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Vorwort

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Arne Büschemann Düsseldorf, im April 2015

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List of Abbreviations

ACB	Asociación de Clubs de Baloncesto
CBA	Collective Bargaining Agreement
DEA	Data Envelopment Analysis
EPL	English Premier League
FCI	Fan Cost Index
FDI	Foreign Direct Investment
FE	Fixed-Effects
FFP	Financial Fair Play
FIFA	Fédération Internationale de Football Association
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
GDPPC	Gross Domestic Product Per Capita
IMF	International Monetary Fund
IPPS	Industrial Pollution Projection System
MLB	Major League Baseball
MNE	Multinational Enterprise
NBA	National Basketball Association
NFL	National Football League
NHL	National Hockey League
NHLPA	National Hockey League Players´Association
OLS	Ordinary Least Squares
RE	Random-Effects
SFA	Stochastic Frontier Analysis
SMSA	Standard Metropolitan Statistical Area
UEFA	Union Européenne de Football Association

1 Introduction

Since the article pioneering the concept of sports economy was published by Simon Rottenberg in 1956, academic studies of professional team sports have steadily expanded and gained attention, especially in the past two decades, when substantial increases in both the demand and supply of professional sport teams have combined with greater professionalism among stakeholders. Rottenberg's (1956) uncertainty of outcome hypothesis predicted that, other things being equal, closer competition between teams and across a professional sport league would increase spectators' interest in the sport and attendance rates. Attendance strongly determines the revenues of professional sport teams and companies associated with the industry, and the increased demand and supply can be best illustrated with data from a single game, the 2014 World Cup Final in Brazil. The combined market value of the teams in the final, Argentina and Germany, amounted to €951 million.[1] On average 53,592 spectators attended 64 World Cup games, for nearly 3.5 million attendees throughout the tournament. Even more impressive are the national and global television ratings: In Germany, they reached an all-time high, with a market share of 86.3% and 34.65 million spectators. Across the globe, an audience of more than 1 billion tuned in to this single game.[2]

In addition to being extremely popular, the professional sports industry differs from any other. For example, a monopoly is neither a profitable nor a desirable state for market participants, because the final good is a joint production of the contestants in each league, single game, or contest (Neale, 1964). The stronger the contenders, the greater the profits are, in line with the uncertainty of outcome hypothesis. To maintain

[1] AGF/GfK Fernsehpanel 13.07.2014.
[2] Data obtained from www.transfermarkt.de, though the data on the final global television audience remains unofficial; http://www.bbc.com/sport/0/football/28278945 12.07.2014.

outcome uncertainty, sports economists cite the need for competitive balance; as many studies show, competitive balance correlates with attendance, such that attendance increases when competing teams are more evenly balanced (Forrest & Simmons, 2002; Krautmann & Hadley, 2006; Meehan, Nelson, & Richardson, 2007; Lee & Fort, 2008; Lee, 2009). Measures to maintain or even increase competitive balance include salary caps, revenue sharing, luxury taxes, reverse-order drafts, and exemptions from antitrust law, all which are predominantly applied in U.S. professional leagues (Fort & Quirk, 1995; Szymanski, 2003).

In European sports leagues, such policies were largely absent before 2009, when the administrative body of the European football association (UEFA) implemented its Financial Fair Play (FFP) regulations. These regulations limit teams to spending no more than they earn, even those teams owned by wealthy owners who are willing to invest private money to strengthen their squads and whose habits had begun prompting most teams to overspend to remain competitive (Sass, 2012). Teams that fail to comply with these regulations face the threats of severe financial penalties, transfer bans, and exclusion from international competitions.

Increasing regulations in turn force professional sport teams to strive even harder for superior organizational performance. The organizational goals and outcomes are much clearer for professional team sports than for companies in most other industries. Their key objectives, given their available resources, are sport success and business performance (Guzmán, 2006). Usually, better sport performance translates into greater revenues and profits for team owners (Frick & Simmons, 2008), but superior business performance depends not just on the organization's resource endowment but also on the efficiency with which the team uses this endowment (Gerrard, 2005). This notion

resonates with the resource-based view (RBV), a popular theoretical model of how firms use their resources and capabilities strategically to achieve objectives in an efficient manner (Rumelt, 1984; Wernerfelt, 1984; Barney, 1991). Specifically, the RBV provides a framework for identifying, defining, and attaining a sustainable competitive advantage through the effective, efficient deployment of each firm's rare, valuable resources, which are neither perfectly imitable nor substitutable without great effort (Barney, 1991; Peteraf, 1993). That is, the following four attributes of a resource must exist for a resource to enable above-normal economic rents: It must be valuable, rare, in-imitable and non-substitutable, as summarized by the VRIN model (Barney, 1991):

1. It must be valuable, in that it exploits opportunities or neutralizes threats in the firm's environment.
2. It must be rare among the firm's current and potential competition.
3. It must be imperfectly imitable.
4. It must be non-substitutable, so there cannot be strategically equivalent substitutes that are valuable but neither rare nor imperfectly imitable.

A resource is any asset, capability, organizational process, attribute, information, or knowledge controlled by a firm that enables it to conceive of and implement strategies to improve its efficiency and effectiveness (Barney, 1991).[3] Thus, outperforming competitors requires more than the availability of resources; it also requires the firm to convert its own resources into effective processes. Consequently,

[3] A more general definition by Wernerfelt (1984) refers to a resource as anything that could be thought of as a strength of a given firm.

the ability to exploit resources better than competitors is a key competency (Reed & DeFillippi, 1990).

As an extension of this view, the VRIO framework adds the consideration of whether the firm is appropriately organized to exploit the resource (Barney, 1995). The rationale for adding this factor is the notion that to realize the potential of a valuable, rare, and costly to imitate resource, the firm must be organized in such a way that it can capture that value, as determined by its formal reporting structure, management control systems, or compensation policies, for example (Barney, 1995).

For professional sports teams, the human capital of their players represents both a primary resource and a key expense. However, players cannot be considered strategic resources, because an effective and regulated labor market exists for them. Rather, the abilities to identify future top players and recruit them, using superior scouting capabilities, represent competencies and resources that might lead to a competitive advantage. In addition, the ability to exploit market inefficiencies and sign players at prices below their marginal revenue contributions constitutes another strategic resource. Fritz (2006) cites several other resources and competencies that possess the potential to invoke competitive advantages, such as drawing potential, or the market potential that a given infrastructure produces. This market potential depends on various factors, including population, income per capita, and the history and reputation of the team. Finally, superior marketing capabilities, which might increase sponsorship revenues, and the competency to create effective player and coaching squads are resources with strong influences on sport and financial success.

This dissertation seeks to answer several research questions related to this field empirically. Accordingly, I have gathered data sets from various professional sports, including data about the team-level financial and sport performance of four North American major sport leagues: the National Basketball Association (NBA), National Hockey League (NHL), National Football League (NFL), and Major League Baseball (MLB), as well as from English Premier League (EPL) clubs. I use detailed individual player performance and salary data related to players in the German Bundesliga. My analyses also rely on game- and season-level data from the Spanish basketball top division Asociación de Clubs de Baloncesto (ACB). The financial performance data of professional sport teams are inherently scarce though. For the U.S. team sports, I gathered industry information about team values and revenues from *Forbes Magazine*. For European soccer teams, *Forbes* only reports team values for the 25 most valuable clubs, not entire national leagues. To analyze the financial performance of EPL clubs, I turned to data provided by Deloitte & Touche GmbH, which calculates and publishes revenues in its Annual Review of Football Finance Report.

With these data, I start with an initial assessment of the uncertainty of outcome hypothesis in Chapter 2, by empirically detailing the trade-off between scoring and competitive balance in professional basketball. When it reduced the time of possession from 30 seconds to 24 seconds in 2000, the Spanish basketball federation sought to increase the speed and attractiveness of the game. Two main consequences should result from this rule change. First, the number of points scored per game should increase, due to the greater number of possessions and shot attempts. Second, competitive balance should decrease, because in any game, relative team inequality implies that an increase in possessions will enhance the chances of the better team to win. Using both game- and

season-level data from the Spanish professional league, Chapter 2 confirms that a resulting increase in scoring was accompanied by decreased competitive balance. This finding empirically reveals the trade-off between these two measures, both of which presumably could drive consumer demand. The implications are straightforward: If a sport's governing body is tempted to increase the speed of the games, it faces a significant drawback, in the form of fewer surprising outcomes and less competitive balance, in conflict with recommendations derived from the uncertainty of outcome hypothesis.[4]

Chapter 3 addresses the financial performance of NHL franchises, prior and after a new collective bargaining agreement (CBA) in 2005, which provides an unique setting in which to analyze the impact of a regulatory intervention on managerial efficiency. The new CBA followed the cancelled 2004–05 season, when team owners and the National Hockey League Players' Association (NHLPA) could not reach agreement on a key point. Team owners demanded cost certainty, noting that player salaries consumed more than 65% of the generated revenues, whereas the NHLPA refused to install salary restrictions. The 2005 CBA introduced both salary regulations and revenue sharing to the NHL, in a bid to restore financial competitiveness. With these objectives, the key question is whether the new CBA actually improved efficiency. Using team values as the dependent variable, I show that an abrupt increase in technical efficiencies resulted from the CBA; in particular, poorly performing teams benefited from the newly introduced measures.[5]

[4] A version of this chapter, "The Trade-Off between High Scoring Games and Competitive Balance in Basketball," has been submitted for publication consideration to *Journal of Sport Economics* (Büschemann & Deutscher, 2014).

[5] A version of this chapter, "Did the 2005 Collective Bargaining Agreement Really Improve Team Efficiency in the NHL?" was published in *International Journal of Sports Finance* (Büschemann & Deutscher, 2011).

With Chapter 4, I extend the efficiency analysis to all North American major league franchises and clubs from the English Premier League, investigating the differences in motives between North American and European sport teams, as well as how sporting performance might differentially influence teams' value and revenues. Prior literature suggests that North American team owners tend to be profit-maximizing business people, whereas European team owners are sportsmen and -women. Rather than maximize profits, the sporting group is willing to sacrifice profits to win, such that they ultimately become win maximizers who seek to win at any cost. Yet empirical evidence of this difference remains scarce. Chapter 4 constitutes the first study to analyze cross-continental empirical data and thereby close a research gap, as well as suggest a novel approach for analyzing the determinants of financial performance and the financial and athletic efficiency of professional sport teams. Using data related to 162 teams' financial and sport performance over nine consecutive seasons (i.e., 1,237 team–season observations from 2001–02 to 2009–10), I show empirically that European teams value athletic achievements differently than do U.S. major league franchises, across several sports. The application of data envelopment efficiency analyses affirms these findings.[6]

In Chapter 5, I turn to an analysis at the individual player level to identify determinants of wage dispersions across professional athletes. Several individual characteristics (e.g., age, experience, talent, position, team effects, country of origin, and especially average performance) likely determine player salaries. This chapter investigates how the consistency of professional soccer players' performance might

[6] A version of this chapter, "Sports or Business Approach? A Cross-Continent Analysis of U.S. Major League Franchises and English Premier League Clubs" has been submitted for publication consideration to *European Sports Management Quarterly* (Büschemann, 2014).

affect their salaries. The data set encompasses 845 different players who played in the German Bundesliga between the 2005–06 and 2009–10 seasons, or 34,413 player–match day observations. To measure performance consistency, I calculated a variation coefficient over each season using player evaluations compiled by experts and published in *Kicker Sportmagazin*, a highly respected soccer magazine. Strong empirical evidence indicates that a salary premium rewards players who exhibit performance volatility. Applying ordinary least squares, fixed effects, and quantile regression analyses to disentangle the influence of performance for different parts of the salary distribution, I show that this effect is robust.[7]

Finally, Chapter 6 offers a broader focus and integrates another field of research, by analyzing the effects of environmental regulations on the foreign direct investment (FDI) patterns of German multinational enterprises. Along the lines of inquiry formulated by the so-called pollution haven hypothesis, a traditional economic view suggests that countries with low environmental monitoring and regulations attract multinational enterprises engaged in pollution-intensive production. Yet this hypothesis still lacks empirical support. The applied panel data set contains information about aggregated German outbound FDI and outbound FDI for selected industries from 2000 to 2006. To test for a statistically significant relationship between German FDI and environmental regulations, I employed an environmental ranking published by the World Economic Forum for each year of the sample period. The results reveal that aggregated FDI is indeed redirected toward pollution havens, and this trend is especially evident in polluting industries such as the chemical industry. The results for the automotive industry show instead that FDI follows strict environmental regulations.

[7] A version of this chapter, "Does Performance Consistency Pay Off Financially for Players? Evidence from the Bundesliga," appeared in *Journal of Sport Economics* (Deutscher & Büschemann, 2014).

These results support the Porter hypothesis and reveal that strong future market potential may create a bias against a pollution haven effect.

Chapter 7 concludes this dissertation by summarizing the results and providing an outlook for further research areas.

2 The Trade-Off between High Scoring Games and Competitive Balance in Basketball

2.1 Introduction

In sport contexts, institutional rule changes often seek to level the playing field for teams or increase the attractiveness of the sport to consumers. In basketball for example, the U.S. National Basketball Association (NBA) sought to reduce the domination of physically superior players such as George Mikan or Wilt Chamberlain and increase competitive balance. Recent rule changes in European basketball leagues have prompted closer assimilation with the rules of the NBA, such as the 24-second shot clock. European basketball leagues adopted this rule in 2000, which represented a decrement from the previous time limit of 30 seconds. The goal was to increase the speed of the game and accordingly increase the number of possessions, which should have two main consequences: First, the number of points scored per game should increase, with the greater number of possessions and shot attempts. Second, competitive balance should decrease, because in any game, relative team inequality implies that the increase in possessions will enhance the chances of the better team to win: More repetitions reduce the impact of randomness on outcomes (Groot, 2009). The lessening impact of randomness in turn should reduce competitive balance across the league.

With this study, we provide a novel empirical analysis of the trade-off between the pace of the game and competitive balance, across 20 seasons of Spanish basketball. We find that scoring improved significantly with the introduction of the shorter shot clock, but competitive balance decreased significantly. The finding offers advice to the

organizers of sports, especially for the open league system in Europe where regulations aiming to increase competitive balance are rather hard to imply.

In the next section, we present an overview of studies that address competitive balance in team sports. The data for the empirical analysis and the empirical results appear in Section 3. We conclude with a discussion of these empirical results and an outlook on further research in Section 4.

2.2 Competitive Balance and its Drivers

Research into competitive balance in professional team sports has a long history, starting with Rottenberg's (1956) uncertainty of outcome hypothesis. That is, in the absence of regulation policies, teams located in larger markets sign the most talented players, resulting in predictable match outcomes, which ultimately lead to lower attendance. Neale (1964) similarly argues for the economic importance of team parity in professional sports leagues, to maximize the profits earned by league participants. Most previous analyses focus on North American team sports, particularly Major League Baseball (MLB), and the effects of competitive balance on attendance. They offer consistent support for the hypothesis that attendance is higher when competing teams are more evenly balanced (Forrest & Simmons, 2002; Krautmann & Hadley, 2006; Meehan, Nelson, & Richardson, 2007; Lee & Fort, 2008; Lee, 2009).

Sometimes unplanned changes affect competitive balance though. For example, following the judgment of the European Court of Justice in 1995 in the Bosman ruling—which pertained to whether players should be free to change teams when their contracts have expired—within-season competitive balance increased, according to Flores, Forrest, and Tena (2010). However, research into the effects of planned

institutional changes, including rule changes, on competitive balance remains sparse. Daly and Moore (1981) on the introduction of the MLB draft, and Croix and Kawaura (1999) on the implementation in the Japanese Professional Baseball league find that competitive balance improved after the introduction of a draft. Kent, Caudill, and Mixon (2013) examine the effects of three rule changes on competitive balance that occurred in 1958, 1970 and 1992 relating to player substitutions, to yellow card penalties and to back-pass delaying tactics of seven European professional soccer leagues, and find mixed evidence regarding match competitiveness, which they measured by the score differential. According to Mastromarco and Runkel's (2009) empirical evidence, the Formula 1 organizational body frequently changes its rules to improve competitive balance and maximize profits. They assert that the number of rule changes depends on the competitive balance in the preceding season. Greater imparity in season t – 1 increases the probability of rule changes at the start of season t.

Various measures might help maintain or increase competitive balance, such as salary caps, revenue sharing, luxury taxes, reverse draft order picks, and exemptions from antitrust law, most of which have been applied in major U.S. sport leagues (Fort & Quirk, 1995; Szymanski, 2003). In European sports leagues, prominent policies include financial fair play (FFP), as implemented by the UEFA, and a change in the point awarding system by European football. Sass (2012) predicts the long-term effects of the competitive balance resulting from FFP and finds a negative influence. The change in the point system (from a 2-1-0 to a 3-1-0 scheme) also appears to have promoted greater competitive imbalance (Haugen, 2008).

These studies explicitly measure the impacts of rule changes on competitive balance, without accounting separately for any impact of increased game speed on competitive balance. Yet rule changes generally aim to make the sport more attractive by increasing its pace, which simultaneously decreases competitive balance. With this empirical study, we propose a novel perspective on the trade-off that regulators face, between increasing the attractiveness of the game and maintaining competitive balance.

2.3 Data and Results

The data for this study comes from 20 seasons of the Spanish top division Asociación de Clubs de Baloncesto (ACB). The Spanish national team has performed well in international competition and also helped encourage successful league competition. Over the 20 seasons we consider, Spanish teams advanced to the finals of the Euroleague, the highest tier in professional basketball competition in Europe, 9 times. The data span all games played between the 1990-91 and the 2009-10 season, or 10 seasons before and 10 seasons after the introduction of the shorter shot clock in 2000–01. In most of these seasons, the league featured 18 teams, each of which played all the others twice each season, providing 306 total observations. We gathered information about the final score of the game, game day, and opponents. By aggregating the regular season scores and comparing them against the final standings, we determined our competitive balance measures. Furthermore, to assess the impact of the shot clock change on scoring and competitive balance, we distinguished game-level and season-level measures for various time intervals.

2.3.1 Short, Mid- & Long-Term Effects

In our estimations, we differentiate between short-, mid- and long-term effects. Rule changes might be anticipated by the teams´ general managers and affect their personnel decisions in advance; alternatively, higher scoring and lower competitive balance might exert influences only after the institutional change has been implemented. To specify the short-term effects, we consider one season prior and one season after the rule change; the mid-term effects refer to respectively three and five seasons before and after the institutional change; and to capture the long-term effects, we use the full range of observations, that is, ten seasons prior to and after the implementation of the reduced shot clock. Figure 2-1 illustrates the different observation periods.

