaching overtime. Although there is as well a smaller fraction of tied overtime games in the NHL after the rule change, the state without the active three-point rule is flagged by a higher portion of games reaching overtime.

cluster). The stated results do not change for all estimations listed here.

6 Conclusion

The Swiss Ice Hockey National League mimicked the 1999-2000 and 2005-2006 NHL rule changes prior to the 2006-2007 season with only one exception: the winner in regulation time is awarded three points (instead of two). This "Swiss exception" is in the catalog of rule changes recommended in the literature in order to reduce the probability of more games reaching overtime after the introduction of the overtime-loss rule.

Indeed, the theoretical predictions made in previous studies that the three-point rule will mitigate the original converse effect of more games reaching overtime are empirically supported by our findings. We see our analysis as the first empirical evidence that supports the theoretical predictions formulated by Abrevaya (2004), Longley & Sankaran (2007), and Banerjee et al. (2007) concerning the introduction of the three-point rule.

It has to be noticed that our study is restricted to a purely empirical analysis of the probabilities that games reach overtime and get decided in overtime. It therefore abstracts from the precise microstructure of the incentive effects triggered by the rule changes as they have been laid out in the strategic and game theoretic models of Longley & Sankaran (2007) or Banerjee et al. (2007). Despite these limitations, our study provides the first insightful empirical review for the theoretical predictions.

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