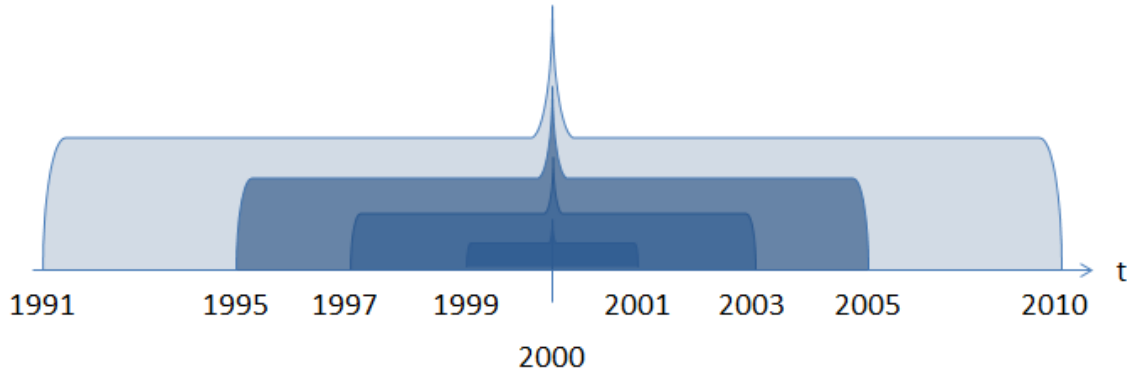

Figure 2-1: Observation periods surrounding the rule change in 2000

2.3.2 Game-Level Measures

The competitive balance measure, at an individual game level, depends on the closeness of the contest, as determined by the absolute difference in points scored. We assume that wins with a narrow margin are more appealing to spectators than games won by large margins.

The absolute value of point differentials $|PD|$ captures the closeness of the score of any single game; on average, these values across the 20 seasons in the sample range

between 9.3 and 12.1. Because our dependent variable $|PD|$ mainly involves small, discrete values, we applied a Poisson regression (Greene, 2003). In addition, we captured the dynamics of each season with the variable "Gameday" serving as a counter for the round of matches within the season, and to control for the difference in ability between teams, we determine the absolute value difference between their ranks in the final table, using the variable DiffStanding.[8]

We apply the following econometric model to determine the impact of the reduction of the shot clock:

$$|PD| = \alpha + \beta_1 Shotclock + \beta_2 Gameday + \beta_3 DiffStanding + \epsilon$$

Table 2-1: Poisson regression: Marginal effects on score differences

| PD |	**Poisson Regression**			
	1-Year Effect	**3-Year Effect**	**5-Year Effect**	**10-Year Effect**
Shotclock	0.806***	0.512***	0.570***	0.930***
Gameday	-0.022+	-0.017+	-0.011**	-0.018***
Diffstanding	0.424***	0.392***	0.379***	0.295***
n	612	1835	3133	6038
Pseudo R^2	0.03	0.03	0.03	0.02

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance.

According to the marginal effects for the estimations in Table 2-1, we find strong support for an immediate impact of the shot clock change on competitive balance. The short-term, one-year effect, which captures differences between seasons directly prior to and after the institutional change, indicates a significant increase of 0.8 in score difference. This result remains consistent for all time frames.

[8] The results for the shotclock variable do not change if we fail to include these control variables.

To measure the impact of the change on scoring, we ran a second regression to determine the drivers of points scored during a game (Total points):

$$Total\ Points = \alpha + \beta_1 Shotclock + \beta_2 Gameday + \beta_3 DiffStanding + \beta_4 Season + \epsilon$$

The marginal effects for these estimations in Table 2-2 again confirm our predictions: The reduction of the shot clock led to an increase in the number of points scored. In the first season after the rule change the influence was especially noticeable, with an increase of 14 points per game. The long-term effects are less convincing but might reflect other factors that emerged over this long period. For example, basketball underwent a development toward greater professionalization during this time, which had effects on the league that are difficult to capture with other control variables.

In both models the mean and the variance are approximately equal neglecting a potential problem from overdispersion in the empirical model.

Table 2-2: Poisson regression: Marginal effects on total points scored

Totalpoints	**Poisson Regression**			
	1-Year Effect	**3-Year Effect**	**5-Year Effect**	**10-Year Effect**
Shotclock	14.62***	6.30***	2.31***	-0.908+
Gameday	-0.033+	-0.000+	-0.057**	-0.081+
Diffstanding	0.156+	0.211***	0.113***	0.067*
n	612	1835	3133	6038
Pseudo R^2	0.04	0.01	0.01	0.00

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance.

2.3.3 Season-Level Measures

At this level, the metrics we use to measure competitive balance reflect the final standings, including indices such as the Gini coefficient and Herfindahl-Hirschman index, as well as deviations in the win percentages. In addition, we consider two dimensions of competitive balance, related to the relative strength of teams in any given season (intra-seasonal balance) or over time (inter-seasonal balance). The most widely applied measure is the ratio of standard deviations (RSD), which controls for both season length and the number of teams (Fort, 2007). The RSD compares the actual standard deviation (ASD) of win percentages against the idealized standard deviation (ISD). Therefore, we compute RSD for a given season t as:

$$RSD = \frac{ASD}{ISD}$$

where:

$$RSD = \frac{\sqrt{\sum_{i=1}^{N} \frac{(WPG_{i,t} - 0.5)^2}{N}}}{\frac{0.5}{\sqrt{N}}}$$

Will N being the number of games each team plays per season, and .5 the win probability for any match in which both teams are equally strong. Greater competitive balance is indicated if the RSD value is lower. Using the final league tables, we measure the average win margin and points scored per match, to control for their effects on game attractiveness, and present the results in Table 2-3.

Table 2-3: Season-level measures of the effects of shot clock rule changes

	Short-Term-Effects			Mid-Term Effects						Long-Term Effects		
Season	1-Year Effect			3-Year Effect			5-Year Effect			10-Year Effect		
	t - 1	t + 1	in%	t - 3	t + 3	in%	t - 5	t + 5	in%	t - 10	t + 10	in%
Totalpoints per match	145	160	10%	154	160	4%	158	160	2%	159	157	-1%
Win margin per match	4.04	5.68	41%	4.18	4.99	20%	4.25	4.72	11%	4.00	4.63	16%
Ratio of standard deviation	1.64	2.31	40%	1.87	2.13	14%	1.95	2.01	3%	1.84	2.00	9%

Immediately after the shot clock reduction, the points per match and win margins rose significantly, by 10% and 41%, respectively. Simultaneously, the competitive imbalance increased by 40%, though the effects diminished over subsequent seasons. These results affirm that an increase in game speed, and thus game attractiveness, is accompanied by a decline in competitive balance, which supports the predicted trade-off between these two outcomes. The contrasting long-term effects might reflect additional rule changes such as the change of the back-pass rule and the stricter interpretation of unsportsmanlike fouls implemented in 2008; the effect of the shot clock change cannot be separated precisely from other, potentially contrary effects.

2.4 Discussion and Conclusion

2.4.1 Limitations

The estimation results offer convincing evidence of a trade-off between scoring and competitive balance, but the impacts on consumer demand can be derived only by relying on previous findings (Szymanski, 2001; Lee & Fort, 2008), because we do not have attendance data for the period we studied. In addition, many studies adopt betting

odds to determine the competitive balance of each game (Deutscher et al., 2013; Berger & Nieken, 2014), with an assumption about the efficiency of betting markets (Fama, 1970; Levitt, 2004), which emerge as valid predictors of actual winning probabilities. Unfortunately, historic betting odds are unavailable.

2.4.2 Implications

This study has demonstrated a trade-off between high scoring games and competitive balance in professional basketball in Spain. Both game- and season-level data support the prediction that the reduction of the shot clock increased scoring but also decreased competitive balance.

The results of the empirical analysis suggest some straightforward policy implications: If a sport's governing body is tempted to increase the speed of the games, it faces a significant drawback, namely, fewer surprising outcomes and less competitive balance. Whereas major U.S. leagues already use instruments such as a rookie draft, salary caps, and revenue sharing, our findings suggest that these procedures are neither limitless nor necessarily successful (Szymanski & Kesenne, 2004). In the worst case scenario, they create incentives for teams to lose games intentionally, in pursuit of better chances of winning more games in subsequent seasons (Taylor & Trogdon, 2002; Soebbing, Humphreys, & Mason, 2013). In Europe, the results are even more noticeable. Its open league system, with promotion and relegation factors, creates a higher hurdle to new rules and regulations, which would affect a large number of clubs.

Basketball is not the only sport that has adjusted its rules to increase the sport's appeal. For example, table tennis increased the required number of sets to win but simultaneously reduced the number of points needed to win a set in 2001. In 1999,

volleyball revised its counting rules. Demand for these sports arguably is lower than that for basketball; it would be interesting for further research to investigate the extent to which these sports experienced effects similar to those that we have outlined here.

Additional research also could investigate another potential positive outcome of the rule change. That is, sports participation might shift due to rule changes that encourage faster, more entertaining games. To test this prediction, researchers could solicit pertinent data from sport federations linked to the development of active members.

3 Did the 2005 Collective Bargaining Agreement Really Improve Team Efficiency in the NHL?

3.1 Introduction

At the end of the 2003-04 season, the National Hockey League (NHL) faced serious financial challenges. Player salaries consumed more than 65% of the generated revenues. Hence, more than 20 of the 30 teams were claiming monetary losses. Small market teams in particular suffered from the steady increase in player salaries; they were unable to compete with big market teams for top players and their generous player contracts. In addition, attendance figures decreased to a 4-year low. Consequently, top free agents were signed by teams with large revenue streams, many of which were located in big markets. There was no new agreement between the team owners and the National Hockey League Players' Association (NHLPA) in sight when the 1995 collective bargaining agreement (CBA) expired. Team owners demanded cost certainty for their teams, whereas the NHLPA initially refused to accept salary restrictions in terms of a salary cap. Subsequently, a novelty in hockey sport history occurred when the team owners announced a lockout and eventually cancelled the entire 2004-05 season. A new agreement was reached in July 2005 and contained several novelties, including a hard payroll cap as well as a revenue sharing plan. The ultimate goal of these measures was to restore financial competitiveness, which as it is proposed, should a priori help financially weak teams to be more competitive. In detail, the CBA includes a salary cap as well as a salary floor. Also, the revenue sharing plan is intended to allow low revenue teams to be more financially competitive. In order to do this, the top ten

teams contribute money to a pool where a minimum of 4.5% of league revenues are to be distributed among the bottom 15 teams.

In order to analyze the financial situation of NHL teams before and after the CBA, and to measure the impact of the CBA, this chapter applies stochastic frontier analysis (SFA). The objective is to provide empirical evidence on whether or not the new CBA did indeed improve financial competitiveness. These impacts of an institutional change can be best observed by analyzing the team efficiency. The methodology has been widely used in the field of sports economics. The most popular choice of output indicators used in the existing literature has been the sporting performance (measured as wins), winning percentage, or points achieved in a given season. For European soccer, Dawson, Dobson, and Gerrard (2000) applied SFA to estimate the efficiency of managers in English professional soccer. In addition, Frick and Simmons (2008) used SFA to measure the effect of variations in managerial compensation on team success in the German Bundesliga. Barros and colleagues (Barros, Del Corral, & Garcia-del-Barrio, 2008; Barros, Garcia-del-Barrio, & Leach, 2009) analyzed technical efficiency of football clubs in the Spanish Primera Division as well as in the English Premier League with a random frontier model. Concerning U.S. team sport franchises Zak, Huang, and Siegfried (1979) were the first to analyze efficiencies of 5 NBA teams with a Cobb-Douglas deterministic frontier model. Hofler and Payne (1997) extended this approach and examined a cross-sectional analysis of all 27 NBA teams for the 1992-93 season in order to observe if teams play up to their potential in terms of actual wins. In a subsequent study, Hofler and Payne (2006) used panel data for the stochastic production frontier model.

In a different strand of literature, Kahane (2005) applied SFA for the NHL and identifies technical inefficiency in production. His results indicate that franchises owned by corporations tend to be more efficient than franchises owned by individuals, and teams with a greater relative presence of French-Canadian players tended to be less efficient. In a similar direction, Fort, Lee, and Berri (2008) applied SFA to address the issue on discrimination in retention of NBA coaches and detected no difference in technical efficiency by race of the coach.

Because team owners postulated over ways to reach cost certainty through the 2005 NHL CBA, it seems to be obvious that team owners are not solely interested in success on the ice and the glory of victory. From the team owners´ perspective, it is imperative that the franchise achieves a positive return of their investment. The present study explores the relationship between the 2005 NHL CBA and financial success of franchise teams relative to their potential. By using team values, as well as franchises´ revenues, as outputs to measure technical efficiencies, the study focuses on economic efficiency. Previous studies, as shown above, predominantly used sporting performance as the output variable for measuring team success. But a sport, even though advocated differently on a regular basis, is not just about winning games. The franchise system of the NHL-which, as stated above, struggled heavily right before the lockout-has to make sure that teams operate efficiently, in terms of financial performance, to ensure the future of the league. Because of this, we deviate from the existing literature by introducing financially important outcome variables.

One method has been ignored in the literature so far: using team values as well as revenues as outputs for measuring technical efficiencies. Thus, the current research is

innovative in this context. Efficiency can also be used as a direct benchmark between franchises operating in the same institutional environment. Our article closes this gap through the analysis of the impact of the new CBA on efficiency; specifically, team value maximization and value generation of low performing teams immediately increased efficiencies after the lockout.

3.2 Data Description

The data set we used includes information on the four seasons prior to the lockout, from 2000-01 to 2003-04, and the four seasons immediately following the lockout, from 2005-06 to 2008-09. At the beginning of the 2000-01 season, the NHL expanded from 28 to 30 teams as the Minnesota Wild and the Columbus Blue Jackets joined the league. Because we took the previous season into account, the resulting (unbalanced) panel data set contained 238 observations on all variables included in the estimates.

Frontier models require identifying inputs and outputs. In order to determine how efficiently the franchises operated, it was essential for us to use a financial ratio as the output. *Forbes* magazine reports data annually on sport franchise´s team values, as well as revenues for all major leagues. It breaks down franchise valuation into four categories: sport, market, stadium, and brand management. Team value has been previously applied as a dependent variable to analyze determinants of franchise values (Alexander & Kern 2004; Humphreys & Mondello, 2008). Therefore, as franchise values are not equally distributed, this study applied the natural logarithm of team values as output. Furthermore, to ensure the robustness of our results, we used the natural logarithm of revenues for each franchise as a second output. This data is also published by *Forbes* magazine on a yearly basis.

The input variables represented the various factors that were most likely to determine a team´s franchise value. Therefore, we included the natural logarithm of the population of each team´s metropolitan area in order to account for market-size effects on franchise values. In metropolitan areas with more than one NHL franchise (e.g., Los Angeles and New York), each franchise was credited with the entire population in the metropolitan area—this is because the market cannot be unambiguously separated between each franchise. Data were obtained from the U.S. Bureau of Economic Analysis´ Regional Economic Accounts and Statistics, Canada. Since franchises share larger pools of potential fans, we expected a positive relationship between teams located in larger markets and franchise values as well as revenues. It should be noted that, unlike in European soccer, only very few fans join their favorite teams for road games. This is due in part to a greater number of games and a lengthier distance between competing teams.

The team´s stadium is another important input factor for multiple reasons. A franchise with a new stadium can expect higher revenues, and hence higher team values due to e.g. state-of-the-art luxury boxes, for example. Alexander and Kern (2004) and Miller (2007) identified that new sport stadiums experience a honeymoon effect, where attendees visit the stadium for the stadium and not necessarily to watch the team, which lasts between 6 to 10 years after inauguration. Hence, we included stadium age, as well as stadium age in quadratic form, in our analysis and expected a negative impact of arena age and an increase in marginal returns on both dependent variables. Data on arena age was collected from Munsey and Suppes´ website (http://www.ballparks.com). In addition, the natural logarithm of attendees per game was included. We assumed that, since each attendee generates revenues for the franchise, the higher the number of

attendees, the greater the team value. To measure this revenue stream, we used the team marketing annual reports from the Fan Cost Index (FCI), which are constructed for each franchise and year.[9] The FCI tracks the cost of attending a sporting event for a family of four.[10] The more a franchise is able to charge for their tickets and other amenities, the more revenues it generates. Thus, we presumed that the coefficient for the FCI would also be positively related to the team value. To analyze how franchise history affects team value, we included the duration of a team in the league and the squared duration of a team in the league. We expect that teams with a longer franchise history also report a higher team value.[11]

We also control for the athletic achievements of a team. Since NHL standings are based on points and not wins, the rank is not expressed in terms of winning percentages; this is because teams receive a point for an overtime loss. We estimated athletic achievement by dividing the team´s total in the previous season by the average points of all teams in the previous season. Following the approach by Miller (2007), points achieved in the previous season are considered to be an important component in determining ticket prices, season ticket sales, media revenues, and advertising prices. We expected a positive coefficient, suggesting that a better athletic achievement in the previous season leads to higher revenues and, therefore, a higher franchise value. One of the most important input factors in professional sports is team expenses. We measure these by including the natural logarithm of the team payroll in our analysis. Data were drawn from *USA Today*

[9] Information is available at Rodney Fort's website at http://www.rodneyfort.com.
[10] The FCI comprises the prices of four average-price tickets, two small draft beers, four small soft drinks, four regular-size hot dogs, parking for one car, two game programs and two least-expensive, adult-size adjustable caps.
[11] We did not include the natural logarithm of the input variables Duration and Age Arena since the value of 0 is not defined.

(http://content.usatoday.com/sports/hockey/nhl/salaries/default.aspx). We assumed that a team with high payroll expenses will offer a superior team quality and, therefore, provides a superior utility to fans. Due to this assumption, we anticipated that higher team expenses would positively influence the team´s value. All monetary magnitudes in this analysis (e.g., team value, FCI, payroll) were deflated by the Consumer Price Index (CPI), which was taken from U.S. Bureau of Labor Statistics, and expressed at prices for the year 2000. Descriptive statistics for all variables introduced above are shown in Table 3-1.

Table 3-1: Descriptive Statistics of indicators influencing team values

Variable	Operationalization	Mean	Min.	Max.
Log Value	Natural log of the team value in Dollar	18.88	18.18	19.78
Log Population	Natural log of metropolitan area population	15.13	13.64	16.76
Age Arena	Tenure of the team in the arena	12.38	0	47
Age Arena²	Squared tenure of the team in the arena	270.0	0	2209
Duration	Duration of the team in the league	34.45	0	99
Duration²	Squared duration of the team in the league	1,964	0	9,801
Relative Points	Achieved points in previous season/average points	1	0.45	1.37
Log Attendance	Natural log of attendance	9.72	9.18	9.97
Log FCI	Natural log of fan cost index	5.46	4.98	5.98
Log Pay	Natural log of team payroll	17.40	16.28	18.11

3.3 Empirical Analyses of Efficiencies

We applied a stochastic production frontier model to explore whether the new CBA did indeed improve technical efficiencies among the teams in the league. In the present study, the output of the teams in the NHL was measured by the team values as

well as revenues after the respective season. To compute technical efficiencies, we applied the model introduced by Battese and Coelli (1995), which allows for time-varying efficiencies. It assumes a log-linear production function for a set of i firms over t time-periods and can be expressed as follows:[12]

$$y_{it} = x_{it}\beta + (v_{it} - u_{it}),$$

$$i = 1, \dots, N \text{ and } t = 1, \dots, T, \qquad (1)$$

Where y_{it} is the natural logarithm of the franchise value, x_{it} is a vector of team-specific input quantities, and β is a vector of unknown coefficients over which the likelihood will be maximized. Furthermore, v_{it} represents a random error term that is assumed to be independent and identically distributed (i.i.d.) $N(0, \sigma_v^2)$. u_{it} is i.i.d. and a non-negative random error term that accounts for technical inefficiency in production, and is further assumed to follow a normal distribution truncated at zero of the $N(m_{it}, \sigma_u^2)$ distribution. m_{it} is given as

$$m_{it} = z_{it}\sigma, \qquad (2)$$

z_{it} is a vector of variables that may influence the efficiency as team value creation, and is a vector to be estimated. Using data from the NHL from 2000-01 to 2008-09, we accomplished a total of 238 observations for 30 teams. Table 3-2 presents the maximum likelihood estimate for our frontier model for franchise values, while Table 3-3 presents results for revenue generation. All results are robust and not vulnerable to either multicollinearity or heteroskedasticity.

[12] The applied software for the frontier analysis is Stata11 SE.

Table 3-2: Stochastic Frontier Estimate for the dependent variable log(Value)

Variable	**Coefficients**	**t-Value**
Log Population	.1076	7.36***
Age Arena	-.0130	-3.25***
Age Arena²	.0003	3.24***
Duration	-.0018	-1.00+
Duration²	.0001	3.62***
Relative Points	.1100	1.46+
Log Attendance	.7048	7.00***
Log FCI	.1333	1.94*
Log Pay	.2955	5.84***
Number of obs.	238	
Log likelihood	86.5	
Chi square	681.83	
Probability	0.000	

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance.

Table 3-3: Stochastic Frontier Estimate for the dependent variable log(Revenue)

Variable	**Coefficients**	**t-Value**
Log Population	.0467	3.63***
Age Arena	-.0067	-1.86*
Age Arena²	.0002	2.06**
Duration	-.0032	-1.97**
Duration²	.0001	4.03***
Relative Points	-.0432	-0.62+
Log Attendance	.7718	8.43***
Log FCI	-.0793	-1.29+
Log Pay	.3609	7.65***
Number of obs.	238	
Log likelihood	107.4	
Chi square	505.44	
Probability	0.000	

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance.

The coherence of the metropolitan area population and both dependent variables was as expected: Market size indeed showed a positive impact. It was not a surprise that both variables—the age of the arena and the squared age—were significant. Although both significance levels were different for the models, both dependent variables decreased as the years played in the facility increase—that is, the arena is not considered to be state-of-the-art after a few seasons, which again reduces fan interest. The positive impact of the squared term can be attributed to relatively old stadiums accommodating nostalgic memories of team history; Madison Square Garden in New York City, for example, is a historic arena, while not belonging to the most modern arenas in the league, still arouses spectators´ interest. As duration in the NHL depicts

the tradition of a team, only the squared term significantly impacted both dependent variables. This can be explained by team tradition, which cannot be established within a short period of time. The negative effect of duration on the nonquadratic term can be explained by the honeymoon effect, which diminished after the inauguration.[13] Although these indicators of arena and team history had the expected impact, sporting performance in the previous season apparently has not—that is, it did not impact team value or revenues in a significant way. In our model, both indicators for match day revenues affected our dependent variables in a positive way: Average attendance and the FCI exhibit statistically significant impacts. Finally, the team payroll-depicting team quality and serving as an indicator for the asset the squad displays—has the expected positive impact on both team values and revenue.

After providing insights on indicators influencing team values in the NHL, and establishing a basis for calculating efficiencies for each team and each season, we pursued the initial inquiry to determine whether the lockout in 2004-05 improved these efficiencies.

Figure 3-1 and Figure 3-2 provide information on the average efficiencies for a particular season on the 10 most efficient teams, the 10 least efficient teams, and the 8-10 teams in between.

[13] The honeymoon effect is an increase in attendance after the opening of a new facility which fades after some time. For literature in major league sports see for example Leadley & Zygmont (2005, 2006) or Scully (1989).

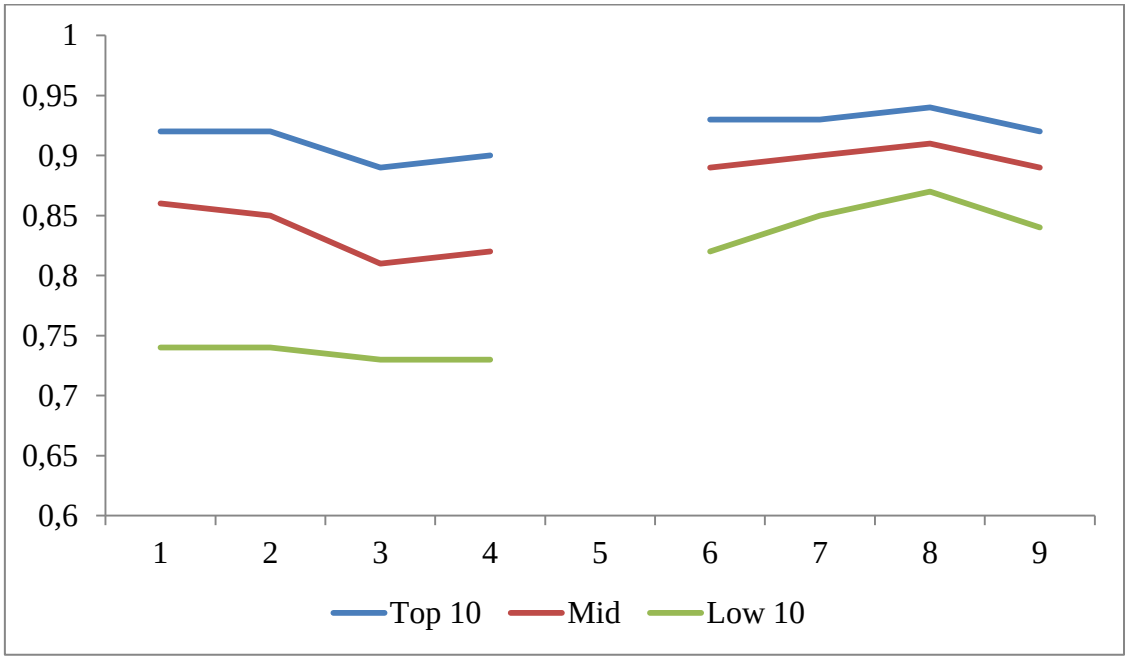

Figure 3-1: Team efficiencies prior to and after the Lockout for the dependent variable log(Value)

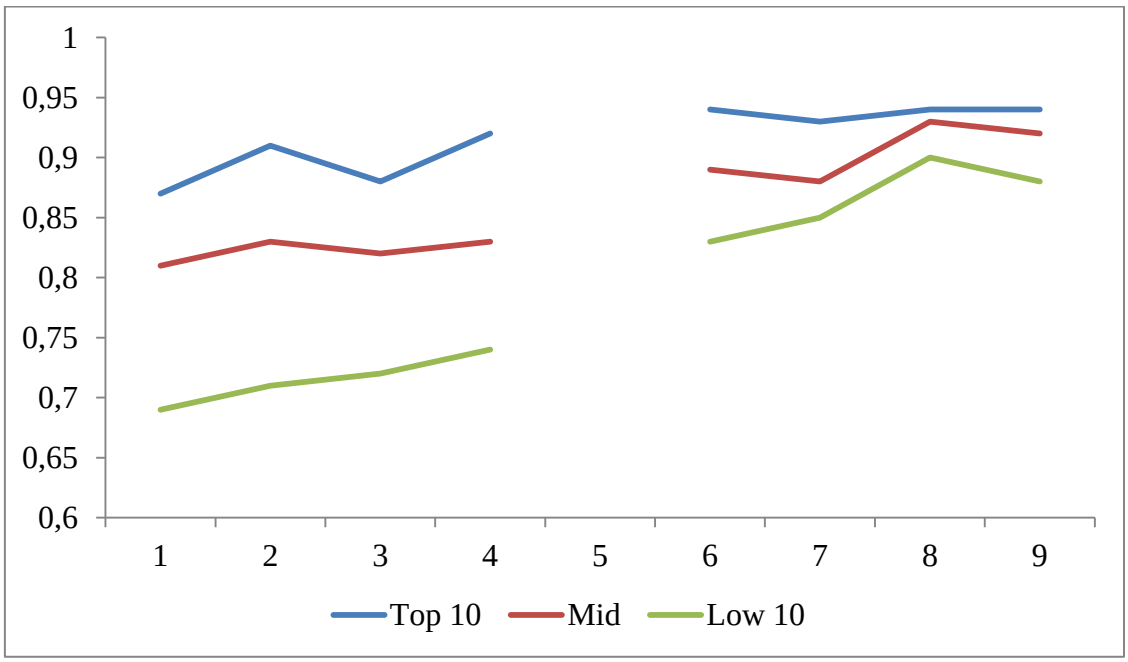

Figure 3-2: Team efficiencies prior to and after the Lockout for the dependent variable log(Revenue)

One can easily observe that efficiencies increased immediately after the lockout season, providing clear support for the hypothesis that the new CBA indeed increased efficiencies. In particular, the low performing teams took advantage of the new CBA to

close the gap to the high performing teams. This is true for both models, as average efficiency for the 10 least efficient teams improved from 0.73 to 0.84 for Model 1, and from 0.72 to 0.86 for Model 2. Once the new CBA was established, average efficiencies leveled off around 7% higher than before the lockout for Model 1 and approximately 9% higher than before the lockout for Model 2. The expectation stated in the introduction, which claims a strengthened competitiveness due to the new CBA, was supported by our estimations.

3.4 Conclusions

This chapter has investigated the impact of the new CBA on efficiencies concerning maximizing team values as well as revenue generation. After the lockout season in 2004, we observed an abrupt increase in technical efficiencies after the new collective bargaining agreement was installed—particularly concerning low performing teams benefitting from salary restrictions and revenue sharing.

As our study is the first to use team values and revenues in connection with measuring technical efficiencies of teams, several follow-up questions arise: For example, it would be of great interest to explore if team efficiencies benefit or suffer from having another major league team in the city; in other words, analyzing whether a tougher competition in a local market would serve as a catalyzer and lead to an increase in managerial performance. Going into more detail, it would be interesting to see if certain combinations of teams from the major league teams could serve as substitutes or complements. As our analysis provides a somewhat surprising result that sporting performance neither influences team values nor team revenues, future research could compare other major leagues to examine its potential influence in other sports.

4 Sport or Business Approach? A Cross-Continent Analysis of U.S. Major League Franchises and English Premier League Clubs

4.1 Introduction

The question of which primary objectives drive professional sport teams has long been controversial among sports economists. A popular strand of predominately U.S. literature adopts the profit maximisation hypothesis, such as in early theoretical models by Rottenberg (1956) and Neale (1964) that regard individual teams or leagues as firms that seek to increase their profits (see also El-Hodiri & Quirk, 1971; Fort & Quirk, 1995; Falconieri, Palomino, & Sákovics, 2004). In contrast, Sloane (1971) provides one of the earliest arguments that European clubs favor wins rather than profits (Rascher, 1997; Késsene, 1999, 2000, 2006; Zimbalist, 2003; Vrooman, 2007). These descriptions have prompted a broad classification, by which North American team owners are profit-maximising business people, whereas European team owners are said to be sportsmen and -women (Fort, 2000; Cain & Haddock, 2005). Rather than maximise profits, the sporting group sacrifices profits to win and ultimately become win maximisers who literally seek to win at any cost (Vrooman, 2007).

A more recent hybrid argument suggests that clubs maximise a weighted sum of profits and wins (Dietl, Grossmann, & Lang, 2011). Although two empirical studies indicate that clubs trade off points and wins (Atkinson, Stanley, & Tschirhart, 1988; Garcia-del-Barrio & Szymanski, 2009), empirical evidence remains scarce, and no cross-continent empirical analysis of North American and European clubs has detailed their distinct economic behaviours or motives contribute to clarify the debate. In response, the current study seeks to both close the research gap and suggest a novel

approach for analysing the determinants of financial performance and the technical financial and athletic efficiency of North American major league sports and English Premier League football (i.e., soccer) teams, using parallel data sets. Information about nine consecutive seasons, from 2001-02 to 2009-10, covers 162 teams from North America's National Hockey League (NHL), National Basketball Association (NBA), National Football League (NFL), and Major League Baseball (MLB), as well as the English Premier League (EPL), producing a total of 1,237 team-season observations. As measures of financial performance, this study uses *Forbes'* franchise valuations for the major league clubs and Deloitte's Annual Review of Football Finance (Deloitte & Touche, 2001-2009) to gather the annual revenues of the EPL clubs. In terms of technical efficiency, this research relies on either winning percentages (NBA, NFL, and MLB) or points per season (NHL and EPL) as a measure of athletic performance. In turn, it offers, to the best of the author's knowledge, the first empirical assessment of the profit and win maximisation hypotheses that combines panel regressions with data envelopment analysis (DEA) in a cross-continental data set.

The results reveal several distinct motives of professional sport teams. In particular, athletic achievement exerts an effect on teams' financial performance only among EPL teams, not across the North American major league franchises. The outcomes of the DEA also indicate that the motives driving the major league franchises tend to be more business oriented, whereas the rationale for the EPL clubs is to maximise their sporting performance.

The next section proceeds with reviews of the existing literature pertaining to the determinants of franchise value and the use of efficiency analyses in professional sports

contexts. Following a brief discussion of the applied data, this study specifies the model and presents the results from the empirical analysis. It concludes with a discussion of the empirical results and limitations, along with an outlook on further research.

4.2 Literature Review

Empirical research into the value of professional sport clubs remains nascent, with just a few exceptions. For example, Humphreys and Lee (2010) and Humphreys and Mondello (2008) analyse franchise sale prices in the four North American Major Leagues. Emphasising the determinants of team value and revenues, Alexander and Kern (2004) find that the income levels and population of the local market, as well as the presence of new facilities and a strong regional identity, influence franchise values for major league teams. Miller (2007) studies MLB, and Miller (2009) investigates the NBA, NFL, and NHL, to extend these approaches and include facility and franchise age, public or private ownership, and duration of the franchise in the city. Büschemann and Deutscher (2011) also incorporate NHL team payrolls, attendance per game, and a fan cost index in their analysis. Scelles, Helleu, Durand, and Bonnal (2013) offer the first comparison of the determinants of franchise values between the North American major leagues and European soccer teams, using the aforementioned set of variables, though they include the team values of only a subset of the 20 most valuable pan-European teams, as published by *Forbes*, which suggests the potential for a selection bias. Table 4-1 contains an overview of previous literature and the relevant empirical findings.

Table 4-1: Literature on determinants of franchise values

Author(s)	Data	Model and Dependent Variable	Empirical Findings
Scelles et. al (2013)	1,130 team-season observations of all major league teams, and 185 European soccer team-season observations, 2004-2011	Panel regression with fixed time effects and natural logarithm of franchise values	Positive influence of historical sporting performance for all major leagues and European soccer; contradictory results for population, income, attendance and sporting performance in t – 1
Büschemann & Deutscher (2011)	Sample of 238 NHL teams from 2000-01 to 2008-09 (except 2004-05 due to lock-out)	Stochastic frontier analysis with natural logarithm of franchise values and revenue	Metropolitan population, team payroll, game attendance, and new facilities increase franchise values; sporting performance in t – 1 and team duration have no significant impacts
Humphreys & Lee (2010)	Sample of 275 franchise sales in the four major leagues from 1960 to 2009	Repeat sales model (generalized least squares) with natural logarithm of franchise sales price	No upward trend in sales prices; market income, population, facility characteristics, and on-field success positively influence franchise values
Miller (2009)	Sample of 1,080 NBA, NFL, and NHL team-season observations from 1991 to 2005	Fixed-effects regression with natural logarithm of franchise value	Local per capita income, sporting performance in t – 1, and private ownership (only NHL) have positive impacts; metropolitan population and duration of teams are not significant
Humphreys & Mondello (2008)	Sample of 173 franchise sales from 1969 to 2006	Hedonic price model with natural logarithm of franchise sales price	Empirical findings indicate that market values are better predicted by expert evaluations. Goals and assists have no significant impact; players' popularity influences their market values
Miller (2007)	Sample of 338 MLB team-season observations from 1990 to 2002	Random effects regressions with natural logarithm of franchise value	Empirical evidence that metropolitan population, sporting performance in t and t – 1, and a new facility, regardless of how it was financed, positively influences team values
Alexander & Kern (2004)	Sample of 680 team-season observations from 1991 to 1997 from all four major leagues (cf. Canadian teams)	Ordinary least squares and fixed-effects regression with franchise value	Market size, team performance, and new facilities increase franchise values. Regional identity, approximated by team name (e.g., Tennessee Titans instead of Nashville Titans), is only significant for MLB teams; income has a negative impact for NHL and NBA and a positive one for NFL

To analyse differences in the motives of owners across countries, this research proposes a nonparametric data envelopment analysis (DEA) as a means to measure efficiency in terms of financial and sporting performance. Prior literature features two approaches to efficiency measures, either DEA or a parametric approach, as exemplified by stochastic frontier analysis (SFA). The main argument in support of DEA is its applicability even with a relatively small sample size (Barros & Leach, 2006; Jardin, 2009; Barros, Assaf & Sá-Earp, 2010). However, unlike SFA, no well-developed statistical tests for DEA exist to validate the specifications of a particular model. Considering though that DEA has been applied in many research fields, including agriculture (Picazo-Tadeo, Gomez-Limon, & Reig-Martinez, 2011), environmental economics (Roghanian & Foroughi, 2010), and public services (Alexander, Haug, & Jaforullah, 2010), and the small sample size mandated by the EPL with its 20 teams per season, the DEA approach seems most appropriate.

Fizel and D´Itri (1997) apply DEA to sports economics to measure the individual efficiency of college basketball coaches. More recent applications of DEA techniques include analyses of sporting and financial performance in European soccer leagues; for example, Barros and Garcia-del-Barrio (2011), Picazo-Tadeo and Gonzalez-Gomez (2010), and Guzman (2006) study the Spanish Primera División; Guzman and Morrow (2007), Barros and Leach (2006), and Haas (2003a) investigate the EPL; Kounetas (2013) studies the Greek Super League; Jardin (2009) focuses on the French Ligue 1; and Espitia-Escuer and García-Cebrián (2010) address participants in the UEFA Champions League. The primary objective of these studies was to examine sporting and financial efficiency and provide benchmarks against peers as the summary in Table 4-2 reveals.

Table 4-2: Literature on data envelopment analysis in sport

Author(s)	Data	Applied Model	Inputs	Output(s)
Kounetas (2013)	14 Greek Super League clubs from 2000 to 2008	Bootstrap DEA and truncated regression	Transfer expenses, contract renewals, operational costs, profits, age, location, and goal ratio	Points and attendance
Barros & Garcia-del-Barrio (2011)	12 Primera Division clubs, from 1996-97 to 2003-04	Bootstrap DEA and truncated regression	Operational costs, team payroll, and total assets	Attendance and other receipts
Barros et al. (2010)	20 Brazilian football clubs from 2006 to 2007	Bootstrap DEA and truncated regression	Operational costs, team payroll and total assets	Attendance and other receipts
Espitia-Escuer & García-Cebrián (2010)	32 teams per season in Champions League from 2003 to 2007	Modified DEA, version by Anderson & Peterson (1993)	Attacking plays, squad size, and ball possession	Goal attempts and number of appearances in UEFA Champions League
Picazo-Tadeo & Gonzalez-Gomez (2010)	20 Primera Division football teams per season from 2001–02 to 2007–08	DEA	Squad size, duration in national first division, and attendance	Points
Jardin (2009)	14 Ligue 1 football clubs from 2004-05 to 2006-07	DEA	Payroll and metropolitan population	Points and turnovers
Guzman & Morrow (2007)	115 EPL team-season obervations from 1997-98 to 2002-03	DEA with canonical correlation analysis	Team payroll and director's remuneration	Points and total revenue
Barros & Leach (2006)	12 EPL teams from 1998-99 to 2002-03	DEA	Squad size, payroll, net assets, and stadium facilities expenditure	Points, attendance, and turnover
Guzman (2006)	14 Primera Division teams from 2000-01 to 2002-03	DEA and Malmquist productivity index	Payroll and general expenses	Turnover
Haas (2003a)	20 EPL teams for the season (2000-01)	DEA	Payroll, coach salary, and metropolitan population	Points, attendance, and revenue
Haas (2003b)	12 Major League Soccer teams in 2000	DEA	Payroll, coach salary, and capacity utilization	Points, attendance, and revenue

Somewhat surprisingly, analyses of the financial efficiency of North American sport leagues remain rare, with the exceptions of Haas (2003b, Major League Soccer) and Büschemann and Deutscher (2011, NHL). Instead, most of these studies focus on the efficiency of sporting performance, measured as winning percentage or points in a given season (Porter & Scully, 1982; Scully, 1994; Hadley, Poitras, Ruggiero, & Knowles, 2000; Einolf, 2004; Hofler & Payne, 2006; Lewis, Sexton, & Lock, 2007). No research addresses cross-continent comparisons.

4.3 Data set and Descriptive Statistics

The analysed data set contains information about nine seasons of four North American major league franchises and all teams participating in the EPL, though the data for the NHL only span eight seasons, due to the 2004-05 lock-out. In total, 32 NBA, 32 NFL, 30 NHL, 31 MLB, and 37 EPL teams appear in the data set, yielding for 1,237 team-season observations. During the observed period, four franchises relocated permanently (Montreal Expos, Vancouver Grizzlies, Charlotte Hornets, and Seattle Supersonics) and thus were treated as new observations, because the franchises began operating in a different market and played in new facilities. The analysis of the determinants of financial performance required the use of a financial ratio as the dependent variable. *Forbes* magazine provides sport franchises' annual team values for all major leagues, departed into four categories: sport, market, stadium, and brand management. It recently has begun to publish team values for European soccer clubs too, but it includes only the 25 most valuable European teams and does not specify valuations for particular leagues. Because of this data constraint, the current study relies on revenues, instead of franchise values, for EPL clubs. Vine (2004) and Fort (2006) further argue that the *Forbes* values generally represent a simple multiple of revenues

by some factor, between 3 and 5.5, so the results should be comparable across the different analysis methods. The EPL data were available in Deloitte's Annual Review of Football Finance (Deloitte & Touche, 2001-2009). Because franchise values and revenues are not normally distributed, this study applies the natural logarithm of team values and revenues.

The explanatory variables represent various factors that prior studies have suggested are likely determinants of franchise values and revenues. The natural logarithm of the standard metropolitan statistical area (SMSA) population and SMSA per capita income both control for market size effects. Teams located in larger, possibly wealthier markets have access to a larger pool of potential fans and thus enjoy favourable positions in terms of negotiating more lucrative cable television contracts or increasing gate receipts and game-day revenues. In metropolitan areas with more than one team (e.g., Los Angeles, New York, London), the entire population in the metropolitan area gets assigned to each team, because it is impossible to unambiguously separate the market across the multiple teams. Ultimately, a positive relationship is likely among population, income, and team values (Alexander & Kern, 2004; Miller, 2009; Scelles et al., 2013). The major league data came from the U.S. Bureau of Economic Analysis, which produces Regional Economic Accounts, and Statistics Canada; the EPL data came from the Office for National Statistics.

Team stadiums also constitute important factors. A team with a new stadium can expect higher revenues, from the sale of luxury suites and enhanced concession revenues (Miller, 2007; Scelles et al., 2013). Therefore, facility age should have a negative sign indicating a positive effect of new opened arenas on team values; the

relevant data came from http://www.stadiumguide.com and http://www.ballparks.com. Another age variable, namely, the duration of a team in the league, accounts for how team history affects team values. A relegation and promotion system exists only in European football, so for the EPL teams, this study uses total duration in the first division. In general though, teams with a longer team history should report higher team values.

In addition, by including the natural logarithm of attendees per game, this study acknowledges that more attendees should increase team value, because each attendee generates revenue. Attendance relates to but is distinct from another potentially influential variable, namely, sporting performance in the previous season (Alexander & Kern; 2004; Miller, 2007). This performance influences ticket prices, season ticket sales, media revenues, and advertising prices. The measure of performance reflects the athletic achievements of the entire team; Winning percentage is included to control for this effect. NHL and EPL standings are based on points, not wins (e.g., a team gains a point for an overtime loss in the NHL or for a draw in EPL), so for these leagues, sporting performance equals the ratio of points achieved by the team in the previous season, divided by the average points of all teams in the previous season. The effect of a strong performance in the previous season on franchise values and team revenues should be greater for win-maximising teams (EPL) than for revenue-maximising teams (all other teams).

The salaries paid to players average at least 50% of total team expenses and are therefore a key determinant and potential differentiating factor. Including the natural logarithm of the team payroll in the analysis reflects the assumption that higher

expenses lead to superior team quality, which has more utility for fans. That is, higher team expenses should enhance team value. Salary data were obtained from Rodney Fort's Sports Business Data for all major league franchises and Deloitte's Annual Review of Football Finance for EPL clubs. Any monetary variables (i.e., team values, revenues, payroll, and income) are deflated by the Consumer Price Index, taken from the U.S. Bureau of Labor Statistics for major league teams and the U.K. Statistics Authority for EPL teams, and normalised to their level in the year 2000 (2000 = 100). The descriptive statistics for all these variables are presented in Table 4-3.

Table 4-3: Descriptive statistics

Variable	Operationalization		NBA				NFL				NHL				MLB				Premier League			
			Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Log Value (Revenue)	Natural log of team value in Dollar (GBP)	overall	8,43	0,11	8,13	8,71	8,83	0,11	8,53	9,13	8,19	0,14	7,90	8,58	8,46	0,18	7,96	9,09	7,78	0,25	6,79	8,44
		between		0,10	8,20	8,66		0,07	8,74	9,03		0,13	8,03	8,46		0,17	8,04	8,94		0,22	7,13	8,27
		within		0,06	8,23	8,55		0,09	8,55	8,99		0,06	8,03	8,33		0,08	8,19	8,68		0,10	7,44	8,12
Log Pay	Natural log of team payroll	overall	7,71	0,11	7,32	8,66	7,89	0,08	7,63	8,09	7,54	0,13	7,07	7,87	7,80	0,18	7,12	8,27	7,59	0,23	7,05	8,20
		between		0,07	7,57	7,90		0,02	7,86	7,93		0,09	7,38	7,73		0,16	7,49	8,19		0,20	7,16	7,96
		within		0,09	7,46	8,54		0,08	7,64	8,08		0,09	7,23	7,79		0,09	7,42	8,05		0,13	7,18	8,20
Log Population	Natural log of metropolitan area population	overall	6,58	0,34	6,00	7,28	6,49	0,35	5,46	7,28	6,57	0,38	5,92	7,28	6,65	0,28	6,18	7,28	5,85	0,68	4,82	6,92
		between		0,34	6,02	7,27		0,35	5,47	7,27		0,39	6,02	7,27		0,28	6,19	7,27		0,63	4,84	6,89
		within		0,02	6,50	6,62		0,02	6,40	6,54		0,03	6,47	6,75		0,01	6,59	6,70		0,08	4,81	6,00
Log Attendance	Natural log of attendance	overall	4,23	0,06	4,05	4,35	4,83	0,06	4,56	4,95	4,22	0,06	4,04	4,35	4,46	0,14	3,90	4,72	4,51	0,15	4,18	4,88
		between		0,05	4,14	4,32		0,05	4,69	4,93		0,05	4,12	4,32		0,14	3,99	4,68		0,14	4,20	4,85
		within		0,02	4,05	4,30		0,03	4,70	4,96		0,03	4,09	4,39		0,07	4,24	4,64		0,04	4,26	4,64
Log Income	Natural log of metropolitan area income	overall	4,54	0,06	4,36	4,70	4,54	0,06	4,43	4,70	4,54	0,10	3,51	4,74	4,55	0,06	4,36	4,70	4,30	0,13	4,08	4,55
		between		0,06	4,36	4,68		0,06	4,45	4,68		0,06	4,43	4,67		0,06	4,40	4,68		0,13	4,10	4,53
		within		0,02	4,46	4,63		0,02	4,50	4,63		0,08	3,61	4,81		0,02	4,47	4,64		0,03	4,20	4,37
Sporting Performance	Achieved WPG/Points in previous season	overall	50,18	14,49	15,85	81,71	50,05	19,27	0,00	100,00	1,00	0,17	0,45	1,37	50,04	7,23	26,54	71,60	1,07	0,28	0,66	1,84
		between		9,61	26,80	70,73		9,88	27,78	70,84		0,11	0,78	1,28		4,78	41,63	59,28		0,24	0,66	1,60
		within		11,48	17,66	80,80		16,65	6,29	88,94		0,13	0,53	1,32		5,49	31,11	70,07		0,12	0,75	1,42
Duration	Duration of team in the league	overall	30,41	14,42	0,00	63,00	43,21	23,46	1,00	89,00	34,16	28,00	0,00	99,00	58,70	40,57	0,00	131,00	119	13,85	73,00	147,00
		between		15,54	1,00	59,00		23,80	4,00	85,00		28,28	4,38	95,00		41,26	2,00	127,00		14,80	75,50	146,00
		within		2,65	25,12	39,12		2,57	39,21	47,21		2,77	29,78	38,78		2,55	54,70	62,70		2,75	113,61	124,01
Age Arena	Tenure of team in the arena	overall	13,86	10,51	1,00	47,00	17,91	15,02	1,00	79,00	14,28	10,84	2,00	49,00	24,47	25,13	1,00	98,00	80,28	47,12	1,00	151,00
		between		10,02	5,00	43,50		12,82	5,00	49,00		10,46	6,00	45,00		23,64	5,00	94,00		46,40	5,67	151,00
		within		3,25	5,64	32,64		8,11	-11,87	76,35		3,36	-2,23	28,65		8,42	-479703	47,14		14,06	31,10	167,08

4.4 Empirical Regression Model

Because of the unbalanced panel traits of the data set, the empirical specification is:

$$lnValue_{it} = a_1\, PAY_{it} + a_2\, POPULATION_{it} + a_3\, ATTENDANCE_{it} + a_4\, INCOME_{it} + a_5\, SP_{it,t-1} + a_6\, DURATION_{it} + a_7\, TENURE_{it} + \beta_i + \varepsilon_{it}\ ,$$

where $lnValue_{it}$ is the logarithm of the value or revenue of team i in year t, $a_{1 \ldots n}$ represent the coefficients of the explanatory variables that determine the value or revenue, β_i (i = 1, …, n) is the unknown intercept for each entity, and ε_{it} is the error term. In this empirical analysis, each league undergoes a separate estimation, because each has different, league-specific regulations and policies. For example, MLB is exempt from antitrust laws; the extent of revenue sharing also strongly varies across leagues (Alexander & Kern, 2004). Because the data exhibit a panel structure, a Hausman test applies to each sub-sample; all data sets rely on fixed effects estimations, with the implication that unobserved team characteristics are present (Hausman, 1978).

4.5 DEA Efficiency Model

To evaluate the relative efficiency of the leagues under consideration with regard to their athletic and financial output, this study uses DEA, a linear programming technique introduced to measure the relative efficiency of decision-making units (DMUs), such as sport teams that transform inputs into outputs (Charnes, Cooper, & Rhodes, 1978; Banker, Charnes, & Cooper, 1984). Specifically, DEA compares the levels of inputs and outputs of one DMU with those of the rest of its peer group. The DMUs that produce the highest output with a given set of inputs define the efficient frontier, and the inefficiency of the other DMUs depends on their distance from this

efficient frontier. The weighting of inputs is defined by the algorithm and is therefore endogenous. Efficiency scores range between 0 and 1, where 1 indicates a perfectly efficient team. Mathematically, DEA resolves a linear programming formulation, assuming constant returns to scale (Farrell, 1957):

$$Min\ \lambda_i$$

subject to $y_i \leq z_i Y$

$$\lambda_i x_i \geq z_i X$$

$$z_i \geq 0$$

where λ_i is the technical efficiency index reflecting an orientation to the input; y_i and x_i are the vectors that represent the quantities of m products produced by the organization and the quantities of k inputs, respectively; Y is the m × n DMU matrix; X is the k × n DMU matrix; and z_i is a vector of constants. According to Dyson et al. (2001), the number of DMUs must be at least twice the product of the number of inputs × number of outputs.[14] For this current data set, the fewest DMUs come from the EPL sample (20), which is greater than 2 × 1 × 7 = 14, so the ratio of DMUs to inputs/outputs is sufficient. Because DEA technique fails to include any statistical properties or account for measurement errors, Simar and Wilson (1998, 2000) propose a bootstrap technique that estimates 95% confidence intervals for each DMU, such that they overcome this limitation and obtain bias-corrected results. Therefore, this study applies bootstrapped DEA with 2,000 replications.

[14] An alternative calculation method is: Number of DMUs = 3 × (m + n), where "m" and "n" are the number of inputs and outputs respectively (El-Mahgary & Lahdelma, 1995; Despotis, 2002).

4.6 Econometric Findings

4.6.1 Results of the Fixed-Effect Regression

Table 4-4 displays the results of the fixed-effect regressions. As expected, the indicator for superior team quality (as measured by team payroll) affects the dependent variable positively, though the impact is not statistically significant for the NBA. The market size indicators, per capita income and population, generally indicate the expected positive sign but are not consistently statistically significant. Population is significantly positive for the NBA and significantly negative for the NFL; per capita income is significantly positive for NHL and MLB franchises and significantly negative for the NFL. In the EPL sample, both indicators reveal a positive but statistically insignificant result, perhaps because almost 60% of the team-season observations refer to three areas (London, Liverpool, and Manchester). The negative impact among NFL teams may stem from the league's extensive revenue-sharing system, which minimises market size effects across teams (Alexander & Kern, 2004). Moreover, the market size effects for MLB in this study contradict the results obtained by Miller (2007).

The proxy for game-day revenues indicates a positive impact on the dependent variable, and average attendance has a statistically significant impact in all samples. In addition, team history reveals the expected positive effect in all samples. Regarding facility age, the expected negative sign emerged in all samples but was significant only for MLB and NFL teams. For the EPL teams, this result might arise because the data set includes information on the overall age of the stadium but does not account for major renovations to existing stadiums due to data constraints.

To test the main hypothesis, namely, that sporting performance affects team values only among win-maximising teams, this study regresses the impact of sporting performance in the previous season on team values. In support of the predicted effects, sporting performance in the previous season was strongly statistically significant for the EPL teams but not significant for any North American major league. In the absence of revenue sharing (cf. national cup games) and with the qualification regulations for participating in European competitions (e.g., UEFA Champions League, UEFA Europa League), superior sporting performance is a requisite condition for EPL teams. Participating in one of the European competitions in turn sparks enormous increases in revenues. For example, gross commercial revenue from the UEFA Champions League for 2013-14 is estimated at €1.34 billion, which gets distributed among the participating teams, according to their level of success. Furthermore, the European system of promotion and relegation is based on win–loss records, and being promoted to the first division leads to higher revenues, due to better merchandise sales, higher ticket prices, and access to more broadcasting rights; being excluded from the first division implies less revenue. In contrast, a poor win–loss record in the North American major leagues actually prompts some rewards, in the form of higher draft picks for the next season.

With regard to the explanatory power of the regressions, the R-square value for the NFL sample is considerably lower than those of the other samples, in line with Miller's (2009) findings. It might reflect the primary driver of NFL revenues, that is, national television contracts. In the descriptive statistics, the betweenness variation for the dependent variable is lowest for the NFL, which implies that the variation in NFL franchise values is small—again likely an artefact of the league's revenue-sharing agreement, which makes it harder to find team-specific determinants (Winfree, 2012).

Table 4-4: Estimates of the fixed-effects regression

	NBA		NFL		NHL		MLB		EPL	
Variable	**Coef.**	**SE**	**Coef.**	**SE**	**Coef.**	**SE**	**Coef.**	**SE**	**Coef.**	**SE**
Log Pay	0.0222	0.0311	0.0573*	0.0337	0.0911**	0.04	0.1704***	0.0375	0.2254***	0.0428
Log Population	1.0451***	0.1751	-0.4353***	0.1646	0.1345+	0.1624	-0.3857+	0.3122	0.0363+	0.0437
Log Attendance	0.6745***	0.0749	0.2951***	0.0881	0.7052***	0.1188	0.2211***	0.0555	0.6509***	0.1438
Log Income	0.1933+	0.1551	-0.8484***	0.16	0.1943***	0.0462	1.2806***	0.1995	0.1457+	0.1858
SP (t-1)	0.0002+	0.0002	-0.0001+	0.0001	0.0268+	0.0277	0.0001+	0.0001	0.1188***	0.0266
Duration	0.0086***	0.0026	0.0363***	0.0013	0.0051***	0.0018	0.0162***	0.0018	0.0162***	0.0026
Age Arena	-0.0008	0.0011	-0.0012***	0.0002	-0.0016	0.0012	-0.005*	0.0003	-0.0001+	0.0004
Constant	-2.6077**	1.3344	12.085***	1.3828	2.5757*	1.0851	1.9090+	2.2343	-0.9567+	1.2735
Number of obs.	263		285		237		269		183	
R-squared within:	0.6098		0.876		0.4459		0.7047		0.8197	
R-squared between:	0.4169		0.0077		0.7004		0.1065		0.263	
R-squared overall:	0.3121		0.0226		0.636		0.0982		0.2792	
sigma_u	0.3986		0.8544		0.1061		0.6517		0.3016	
sigma_e	0.0424		0.035		0.0505		0.0474		0.0472	
rho	0.9887		0.9983		0.8154		0.9947		0.976	
Probability	0		0		0		0		0	

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance; SP = Sporting performance; SE = standard errors.

In summary, the differences in the determinants that influence team values and revenues between North American major leagues and the English Premier League is apparent only through a close consideration of sporting performance. To explicate the results from the regression analysis in more detail, the next section focuses on athletic and financial efficiency results as well.

4.6.2 DEA Efficiency Results

On the basis of an efficiency analysis with an assumption of constant returns to scale, Table 4-5 provides the bootstrapped global technical efficiency scores for sporting technical efficiency, for which winning percentage or relative points obtained in season t is the output. Table 4-6 then presents the global technical efficiency scores for financial efficiency, where franchise values or revenues for EPL are the output. The input factors are identical to the explanatory variables applied in the regression analysis. The separate analyses for each league reflect each team's annual efficiency scores for 2001-2009, using a comparison of each team with its peers on an annual basis.

Table 4-5: Global technical efficiency scores for sporting efficiency

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Mean**
EPL	0.905	0.928	0.950	0.879	0.806	0.915	0.892	0.919	0.972	**0.907**
NBA	0.840	0.828	0.805	0.767	0.813	0.856	0.824	0.744	0.791	**0.807**
NFL	0.718	0.809	0.735	0.739	0.703	0.763	0.685	0.710	0.697	**0.729**
NHL	0.886	0.914	0.887	0.922	-	0.855	0.875	0.941	0.940	**0.902**
MLB	0.934	0.928	0.911	0.933	0.926	0.939	0.905	0.869	0.942	**0.921**

In the test to determine if the overall sporting efficiency in the EPL exceeds that of the major league franchises—which would affirm that the EPL is more win-oriented

than its North American counterparts—the EPL actually ranked second, with a mean efficiency of 0.907, whereas the mean efficiency of MLB was 0.921. In general, these results indicated that the two leagues achieved 90.7% and 92.1% of their potential, respectively. The mean efficiency scores across the other major league franchises varied considerably, such that NFL franchises exhibited an efficiency score of just 0.729, and the NBA franchises reached 0.807. Applying a t-test proves that the difference of means between the leagues is statistically significant different from 0.[15] The likely explanation for the considerably lower score for the NFL again derives from the revenue-sharing regulations. Regardless of their level of success on the field, NFL franchises receive a fixed percentage of the league's overall revenues, such as those earned through broadcasting contracts. Therefore, NFL franchises do not depend as much on local income, such as game-day revenues, as the other major leagues do.

This argument also received support from the results for financial efficiency in Table 6, because the revenue-maximising major league franchises performed closer to the efficiency frontier than the win-maximising EPL clubs. That is, all the North American major leagues reported higher overall mean efficiency scores than those obtained by the EPL. The NBA and NFL franchises were the top ranked, with overall mean efficiency values of 0.919 and 0.909, respectively, followed by MLB (0.897) and NHL (0.886) franchises. The EPL's overall mean efficiency score of 0.878 ranked last. In a comparison with the results for sporting efficiency, if the NBA and NFL are excluded as outliers, all leagues operated in similar proximity to the economic frontier,

[15] The p-Value of 0.000 denotes rejecting the null hypothesis that the difference between the means is zero.

such that the difference between the first ranked NBA and last ranked EPL was relatively small.

Table 4-6: Global technical efficiency scores for financial efficiency

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Mean**
EPL	0.882	0.848	0.841	0.919	0.901	0.828	0.909	0.885	0.890	**0.878**
NBA	0.937	0.946	0.905	0.926	0.875	0.911	0.911	0.922	0.938	**0.919**
NFL	0.812	0.869	0.929	0.934	0.915	0.925	0.955	0.922	0.922	**0.909**
NHL	0.901	0.867	0.877	0.902	-	0.898	0.886	0.871	0.882	**0.886**
MLB	0.884	0.882	0.882	0.891	0.899	0.899	0.922	0.932	0.878	**0.897**

Finally, the analysis of the margin of efficiency scores, as summarised in Table 4-7, confirmed the hypothesis that the major league franchises tend to be business driven. Margin of efficiency scores reflect the difference between sporting and financial technical efficiency. In this analysis, a greater positive value indicated the predominance of a sporting focus, whereas an increasing negative value suggested a business-oriented organization. If the margin between sporting and financial efficiency was smaller, the two factors appeared more balanced.

Table 4-7: Global technical efficiency margin scores of sporting and financial efficiency

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Mean**
EPL	0.023	0.079	0.109	-0.040	-0.095	0.087	-0.017	0.034	0.082	**0.029**
NBA	-0.097	-0.118	-0.099	-0.159	-0.063	-0.055	-0.087	-0.178	-0.147	**-0.112**
NFL	-0.095	-0.059	-0.194	-0.195	-0.212	-0.162	-0.269	-0.213	-0.226	**-0.181**
NHL	-0.015	0.047	0.009	0.020	-	-0.043	-0.010	0.069	0.058	**0.017**
MLB	0.051	0.046	0.029	0.042	0.026	0.040	-0.017	-0.064	0.064	**0.024**

In this comparison, the EPL emerged with the highest positive value across all leagues, in support of the sporting rationale. The calculations for MLB and NHL also show positive values; the NFL and NBA revealed negative values. Thus, the results aligned with the prediction that North American major league franchises would be more focused on business, while EPL clubs pursue success on the field.

4.7 Summary and Concluding Remarks

In investigating the determinants of major league and English Premier League franchise values and revenues, this study shows that the impact of athletic achievement on financial performance is significant only for EPL clubs, not for teams in North American major leagues. The analyses of the different leagues' sporting and financial efficiency support the sporting hypothesis, which holds that EPL clubs value sporting performance over financial performance, in contrast with the major league franchises. This outcome might also reflect the differences in the league systems; for example, in European soccer leagues, an improved league position directly increases revenues, by granting those teams the right to participate in European competitions. In the major leagues, revenue sharing and drafting rights instead ensure consistent revenues and benefits, even for franchises with an inferior sporting performance.

Due to data constraints the applied sample is composed by four U.S. leagues and solely one European league and might be unbalanced in geographic representativity. In addition, all leagues belong to different sports and consequently the observed differences might not be explained only by a difference in pursued objectives.

Accordingly, further studies should investigate whether other European leagues (e.g., Spanish Primera Division, German Bundesliga) exhibit similar efficiency levels in

their sporting and financial performance. Additional research also could draw comparisons with other leagues, to examine the extent to which sporting performance influences team values and revenues. However, such investigations could be hindered by the lack of publicly available data.

5 Does Performance Consistency Pay-Off Financially for Players? Evidence from the Bundesliga

5.1 Introduction

In recent years professional team sports steadily gained popularity around the globe entailing an expanding industry with large revenues and increasing employment. Coincidental professional team sports drew the attention of academics as numerous economic studies have been published in the field of sports economics ever since. A particularly popular strand of literature analyses the remuneration of professional athletes to explain observable wage dispersions in professional sports. Previous studies in the field frequently relied on the Mincerian income equation (1974) to analyze the impact of manifold drivers of salary. Several individual characteristics including age, experience, talent, position, team effects, country of origin and especially *average performance* have been found to define player salaries. By contrast, research concerning *consistency of performance* is still in the beginning. This is to some extent surprising as supposedly owners and managers would favor high consistency in performance by their employees in order to reduce monitoring costs as well as the uncertainty of output generation. Maybe surprisingly our estimations reveal that while average performance influences salary in a significant positive way, consistency of performance reduces players' remuneration.

The current research is innovative by closing this gap in the literature and providing a novel approach as we analyze game level data from the German Bundesliga soccer for five consecutive seasons between 2005-06 and 2009-10. The data set contains information for 845 different players and totals in 34,413 game-level performance

observations. To measure performance consistency, the variation coefficient over each season is calculated for player evaluations compiled by experts and published in "Kicker Sportmagazin", a highly respected soccer magazine. To the best of our knowledge, this is the first empirical approach to determine if consistency in player performance is rewarded monetarily in professional soccer. Further, our research disentangles the influence of consistency for different parts of the salary distribution providing information if consistency of performance by "star-players" have a different impact on salary compared to average players. Our analysis suggests that the negative impact of consistency on salary is observable for different parts of the salary distribution. Finally, we present suggestions for these unreckoned findings to identify avenues for further research in this understudied field highlighting the importance of sport specific impact by its given rules and regulations.

The chapter is organized as follows: The next section provides a review of the existing literature on salary determination in professional soccer followed by a brief discussion of the results. Section 3 introduces the applied data, specifies our model and presents the results of the empirical analysis. The paper concludes with a discussion of the empirical results and limitations to present an outlook on future research.

5.2 Literature Review

Fertilized by available and detailed information on player salaries, performance statistics and individual characteristics a large number of studies have already been published on the drivers of remuneration in professional soccer. When it comes to performance related information studies uniformly rely on average performance (mostly from the previous season) neglecting if players perform consistently or volatile.

Concerning professional soccer Bryson, Frick & Simmons (2013) find empirical evidence of a salary premium for two-footedness as well as a statistically significant impact of players' age, number of international appearances and position on the pitch. Similar results for age and experience are repeatedly reported in the literature (Lehmann, 2000; Huebl & Swieter, 2002; Lucifora & Simmons, 2003; Garcia-del-Barrio & Puyol, 2007; Wicker et al., 2013). Continuously determined is a reversed U-shaped relationship between age and salary as physical performance erodes over time.

In addition, salaries reportedly rise with experience, as in number of league games (Lehmann & Weigand, 1999; Huebl & Swieter, 2002; Frick, 2007) as well as international appearances for the national team or appearances in European and World Cups (Lucifora & Simmons, 2003; Franck & Nüesch, 2008; Lehmann & Schulze, 2008) entail higher salaries, again supporting diminishing returns.

Previous research also accounts for the position on the field and its impact on salary. Studies predominantly report that more offensive positions are paid a wage premium (Huebl & Swieter, 2002; Lucifora & Simmons, 2003; Frick, 2006). Due to their high specialization and low flexibility to take other positions on the field goalkeepers on average earn the least while forwards receive the highest salaries (Lehmann, 2000).

Studies focusing on the major North American sport leagues (NBA, NFL, MLB, NHL and MLS) also found a significant impact of experience, performance and peer reputation on players´ salary (Kahn, 1993; Hamilton, 1997; Quirk & Fort, 1999; Idson & Kahane, 2000; Zimbalist, 2002; Berri & Simmons, 2009; Lee & Harris, 2012). Perhaps surprisingly, to the best of our knowledge only one empirical work is

concerned with players' consistency to explain salary. Bodvarsson & Brastow (1998) analyze players from the National Basketball Association. They follow the argument that for a given average performance coaches as well as general managers prefer consistent over volatile performance. Compared to their study our work offers several important contributions. First, in contrast to Bodvarsson & Brastow (1998) our data offers information over several seasons, allowing for a longitudinal analysis controlling for unobservable factors. Given the large number of observations we are furthermore able to control for team, season and position effects. In addition, we extend understanding of how consistency of performance is rewarded or punished for different parts of the salary distribution by applying quantile regressions. Further, we are able to rely on a single performance measure accounting for overall performance which is unavailable in other sports. An overview of previous literature and the empirical findings is provided in Table 5-1.

Summarizing, it appears that salaries in professional soccer are not just random, but that systematic factors determine salaries to a large extent and that these systematic factors (e.g. age, experience and performance) are very similar to those found for other occupations (Bryson, Frick & Simmons, 2013). However, the variation in salaries in professional sports that can be explained by a small set of variables is quite large compared to studies analyzing representative labor market surveys. What previous studies have in common is a recurrent measurement of average performance to determine its impact on salary (see Table 5-1). As not all participants in sports are identical in terms of performance consistency, our research expands existing work as we account for volatility in performance. The relation to labor markets is straightforward. While some individuals are able to perform at a very consistent rate others do not. The

question arises how managers value consistency by determining the financial surplus to the athlete. One argument in favor of a salary premium for consistent performance follows the rationale of monitoring costs. Monitoring costs are presumably lower for workers displaying a constant productivity compared to those whose performance is rather volatile. For a given average performance monitoring costs decrease as consistency increases which leads to the assumption that salary offers are higher for those employees who are performing more consistently.[16] For professional soccer the implication might not be that straightforward, since the composition of workforces differs dramatically from those of companies competing in traditional markets. Firstly, performance can be observed easily and hence at lower costs. This would suggest less difference in salaries due to variance in performance. Secondly, coaches can simply substitute players displaying a bad performance in the production process. This might even result in a preference towards inconsistent players as performance outliers reach higher levels for inconsistent players who can be substituted or simply disregarded in the initial line-up. A possible result of this could be a wage premium for inconsistent players.

Given these arguments the relation between performance consistency and salary remains unclear from a theoretical standpoint. As game-by-game performance is observable for soccer we are able to estimate how consistency affects remuneration for the specific labor market the German Bundesliga.

[16] See Bodvarsson & Brastow (1998).

Table 5-1: Literature on salary determination for professional soccer

Author(s)	Data	Applied Model	Empirical Findings
Wicker et al. (2013)	Sample of 877 players from the 2011-12 and 2012-13 season of the German Bundesliga	Fixed- and random effects regression with natural logarithm of market value	The results indicate that effort approximated by running distance and average number of intensive runs has no significant positive impact Games played, age as well as scoring performance show a positive impact on market values
Bryson, Frick & Simmons (2013)	Data 1: 1,991 European league players of the 2005-06 season Data 2: Bundesliga panel with 1,314 player-season observations over 2002-03 to 2006-07	OLS and quantile regressions with natural logarithm of annual salary	The authors find empirical evidence that the ability of two-footedness is rewarded monetarily. Further, variables such as age, height, goals per game in the last season as well as international appearances generate an increment in salary
Frank & Nüesch (2008)	Sample of 429 players from 2004-05 German Bundesliga season	OLS and quantile regression with natural logarithm of market value	Empirical findings indicate that market values are better predicted by expert evaluations. Goals and assists have no significant impact whereas player´s popularity influence market values
Garcia-del-Barrio & Puyol (2007)	Sample of 369 players appearing in the Spanish Primera Division in 2001-02	OLS regression with natural logarithm of market value	The results display that commercial attractiveness (measured by Google hits), sporting performance (measured by external ratings) and international experience of players are rewarded monetarily

Table 5-1: Literature on salary determination for professional soccer (continued)

Author(s)	Data	Applied Model	Empirical Findings
Lucifora & Simmons (2003)	1995-96 single season data including 730 outfield players from the Italian Serie A & B	OLS regression with natural logarithm of gross salary	The results reveal the presence of a superstar effect on salary as well as significant impacts of experience, performance and reputation on salary
Huebl & Swieter (2002)	Panel data set for the seasons 1994-95 to 1999-2000 containing 574 player appearances in the German Bundesliga	OLS and random-effects with natural logarithm of annual salary	The authors find a reversed U-shaped relationship between age, career games and salary. In addition, the authors find an impact of contract duration, team change, sponsoring revenues as well as qualification for European cups on salary
Lehmann (2000)	1999-2000 single season data including 463 player observations from German Bundesliga	OLS regression with natural logarithm of annual salary	Positive influence of games played last season, country of origin, tackles, assists and sponsoring revenues on salary. In contrast, substitutions are reported to have a negative impact
Lehmann & Weigand (1999)	1998-99 single season data including 468 player observations from German Bundesliga	OLS regression with natural logarithm of annual salary	The authors find evidence that career games, country of origin, attendance, sponsoring revenues and qualification for European cups impact salaries

5.3 Data Set and Descriptive Statistics

The data set we analyze in this paper contains season statistics for all players who appeared in the German Bundesliga anytime between the 2005-06 and the 2009-10 season. In addition to average statistics we gathered game-by-game performance measures for each game a player appeared in and had been rated by external experts. Our data set contains 845 different players and yields in 34,413 player-match day-observations. The Bundesliga continuously consisted of 18 teams with 34 match days in each of the five analyzed seasons and therefore the data set includes player statistics from a total of 3,060 season games. In contrast to the closed-shop major leagues in the U.S. most European leagues apply a relegation and promotion system. Each season the three worst performing teams in the German Bundesliga are replaced by the top three teams from the second division (2nd Bundesliga) resulting in a varying composition of the league over the analyzed period. During the five seasons 26 different clubs played in the Bundesliga due to annual promotion and relegation.

The primary data source for this study is the highly respected German sports journal "Kicker Sportmagazin" that publishes salary estimations prior to the start of each season as a reliable proxy for the otherwise undisclosed salary. Based on previous publications we approximate salaries for season t as follows:

$$Salary\ (t) = \frac{kicker\ valuation\ (t)}{1.5}$$

The reliability of this salary information has been documented repeatedly: Torgler and Schmidt (2007) confirmed robustness by comparing salary information by Kicker with the market value evaluations by www.transfermarkt.de, another reliable data source. The correlation between the two data sources is reported to be as high as 0.75. Furthermore, Frick (2006) correlates the salary information by Kicker with a subset of actual salary data for 2 seasons from the Bundesliga finding the correlation to be high as 0.8. Further studies using the salary estimations by "Kicker" include Eschweiler & Vieth (2004), Hübl & Swieter (2002), Lehmann & Weigand (1999), as well as Lehmann & Schulze (2005). Our study follows this literature and uses this proxy to analyze the impact of performance consistency on player salaries.

Moreover, Kicker weekly publishes a subjective individual performance evaluation following each Bundesliga match. It accounts for overall performance throughout the match as the output of professional players is highly complex and can hardly be defined by only one objective measure such as number of tackles, goals scored or assists. This is especially useful because of the varying job descriptions (goalkeeper, defender, midfielder, forward) as each position is assigned with a different duty (see Lehmann & Weigand, 1999; Lucifora & Simmons, 2003; Frank & Nüesch, 2010). Trusting evaluations by experts is common practice in the sport economics literature (Littkemann & Kleist, 2002; Garcia-del-Barrio & Pujol, 2005; Bryson, Frick & Simmons, 2013). Performance evaluation is comparable to performance measuring in the German school system and itemizes grades from 1.0 (excellent) to 6.0 (very poor). To receive grading after a match a player has to be on the pitch for a minimum of 30 minutes.

Our analyses accounts for the average grade (GRD) over a season as we set the minimum number of appearances during a season to five.

The main contribution of this paper is to shed light on the impact of consistency of performance on salaries of professional soccer players in Germany. We define consistency as the deviation of performance around average performance for a given player and season. Consequently we analyze to what extent variations in player performance explain variations in player remuneration. As variance increases with the mean we compute the variation coefficient (VAR) of performance over a season as follows:

$$Variation\ coefficient\ (t) = \frac{Variance\ (t)}{\emptyset\ Grade\ (t)}$$

Admittedly one could argue that for a given variance in performance, a higher (worse) average grade reduces the coefficient of variation. To lessen this concern, all results to follow still hold as we conduct the estimations substituting the variation coefficient of performance by the variance of performance to display performance consistency.

Apart from (average) performance and its consistency other factors possibly determining players' salaries have to be accounted for. Previous job experience is expected to have a positive impact on remuneration according to human capital theory. Our measures for age (AGE), games played in the Bundesliga (BLG) and number of appearances on national squads (NAT) (all measured prior to the respective season) display players' experience. We expect a positive impact of experience on salary

accompanied with decreasing marginal returns (negative impact of AGE2, BLG2 and NAT2), equivalent to an upward-sloping experience-earnings profile. To account for any positional or team bias in ratings we include team as well as season dummies. Team effects are supposed to have a significant influence on player salaries as some teams were found to pay their players a premium salary (Idson & Kahane, 2000; Frick, 2008). A summary of all variables included is presented in Table 5-2 while summary statistics are provided in Table 5-3.

Table 5-2: Overview of variables

Variable	**Operationalization**
lnPAY	natural logarithm salary
VAR (t-1)	Variation coefficient of performance evaluation (T-1)
GRD (t-1)	performance evaluation (T-1)
AGE	Age (at beginning of season)
AGE2	squared age (at beginning of season)
NAT (career)	appearances national team (at beginning of season)
NAT2 (career)	squared appearances national team (at beginning of season)
BLG (career)	Bundesliga career games (at beginning of season)
BLG2 (career)	squared Bundesliga career games (at beginning of season)
GK	Goalkeeper (Dummy; 1=yes) Reference
DEF	Defender (Dummy; 1=yes)
MID	Midfielder (Dummy; 1=yes)
FOR	Forward (Dummy; 1=yes)
Team Dummies	Dummy-variable for players´ team
Season Dummies	Dummy-variable for analyzed season

Table 5-3: Summary of descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
lnPAY	845	13.97	0.72	11.11	16.11
VAR (t-1)	845	0.21	0.11	0	0.88
GRD (t-1)	845	3.62	0.39	2.38	5.1
AGE	845	25.86	4.04	16	41
AGE2	845	685.54	215.43	256	1.681
NAT (career)	845	13.28	20.61	0	138
NAT2 (career)	845	600.81	1520.09	0	19.044
BLG (career)	845	65.71	76.45	0	531
BLG2 (career)	845	10.158,9	22.090,97	0	281.961
GK	845	0.08		0	1
DEF	845	0.33		0	1
MID	845	0.38		0	1
FOR	845	0.2		0	1
Team Dummies				0	1
Season Dummies				0	1

During the observed time period the average salaries rose by approximately 39% from 1,185,014€ in 2005-06 to 1,642,796 € in 2009-10. A similar trend can also be observed over the different positions on the field. On average the more offensive positions on the field receive higher salaries. Since we required a minimum of five appearances for a given season to be included in the estimation, the number of Goalkeepers (135) in the data set is comparably low as the position is only occupied once and substitution of goalkeepers is very rare. Therefore, the less earning substitute

goalkeepers are seldom included in the sample. Waiving our minimum number of appearances the average salary of goalkeepers would drop below the average salary of defenders.

Concerning average performance Figure 5-1 suggests that goalkeepers receive the lowest (best) whereas forwards receive the highest (worst) ratings. Defenders and midfielders receive almost identical average ratings. Interestingly, out of all players who were graded with 1.0 (excellent) for a single game forwards accounted for 55%. In contrast, goalkeepers only accounted for 15% of the top grades but also account for 9% of all player appearances.

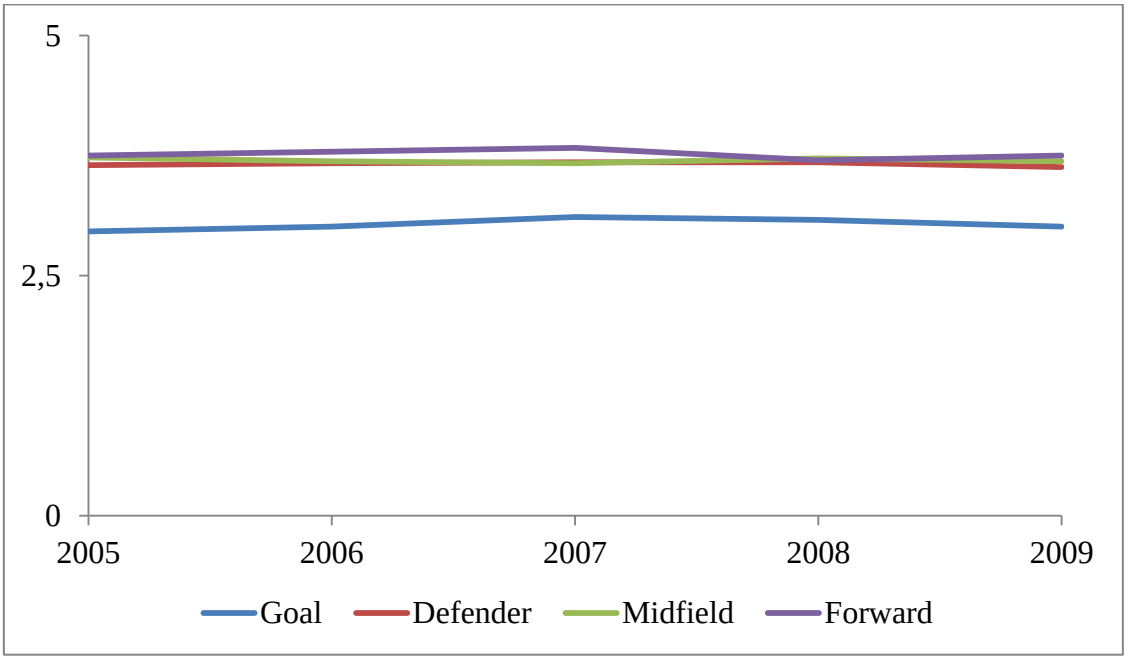

Figure 5-1: Average expert ratings by position

The variation coefficient for performance by position is documented in Figure 5-2. Comparable to the variable average performance, our key variable displaying consistency, influences players' salaries also shows positional differences. In particular for the offensive forwards and midfielders we observe a higher variation coefficient

compared to defenders and goalkeepers. Especially forwards exhibit above average values in each season considered. This finding is supported by a t-test.[17]

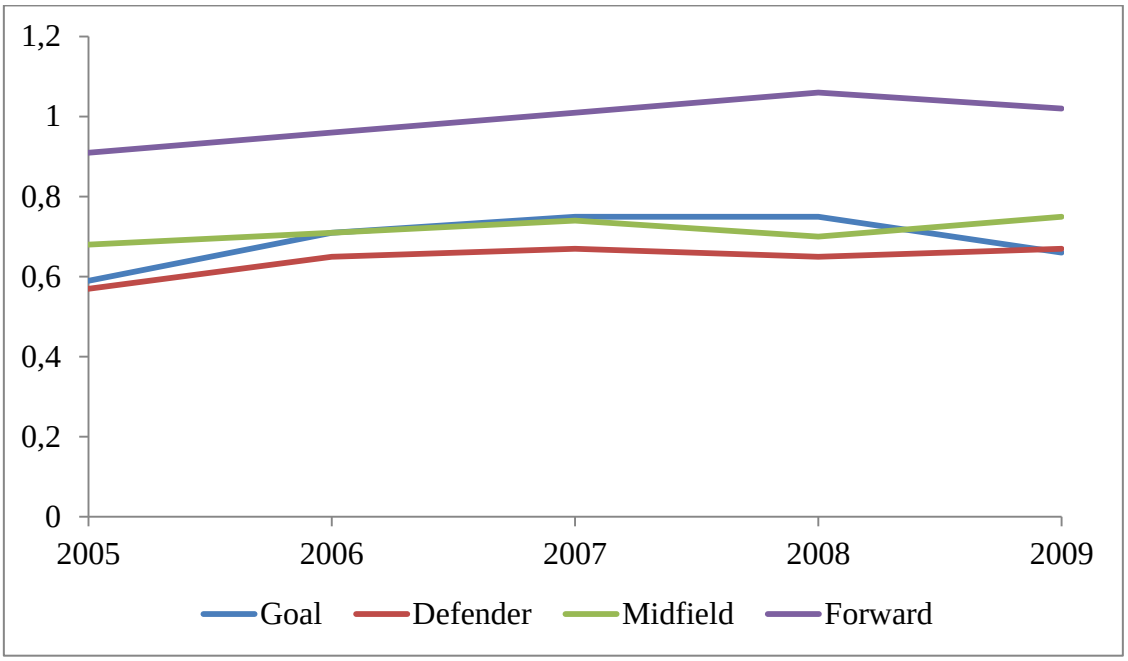

Figure 5-2: Variation coefficient of performance by players´ position

Additionally, the variation coefficient increased considerably for each position between 2005-06 and 2009-10. For forwards it increased by 17%, for defenders by 16%, midfielders reported an increase of 14% and goalkeepers slightly increased by 7% with a decreasing value over the last two seasons analyzed.

5.4 Econometric Findings

Our analysis uses the standard ordinary least squares (OLS) earnings function. As this estimation technique works best under the assumption of normal error distribution it is very sensitive towards outliers. As salary is clearly non-normally distributed quantile regressions (.10, .25, .50, .75, .90 quantile) with bootstrapped standard errors (100

[17] The p-Value of 0.000 denotes rejecting the null hypothesis that the difference between the means is zero.

repetitions) are applied to estimate varying marginal effects of the independent variables at different parts of the salary distribution.

A possible endogeneity problem between performance and salary was met by the introduction of a time lag of one season. While salary information is obtained from season t, the independent variables concerning performance are drawn from the respective previous season t-1.

The empirical specification adopted is

$$lnPAY_t = a_0 + a_1\, VAR_{t-1} + a_2\, GRD_{t-1} + a_3\, AGE_t + a_4\, AGE^2{}_t + a_5\, NAT_{t-1} + a_6\, NAT^2{}_{t-1} + a_7\, BLG_t + a_8\, BLG^2{}_t + a_9\, GSC_t + a_{10}\, POSITION_{t-1} + a_{11}\, TEAM_t + a_{12}\, SEASON_t + \varepsilon$$

Where $\ln PAY_t$ represents the natural log of the salary, a_0 is a constant, a_1 to a_{12} are vectors of parameters to be estimated and ε is an error term. Given the panel structure of the data the Hausman test suggests to rely on the fixed-effects estimation implying that unobserved player characteristics are present.[18]

[18] Results from Hausman test (Hausman, 1978): $\chi^2 = 98.61$, $p < .05$.

Estimation for OLS- and fixed-effects regressions are presented in Table 5-4.

Table 5-4: Estimation results for OLS and fixed-effects regressions

lnPay	**OLS robust**	**Fixed-Effects**
VAR (t-1)	0.9231***	0.4269***
GRD (t-1)	-0.7216***	-0.4863***
AGE	0.0881**	-0.2276+
AGE2	-0.0022***	-0.0038*
NAT (career)	0.0055***	-0.0018+
NAT2 (career)	-0.0001+	-0.0001+
BLG (career)	0.0017***	0.0133***
BLG2 (career)	-0.0009**	-0.0001***
DEF	0.1585**	0.0024+
MID	0.1975***	0.0529+
FOR	0.3652***	0.2168**
CONS	15.66***	18.36***
Team Dummies	included	
Season Dummies	included	
N of Obs.	845	845
N of Players	432	--
R2*100	58.01	42.12
F-Value	31.90***	8.64***
sigma_u	--	0.7471
sigma_e	--	0.2408
rho	--	0.9058

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance.

As expected the estimations go in line with human capital theory with the age-salary profile being upward sloping and concave. Analogue experience as in career Bundesliga games (BLG) and appearances for the national team (NAT) proves to increase salaries at a decreasing rate.

Outfield players receive a significantly higher salary compared to the reference position goalkeeper. For outfield players the more offensive a position is, the higher is the salary premium for the position. Remembering the descriptive statistics we can conclude that the more offensive a position the poorer the average ratings but at the same time the most offensive position on the field forwards receive the highest salary premium.

The assumption that *average* performance influences salaries can be confirmed. In both estimations the coefficient is statistically significant with a negative sign. Since the lowest rating (1.0) equals the best possible performance by a player a negative sign was expected. The relative weight of the variable in the OLS model shows that a one standard deviation improvement in rating increased the salary of a player by 72%, respectively 47% in the fixed-effects estimation.

To test the main hypothesis which claims that performance consistency is rewarded monetarily, we analyze the impact of the variation coefficient of performance on player salaries. Both estimations reject our assumption that consistency is rewarded monetarily. Quite the contrary can be observed as the coefficient of VAR is highly significant in both regressions, but instead of the expected negative sign the influence is positive. Interestingly, a one standard deviation increase in our measure of inconsistency is rewarded with a surplus of 92% in the OLS and a 48% increase in

player salaries in the fixed-effects model. For a given average performance managers and team owners seem to prefer unpredictable players that on a good day might make the difference in order to win a match.

In the 2009-10 season the 25% highest paid players accounted for 46% of the total sum of salaries paid. This skewed income distribution can be explained with Rosen´s theory of superstars where small differences in talent translate into large differences in pay (Rosen, 1981, 1983), supported by Figure 3. Applying the D´Agostino test (D´Agostino, Belanger & D´Agostino Jr., 1990) we get further approve that salaries significantly differ from a normal distribution.[19]

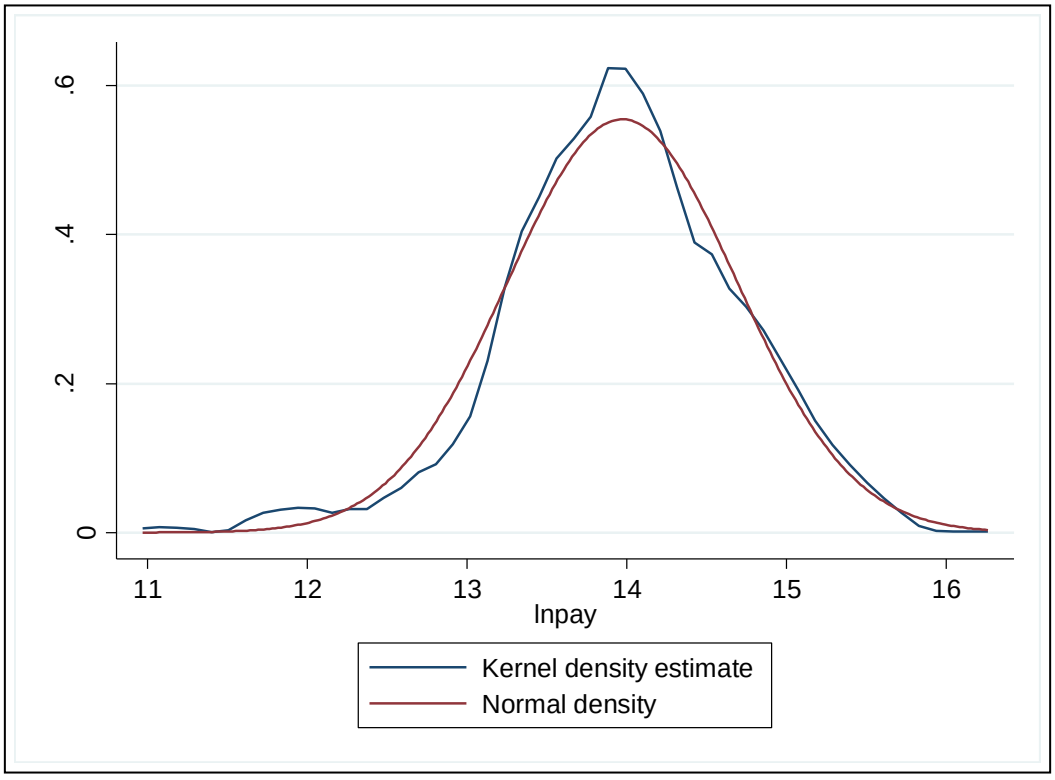

Figure 5-3: Kernel Density Estimates of player salaries

[19] The p-value of 0.000 suggests rejecting of the null hypothesis that kurtosis does not depart from a normal distribution.

Given this skewed distribution previous studies called for quantile regressions, originally developed by Koenker and Bassett (1978), (see Hamilton, 1997; Franck & Nüesch, 2008; Lehmann & Schulze, 2008; Berri & Simmons, 2009; Simmons & Berri, 2009; Vincent & Eastman, 2009; Kahane, 2010 for sports economics applications). The particular advantage of quantile regression is to measure the impact of performance and characteristics for different parts of the salary distribution (Koenker, 2005). In order to ensure robustness of standard errors, we apply bootstrapping with 100 replications. The results of the quantile regressions are reported in Table 5-5.

Table 5-5: Impact of consistent performance on salary (Quantile Regressions)

lnPay	**0.1**	**0.25**	**0.5**	**0.75**	**0.9**
VAR (t-1)	1.1094**	1.2123***	1.0068***	0.9535***	1.0349***
GRD (t-1)	-0.7522***	-0.7691***	-0.7579***	-0.7041***	-0.6292***
AGE	0.1476**	0.1531**	0.1191**	-0.0001+	0.0465+
AGE2	-0.0034**	-0.0035**	-0.0028**	-0.0003+	-0.0011+
NAT (career)	0.0052*	0.0061**	0.0054**	0.0038+	0.0042**
NAT2 (career)	-0.0001+	-0.0001*	-0.0197+	-0.0081+	-0.0001+
BLG (career)	0.0041***	0.0028**	0.0021***	0.0016**	0.0012**
BLG2 (career)	-0.0001***	-0.0141+	-0.0118**	-0.0091**	-0.0098***
DEF	0.2710**	0.2711**	0.2163**	0.1258+	0.0735+
MID	0.2203**	0.3091**	0.2881***	0.1699**	0.1527**
FOR	0.4342***	0.4348***	0.4348***	0.3175***	0.2211***
CONS	14.69***	14.76***	17.64***	16.84***	17.99***
Team Dummies			included		
Season Dummies			included		
N of Obs.			845		
Pseudo R2*100	31.64	34.62	39.29	42.12	44.45

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance.

The estimations retrieved from the quantile regression in general support the results obtained from the OLS and fixed-effects regression revealing further interesting insights. The results demonstrate that AGE only seems to influence salary for the lower paid players at the .10, .25 and .50 quantile whereas BLG remains significant for all quantiles with a constant decreasing influence as salaries increase. Also international experience (NAT) remains significant for all quantiles with a decreasing impact as salaries rise. The position a player contains also loses importance as the bonus for the offensive positions MID and FOR diminishes.

Paying attention to the main variables we observe that both performance measures are statistically significant throughout all quantiles. In addition, the average performance displays a surplus of up to 76% for the .25 and .50 quantile.

Regarding performance consistency the quantile regressions even strengthen the results from the OLS and fixed-effects regression. Therefore, inconsistency or the characteristic of a player to be unpredictable is rewarded monetarily. The salary premium is reported for all quantiles in the sample.

5.5 Summary and Concluding Remarks

Since little is known about the impact of consistency on player remuneration in professional sports this paper presents insights for professional soccer in Germany. We find strong evidence for a salary premium for players who perform inconsistently. These results contradict the findings by Bodvarsson & Brastow (1998) who were the first to empirically analyze the relationship between pay and consistency in performance. Instead of rewarding consistency general managers seem to reward inconsistency in performance monetarily. A possible explanation for the contrary results

might be found in the data. The data richness in this study as well as the panel characteristic of the data set offer the possibility of advanced empirical analyses improving the efficiency of econometric estimates.

In addition, the rules of the game might also help to explain this result: A single goal scored or a pass that leads to a goal and even one defensive stop often make the difference for the outcome of a game. This is to be valued even more since soccer increased the number of points being rewarded for a win from two to three. The applied non-zero sum reward scheme in soccer with a 3-1-0 system (3 points for a win,1 point for a tie and 0 points for a loss) consequently leads to a more offensive and therefore more riskier style of play with fewer ties and more wins (see Baslevent & Tunali, 2001; Haugen, 2008; Dilger & Geyer, 2009 and Moschini, 2010).

In the adopted reward scheme the gain from a win is disproportionately higher than from a tie, illustrated in Figure 5-4 (Grund & Gürtler, 2005). As a result it is generally advantageous to follow a riskier strategy by adding more inconsistent players. More precisely this seems to apply especially for offensive players as suggested by the analyzed data. In terms of influencing the outcome of a game a forward might not score from several chances but simultaneously will not affect the score. In contrast, a missed tackle by a defender or goalkeeper might directly influence the score and the outcome of the game.

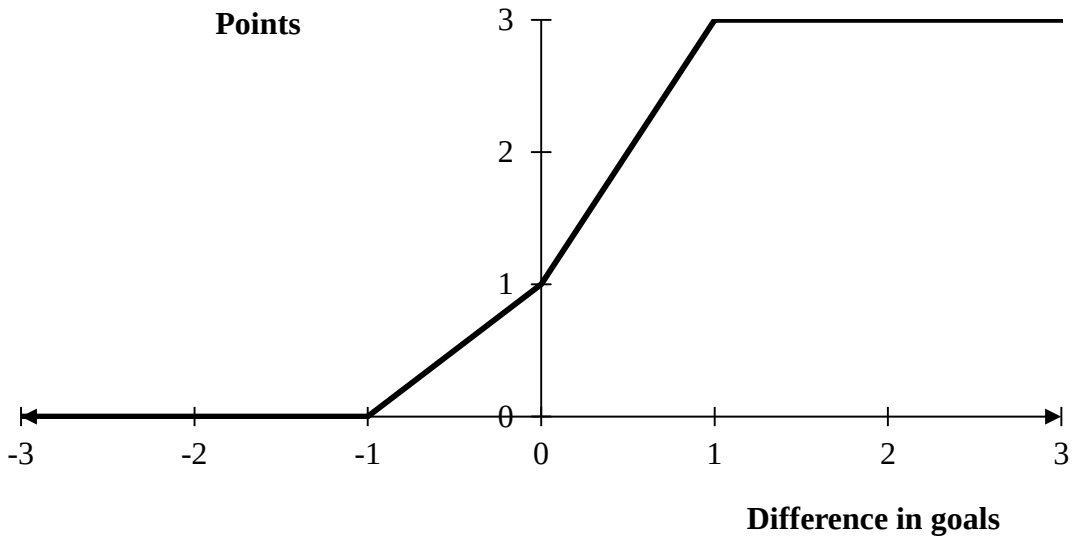

Figure 5-4: Reward scheme Bundesliga

Hence players with varying performance might be preferred as they are able to make the difference with a higher probability. Additionally, Longley (2005) points out that the risk of the employer decreases as the number of employees increases, powering the idea that a below average performance by one employee can be offset rather easily by another employee. As soccer sees a rotation in the line-up on a very regular basis this might additionally drive the results as coaches are able to replace underperforming players by players of adequate skill.

As studies on consistency of performance are very rare manifold research strings seem to be promising: In order to serve as robustness checks, a cross-sport evaluation seems promising. Collecting panel data, e.g. from professional basketball, football and ice-hockey would serve as comparison to check if inconsistent player evaluations improve salaries and if there are sports related differences in results.

6 Environmental Regulations and the Relocation of Production: A Panel Analysis of German Industry Investment Behaviour

6.1 Introduction

Foreign Direct Investment (FDI) has risen dramatically in recent years. In 2006, global FDI flows amounted to $1305.9 billion compared to $832.6 billion in 2001. This represents an average growth rate of 7.79% per year. Developing economies report an average growth rate of 10.17% per year and therefore are a major factor in this trend. Contrary to the developing countries, developed economies only report an average growth rate of 5.87% per year (UNCTAD, 2007). Simultaneously, with increasing FDI flows environmentalists and ecologically-orientated academics argue that multinational enterprises (MNE) engaged in highly polluting activities move to developing countries, where the costs of complying with environmental standards are significantly lower.

The aim of this article is to provide new empirical evidence to the debate of the pollution haven hypothesis and the existence of a pollution haven effect. The paper will analyze Total German outbound FDI as well as German outbound FDI on selected industries in the manufacturing sector and provide several novelties that have not been applied in previous studies. Firstly, the article solely employs data from Germany rather than data from the U.S., which was primarily used in previous studies. In addition, the determinants of FDI are customized and specifically tailored to German outbound FDI using the theoretical approach on FDI by Dunning (1988) combined with empirical evidence from German surveys conducted by several leading institutions. In order to control for unobserved country heterogeneity in the empirical analysis the study applies a panel data set to analyse German FDI flows from 2000 to 2006. To test whether there

is a statistically significant relationship between German FDI and environmental regulations, the study employs an environmental ranking published by the World Economic Forum for each year of the sample period. This new approach makes it possible to combine German outbound FDI flows with a reliable measured variable on environmental regulations for almost every country that received German FDI.

6.2 Literature Review

The pollution haven hypothesis or pollution haven effect argues that a country with a lower than average level of environmental regulations will find itself with a comparative advantage in pollution-intensive production (Levinson, 2008). Therefore, countries with low environmental monitoring and regulations will attract MNE´s engaged in pollution-intensive production. Consequently, MNE´s will relocate their production facilities, while countries with the comparative advantage will become "havens" for the polluting industries. The rationale behind this sounds plausible: if it costs money to conform to more stringent environmental requirements in developed countries, profit maximizing firms would want to relocate their production activities (Javorcik &Wei, 2004). Consequently, the relocation of polluting industries to developing countries with less stringent environmental regulations would enhance pollution; directly through an increase in the scale of economic activity and transportation, as well as indirectly through changes in the composition of industries (Brunnermeier & Levinson, 2004).

However, the findings in the literature to date do not show a clear pattern of this effect. Xing and Kolstad (2002) conducted an empirical study by examining the FDI of 6 U.S. manufacturing industries in 1985 and 1990. Their cross-section data set covers

22 countries including 7 developing countries and 15 developed countries. In order to measure environmental regulation, Xing and Kolstad (2002) used sulfur dioxide (SO_2) emissions in the host countries. The results show that host country emissions have an insignificant effect on FDI. Once the study uses instrumental variables for SO_2 (infant mortality and population density) the results change dramatically. The results show that predicted host country emissions have a significant negative effect on FDI in high polluting industries. The effect suggests that for polluting industries, more lax environmental regulations do tend to attract foreign investment.

A different conclusion is provided by Eskeland and Harrison (2003). Their study focuses on the relationship between pollution abatement costs and the pattern of foreign investment. The study investigated inbound FDI in 4-digit sectors in Côte d´Ivoire (1977-1987), Morocco (1985-1990), Venezuela (1983-1988), and Mexico (1984-1990) as well as U.S. outbound investment by sector. In order to measure pollution intensity the study used data on U.S. pollution abatement capital expenditures and operating costs from the PACE survey as well as data from the Industrial Pollution Projection System (IPPS).[20] The results show an insignificant effect of pollution abatements costs and U.S. outbound FDI. Hence, the authors conclude that U.S. outbound FDI is highest in sectors with low abatement costs (Eskeland & Harrison, 2003). Based on these results, there is no evidence for the pollution haven hypothesis. De Santis and Stähler (2009) studied the effect of FDI on environmental policy stringency in a two country model with trade costs. Their results revealed if FDI is liberalized it does not lead to ecological dumping and is more likely to occur in the absence of FDI.

[20] The data comes from the U.S. Bureau of Census, Center for Economic Studies and was conducted by a World Bank research project in order to infer the level of industrial pollution in foreign countries.

Javorcik and Wei (2004) examined inbound FDI in transition economies in Eastern Europe and the former Soviet Union from multiple countries. The study used firm-level data rather than industry-level data. Therefore, the FDI data comes from a data set based on the results from a foreign investment survey conducted in 1995 for the period 1989-1994. The fixed-effects regression analysis show some evidence that countries with less stringent environmental regulations (only taken for participation in treaties) are attracting more FDI. But the findings are not robust. Furthermore, the authors stated that there is no evidence suggesting that multinationals in pollution-intensive activities are more likely to invest in locations with weaker environmental standards (Javorcik & Wei, 2004).

Cole and Elliot (2005) tried to explain the missing evidence for pollution havens by taking the role of factor endowments in the decision of an MNE to relocate or set up a plant in a foreign country into account. Their results indicate that Brazil and Mexico are two of the more likely contenders to do so. Furthermore, Cole and Elliot (2005) analysed U.S. multi-sector outbound FDI to Brazil and Mexico for the period 1989-1994 at the three-digit U.S. SIC level of industry aggregation. Their independent variables to determine outbound FDI to Brazil and Mexico include the physical capital intensity of each sector, the sectors pollution abatement costs, market size, the wage differential between the U.S. and Brazil/Mexico, R&D expenditures, a proxy for economies of scale, and distance. By using fixed effects and random effects specifications the results show that pollution abatement costs in a U.S. industry is a statistically significant determinant of that industry's FDI to Brazil and Mexico indicating evidence of a pollution haven effect (Cole & Elliot, 2005).

Wagner and Timmins (2009) investigated German outbound FDI flows by German manufacturing firms into different destination countries between 1996 and 2003. The study analysed 6 different manufacturing industries and used a two-step econometric procedure that explicitly controls for agglomeration effects and unobserved heterogeneity between countries. To determine environmental stringency the authors used a survey measure of environmental stringency developed by the World Economic Forum and published in the Global Competitiveness Report. Additional independent variables for the host country include accumulated FDI stock, GDP, corporate income tax, the exchange rate, the level of tariff protection, the literacy rate, tuberculosis cases, and distance. Wagner and Timmins (2009) results show statistically and economically significant evidence that more stringent environmental regulation deters FDI in the chemical industry. Consequently, this is interpreted as evidence of a pollution haven effect for the chemical industry (Wagner & Timmins, 2009).

Spatareanu (2007) analysed data on new subsidiaries established in 16 Western European and 9 Central and Eastern European countries by the largest 10,000 firms operating in Europe during 1998 to 2001. By using the fixed effects logit and the Tobit specifications the results show that stronger environmental rules in the firm's home economy relative to the host country are associated with a higher volume of FDI. Furthermore, industries with higher abatement costs are likely to undertake more FDI. However the results do not indicate that polluting industries are attracted more to countries with weaker environmental standards.

There are several drawbacks in the existing literature that might have masked a pollution haven effect. In order to identify a pollution effect it is essential to apply a

measure of environmental stringency as a variable. To measure environmental stringency, researchers have used a variety of variables or proxies in the literature. One reason is that there is almost no data set that covers a long time period measuring the environmental stringency of various countries. Especially lower advanced economies do not publish a large amount of data on emissions or environmental stringency. Most of the existing literature therefore relies on U.S. data or solely analysed U.S. FDI and trade flows. Particularly the earlier studies solely examined plant births in the U.S. or inbound or outbound FDI from or into the U.S.. Furthermore, the literature identified two major drawbacks on the methodology of studies. On the one hand, earlier studies only used cross-sectional data. These studies tend to reject the existence of a pollution haven effect. The major drawback of using cross-sectional data is that it is not possible to control for unobserved attributes of countries or industries that are correlated with regulatory stringency and economic strength (Brunnermeier & Levinson, 2004). A country with an unobserved comparative advantage in a polluting good is likely to export that good and enact strict environmental regulations. The simplest solution to the problem of unobserved heterogeneity is to apply a panel data set and include fixed or random effects by country. These fixed or random effects models capture the unobserved characteristics of countries that make them likely to have both strict environmental regulations and high levels of activity (Levinson, 2008). On the other hand, an econometric issue confronting most of the studies is that economic activity and pollution regulations may be determined simultaneously. The pollution haven hypothesis suggests that environmental regulations affect exports, but the reverse may also be true; exports may affect regulation. Therefore, the econometric model has to be adjusted for endogeneity. In order to solve the problem of potential endogeneity the

study uses a subjective measure of environmental stringency. Furthermore, we use random-effects instead of a fixed-effects model due to the fact that some of our independent variables, e.g. distance, are time-invariant.

6.3 Empirical Model

Germany is an attractive country for testing the pollution haven hypothesis for numerous reasons. Firstly, Germany is the country with the most severe and strict environmental standards and regulations (World Economic Forum et al., 2000-2006). Furthermore, through the central location, German firms have a large pool of possible destinations to invest that are located close to Germany but significantly differ in country attributes such as market size, wages, country risk and/or in environmental stringency (Wagner & Timmins, 2009). This suggests that, ceteris paribus, pollution intensive industries in Germany have a stronger incentive to set up production facilities in foreign destinations than they do in most other countries in the world. Hence, we expect to find a negative relationship between German outbound FDI and environmental regulations. This implies that German companies prefer to invest in countries with low environmental regulations. Consequently, this leads to the first hypothesis:

Hypothesis 1: Host countries that have lower environmental regulations compared to Germany will attract significantly higher German outbound FDI.

Furthermore, the German manufacturing industry is highly competitive and accounts for 30% of Germany's gross value creation and employs 26% of the German workforce (Statistisches Bundesamt, 2008). This also affects the pattern of German FDI which is rather concentrated. There are four major industries that are responsible for

approximately 80% of the undertaken FDI within the manufacturing industry, i.e. automotive, chemical, electric, and engineering. By distinguishing between "clean" and "dirty" industries we expect that the tendency to shift production to countries with lower environmental standards is more pronounced for dirty industries. Hence, the second hypothesis results to:

Hypothesis 2: "Dirty" industries will show a negative statistically significant effect between FDI and environmental regulations. In contrast, the defined "clean" industries will not present a negative statistically significant effect.

Besides that, the study expects to find a positive relationship between FDI and the variables Gross Domestic Product per Capita (GDPPC), population, the KOF index of globalisation, innovation, government effectiveness, as well as labour market flexibility. These expected positive relationships, expressed through a positive statistically significant coefficient in the regression analysis, would indicate that German outbound FDI is attracted. Furthermore, the study expects to find a negative relationship between FDI and the variables distance, inflation, and labour costs.

This negative relationship, expressed through a negative statistically significant coefficient, will deter German outbound FDI in host countries. By including all the variables in the estimation the following equation is obtained:

$$\ln FDI_{i,t} = \beta_0 + \beta_1 \ln GDPPC_{i,t} + \beta_2 \ln POP_{i,t} + \beta_3 \ln DIST + \beta_4 INFL_{i,t} + \beta_5 INNOVATION_{i,t} + \beta_6 KOF_{i,t} + \beta_7 FLEX_{i,t} + \beta_8 WAGE_{i,t} + \beta_9 STRINGENCY_{i,t} + \beta_{10} GOV_{i,t} + \beta_{11} OECD + \omega_{i,t} \quad (1)$$

Where i denotes country and t denotes year.

6.4 Panel Data Description

For testing the pollution haven hypothesis we use German FDI flows panel data by destination country as well as German FDI flows by country and four major industries from the manufacturing sector as the *dependent variable*.[21] Data was taken from the Deutsche Bundesbank which publishes data on Total outbound FDI from the industries as well as breaks down outbound FDI within the manufacturing industry into four major sectors.[22] Unfortunately, the Deutsche Bundesbank does not publish further data on other branches within the manufacturing industry and their outbound FDI. The sample for Total outbound FDI comprises flow data for the period from 2000 to 2006 and covers all 89 destination countries that are included in the Deutsche Bundesbank report. Due to data constraints 39 countries are included in the sample for Total German outbound FDI.[23] The country coverage for the industry samples is limited since the Deutsche Bundesbank provides less data on the industry level. Therefore, the sample for the chemical, automobile, electrical, and engineering industry consists of 35 countries.

In line with the current literature we use pollution abatement expenditures to classify industries according to their pollution intensity (Wagner & Timmins, 2009). An industry with high pollution abatement expenditures is expected to have a larger incentive to set up production facilities abroad. In addition, the higher the share of investments in pollution abatement on total investments, the more an industry faces a

[21] German enterprises and households are required by law to report all direct and indirect holdings of 10% or more of the capital shares or voting rights in a foreign company which has a balance sheet total of more than three million Euros or the equivalent of three million Euros in a different currency. In addition, all branch offices or permanent establishments in a foreign country with operating assets of three million Euros or more have to be reported to the Deutsche Bundesbank.

[22] The industries and their WZ 2008 codes are C20 – manufacture of chemicals and chemical products (chemical), C27 – manufacture of electrical machinery and apparatus (electrical), C28 - manufacture of machinery and equipment not elsewhere classified (engineering), and C29 – manufacture of motor vehicles, trailers and semi-trailers (automobile).

[23] In particular, Bermuda, Cayman Islands, Guernsey, Isle of Man, Jersey, Liechtenstein, Saudi Arabia, Zambia, and Zimbabwe were excluded from all samples.

cost disadvantage in countries with strict environmental regulations. The data is collected by the German Federal Bureau of Statistics (Statistisches Bundesamt) and is available from 2002 to 2005.[24] Figure 6-1 shows that the chemical industry has the highest share of pollution abatement investment in total investment. The average share for the chemical industry per year is 6.15% between 2002 and 2005. The mean for the total manufacturing industry is 2.82% over this time period. Based on this data, the cleanest industry in the sample is the electrical industry with 0.8% followed by the engineering industry with 1.05%. The second most polluting industry is the automobile industry with 1.72%, slightly under the mean for the total manufacturing industry.

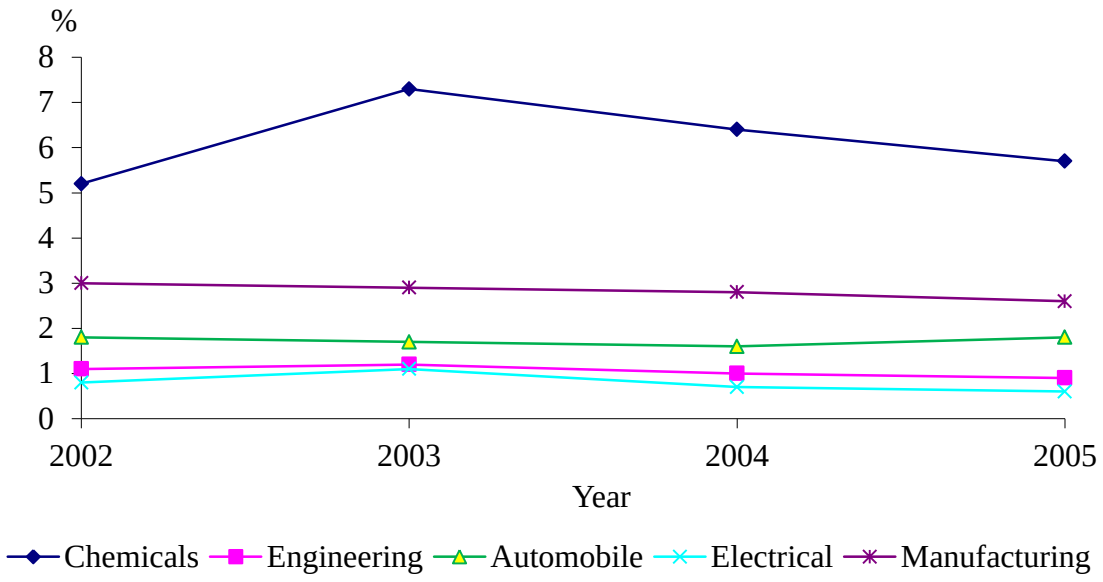

Figure 6-1: The share of pollution abatement investment in total investment[25]

In order to capture the effects of the stringency of environmental regulations (STRINGENCY) of German FDI flows, the study uses a variable taken from the Global Competitiveness Report (GCR) published by the World Economic Forum (Spatareanu,

[24] The German Federal Bureau of Statistics publishes the data in its "Fachserie 19, Reihe 3.1 Investitionen für den Umweltschutz im Produzierenden Gewerbe".
[25] Own calculation based on data from the German Federal Bureau of Statistics (Fachserie 19, Reihe 3.1).

2007; Wagner & Timmins, 2009).[26] There are various advantages of using the GCR index. Most of the indices used in previous studies lack on country coverage and were not available on an annual basis. This is one reason that previous studies could not control for unobserved heterogeneity by applying a panel data set. Instead, most studies relied on U.S. pollution abatement data that appears to be endogenous. The GCR index can overcome such drawbacks since it is a subjective measure of environmental stringency determined by leading decision makers who decide on FDI flows. In addition, the GCR ranking is available for all countries in the sample and covers the time period of 2000 until 2006.

Apart from analyzing the effect of environmental stringency we will control for several other variables, i.e. market size, host country wages, transportation costs, FDI restrictions, institutional quality, innovation, country risk, and labour market flexibility. In order to determine the market size the study uses GDP (constant prices in U.S. Dollars) in each country in the years 2000-2006. The theoretical link between market size and FDI is that FDI is supposed to be attracted by larger and more profitable markets. To lessen the effect of large outliers the study applies the logarithm of GDP. The variable comes from the World Economic Outlook Database 2008 provided by the International Monetary Fund (IMF). Host country wages can be best measured and compared through data on hourly compensation rates in various countries. Unfortunately, data on labour costs and specifically data for hourly compensation rates in various countries is very scarce since not all countries included in the sample report

[26] In order to measure environmental stringency the GCR survey asked respondents the following question: "Is the stringency of overall environmental regulations lax compared to most other countries or among the worlds most stringent?" Business executives had to rank their country on a scale between 7 for countries with the most stringent environmental regulations and 1 for the countries with the most lax environmental regulations.

statistics to a labour organisation or to a central agency. Especially, non-member countries of the EU or OECD do not report these data. Therefore, hourly compensation rates (WAGE) are solely available for 42 countries in the sample.[27] The proxy for transportation costs is the direct-distance (DIST) between the source countries capital (Berlin) and the capital of the host country in kilometers. The assumption is that the closer a country is located to the source country, the lower the transportation costs.

FDI is also affected by the extent of openness (OPENESS) of an economy. In order to control for this we use KOF Index of Globalisation developed by Dreher (2006) and updated by Dreher, Gaston, and Martens (2008). The KOF index covers the economic, social and political dimensions of globalisation. The assumption is that a country with a high ranking in the KOF index will be more attractive for receiving more FDI. The determinant institutional quality is covered through a government indicator (GOV) in the host countries provided by the World Bank. The study assumes that a higher value corresponds to better governance outcomes and therefore will attract German outbound FDI. We furthermore assume that the relocation of production is also driven by the innovative environment host countries offer. In particular, technology-intensive firms tend to invest in locations with high agglomeration in order to profit from spillovers. Hence, we assume that shifting production to foreign locations is also affected by the pursuit to perform R&D activities and to profit from firm spillovers. To control for this we use OECD patent data, i.e. how many patents foreign firms hold in

[27] In the data set for the manufacturing industries data is missing for Turkey, Malaysia, India, Argentina, and for the Russian Federation. In addition, the data comes from various sources namely the U.S. Department of Labour, Bureau of Labour statistics (BLS), Eurostat (covering data for Romania, Slovenia, and Latvia), and the data for China comes from a special report published by the BLS. Additionally, data from China is only available from 2002-2004. The compensation rates published in Euros (Eurostat) were converted into U.S. Dollars using annual average exchange rates taken from the International Financial Statistics.

that particular host country. To account for the determinant country risk the study uses the annual percent change of average consumer prices expressed through the inflation rate (INFL). The data is available for all countries and all years in the sample and also comes from the IMF World Economic Outlook database. A higher inflation rate would indicate political instability and hence a greater country risk. A higher value would indicate a lower country risk. In general, it is assumed that a higher country risk would be a deterrent for FDI expressed through high annual changes in the inflation rate. Finally, to control for labour market flexibility and regulations we use a proxy for the Flexibility in Hiring and Firing Practices also from the GCR (2000-2007). It is assumed that FDI is attracted by countries with more flexible labour market regulations. Table 6-1 provides an overview and definition of the applied variables.

Table 6-1: Overview and definition of variables

Variables	Definition	Source	Proxy for	Author(s)
FDI	Total amount of FDI from Germany to various destination countries in €. Expressed in logarithmic form	Statistisches Bundesamt Sonderveröffentlichung 10, "Bestandserhebung über Direktinvestitionen"	Dependent Variable	Xing & Kolstad (2002) Eskeland & Harrison (2003) Cole & Elliot (2005) Wagner & Timmins (2007)
GDP (GDP)	GDP at current prices in US$. Expressed in logarithmic form	International Monetary Fund: World Economic Outlook Database 2008	Market size	Xing & Kolstad (2002) Javorcik & Wei (2004) Wagner & Timmins (2007) Spatareanu (2007)
Distance (DIST)	The distance between the host country capital to the destination country capital as the crow flies in km. Expressed in logarithmic form		Transportation costs	Javorcik & Wei (2004) Cole & Elliot (2005) Wagner & Timmins (2007)
Inflation rate (INFL)	Annual change. Expressed in percentages	International Monetary Fund World Economic Outlook Database 2008	Country risk	
INNOVATION	Patents hold by foreign firms in particular host country	OECD	R&D	
Governance (GOV)	Ranges from -2.5 to 2.5, with higher values corresponding to better governance outcomes	World Bank	Institutional quality	
KOF Index of Globalisation (KOF)	Higher values denote more globalisation	Dreher (2006): Does Globalisation Affect Growth? Evidence from a new Index of Globalisation, Applied Economics 38, 10: 1091-1110.	FDI restriction in host countries	
Global Competitiveness Report (GCR) flexibility in hiring and firing practices "Flexibility" (FLEX)	Ranges from 7 for most flexible regulations, to 1 for most rigid	Global Competitiveness Report 2000 - 2007	Labour market flexibility	Spatareanu (2007)
GCR stringency of environmental regulations (STRINGENCY)	Ranges from 7 for most stringent, to 1 for most lax	Global Competitiveness Report 2000 - 2007	Environmental stringency	Wagner & Timmins (2007) Spatareanu (2007)
Labour costs (WAGE)	Annual Labour compensation per employee (PPP) in US$	Source OECD Database/Eurostat Database	Host country wages	Eskeland & Harrison (2003) Cole & Elliot (2005)
OECD	Equal to 1 if country is member and 0 otherwise	CIA The World Factbook		Cave & Blomquist (2008)

Table 6-2 provides an overview of the descriptive statistics of the data sample. As mentioned above, data for labour costs and especially data on hourly compensation rates in various countries is very scarce. Therefore, the variable WAGE is limited to 283 observations. The KOF Index did not include Hong Kong and Taiwan and due to a missing value in the Deutsche Bundesbank report from the Philippines in 2006, the total number of observations is 268.

Table 6-2: Descriptive Statistics Total German outbound FDI

Variable	Observations	Mean	Std. Dev.	Min	Max
lnFDI	268	8.221	1.933	3.258	12.22
lnGDP	269	19.082	1.671	15.543	23.303
lnDIST	269	7.460	1.164	5.662	9.806
INFL	269	3.526	4.205	-1.08	45.66
INNOVATION	269	96.49	227.36	0	1201
KOF	269	74.88	11.739	50.51	93.65
FLEX	269	3.594	0.921	1.9	6.3
WAGE	269	14.32	9.707	0.57	41.05
STRINGENCY	269	5.117	0.985	2.8	6.7
GOV	269	1.251	0.745	-0.352	2.341
OECD	287	0.658		0	1

6.5 Empirical Results

6.5.1 Descriptive Statistics

Before turning to the empirical results, we will give an overview of important descriptive findings in the data set. This includes the question of whether German industries in the sample with high pollution abatement expenditures are likely to

undertake more FDI or not. Firstly, Figure 6-2 shows the annual change in percentage of Total German outbound FDI as well as from the industries included in the sample. It can be observed that there was a major decline during the period between 2000 and 2002. During this period global FDI flows declined originating from weak economic growth, tumbling stock markets and institutional factors such as deceleration of privatisation in several countries (UNCTAD, 2003).

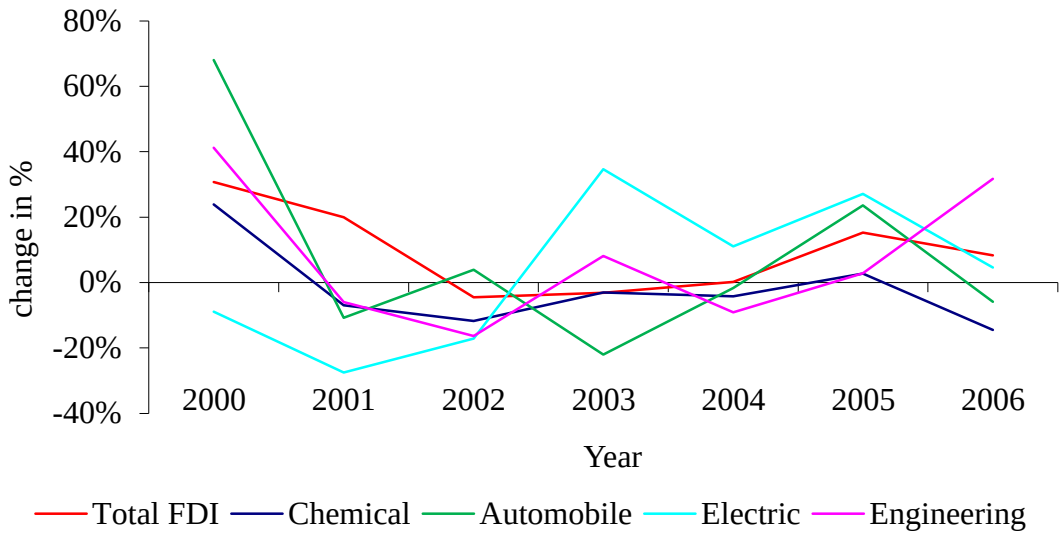

Figure 6-2: Annual change of outbound FDI in percent

In order to find out if pollution intensive industries from Germany undertake more FDI than less polluting industries, the study will compare the findings from the share of pollution abatement investment in total investment and the volume of expenditures for pollution abatement with the actual data on FDI flows. Figure 6-3 shows the volume of FDI from the four industries included in the sample.

The automobile industry is the industry that undertakes the most FDI across all industries in the sample. On average the industry invested € 93.6 billion per year in the period 2000 to 2006. With an average of € 39.5 billion per year the chemical industry

ranks second. The electrical and engineering industries invest far less with an average of € 18.7 billion and € 14.8 billion. Additionally, it can be observed that the automobile and chemical industry reduced FDI during the period. On average the FDI from the automobile industry declined by 0.42% per year and FDI from the chemical industry declined by 3.93% per year. In contrast, the electrical and engineering industry increased FDI by 4.51%, respectively 2.46% per year. Bearing in mind that the automobile and chemical industry are the most polluting industries in the sample with 6.15% investment in pollution abatement in total investment, and 1.72% respectively, it is illustrated that those two industries are also the most likely to undertake more FDI compared to the "clean" industries in the sample (see Figure 6-1). This finding is in line with the findings of Spatareanu (2007).

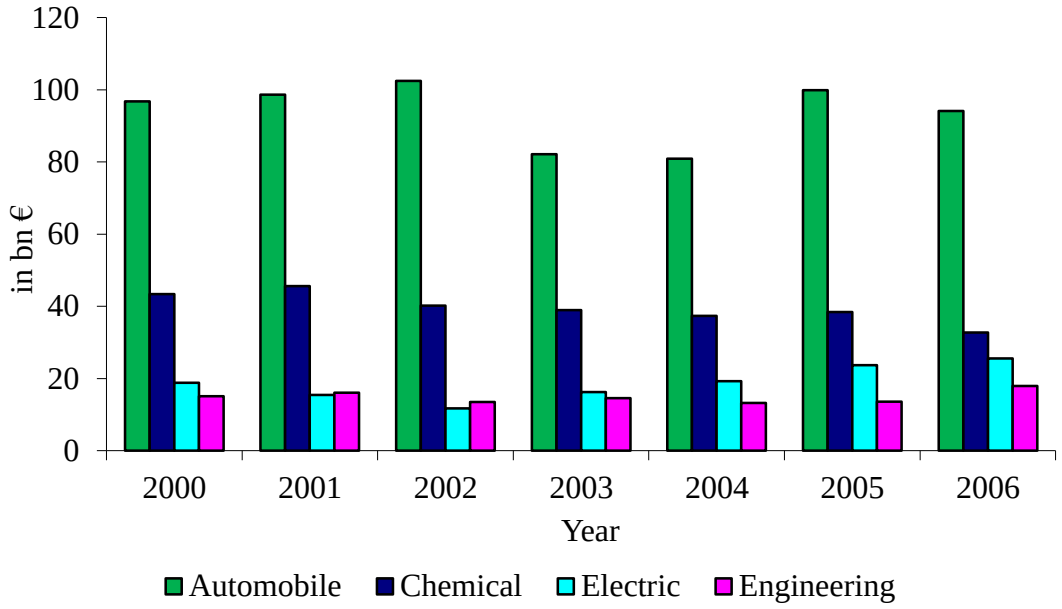

Figure 6-3: Total outbound FDI by industry in billion €

In order to analyse whether German companies prefer to invest in countries with low environmental regulations, it has to be defined which countries actually have

relatively low environmental regulations compared to Germany (GCR 2000-2006). The mean value for Germany during the period 2000 to 2006 is 6.64 on a scale ranging from 1 to 7, where 7 indicates the most severe regulations. This is also the highest value across all countries in the sample. The mean value across all countries in the sample is 4.28. Therefore, we define all countries with a value under the mean of 4.28 as countries with low environmental regulations compared to Germany. This splits the sample into 42 low regulated countries and 38 countries with strict environmental regulations. By adding the annual growth rate of German outbound FDI in relation to the environmental stringency of the two groups it is possible to observe which group has the highest annual growth rates of receiving German outbound FDI.

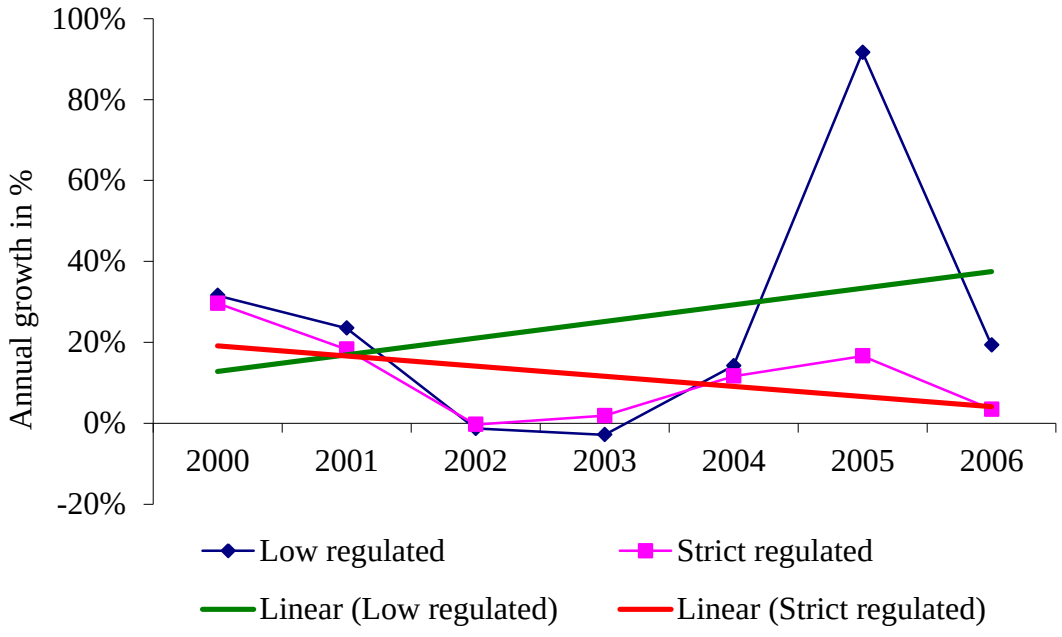

Figure 6-4: German FDI growth rates of countries with low/strict regulations

Figure 6-4 shows that the growth rates of low regulated countries outperform the growth rates of the strict regulated countries in almost every year. Solely during the downturn in 2002 and 2003, strict regulated countries had slightly higher growth rates

compared to low regulated countries. The green trend line clearly shows that countries with low regulations have a positive linear trend in the sample period, whereas the red trend line shows a negative trend for the strict regulated countries. This illustration only takes the growth rates in relation to the environmental stringency of a country on a yearly basis into account but excludes all other factors such as volume of FDI or other explanatory variables that might explain FDI flows.

6.5.2 Empirical Results on an aggregated level

The results of the panel regression on an aggregated level are shown in Table 6-3.[28,29] In particular, the results show that six out of the eleven variables are statistically significant. The variable for market size GDP is significant at the 1% level. The variable DIST shows the expected sign, which means that economies in proximity to Germany attract German FDI, and is statistically significant at the 1% level. The FLEX shows a negative sign but is not significant. The KOF globalisation index doesn't have the expected sign but is at the same time not statistically significant in this analysis. The variable for Innovation is not significant whereas the variable for institutional quality (GOV) shows the expected sign and is significant at the 5% level. The variable WAGE is highly significant at the 1% level and has the expected negative sign. The negative sign confirms the assumption that German outbound FDI is attracted to countries with lower labour costs or countries with lower hourly compensation rates. The mean value for hourly compensation rates in Germany is $28.58 per hour, which differs strongly

[28] In general, panel regressions suffer from non-stationarity. In order to check whether the panel shows non-stationarity we applied the Augmented Dickey-Fuller test for each independent variable. There were no signs of non-stationarity.

[29] The Wald chi2 test also indicates that the model itself is highly significant and that all variables should be included in the model. We have also controlled for the issue of multicollinerarity. An examination of the correlations of the independent variables revealed that multicollinearity is not exerting an undue influence on the results. Also, the corresponding variance inflation factors (VIF) do not reach critical values.

from the mean value in the sample of $13.95 per hour. Since the numbers are based on the manufacturing sector it can be assumed that the German manufacturing sector has a clear disadvantage in terms of labour costs compared to other countries.

Table 6-3: Determinants of Total German outbound FDI

	Random-Effects Regression			**Fixed-Effects Regression**		
Variable	Coefficients	Z-Value	Standard Error	Coefficients	t-Value	Standard Error
lnGDP	0.895***	10.93	0.084	0.969***	5.76	0.106
lnDIST	-0.595***	-4.02	0.148			
INFL	-0.007+	-1.28	0.005	-0.007+	-1.02	0.007
INNOVATION	-0.0001+	-0.05	0.002	-0.0004+	-1.43	0.0003
KOF	-0.013**	-1.96	0.010	-0.019+	-1.06	0.018
FLEX	0.0003+	-0.01	0.040	0.001+	0.05	0.036
STRINGENCY	-0.153**	-2.94	0.052	-0.173**	-2.93	0.059
OECD	1.092**	1.89	0.576			
WAGE	-0.019***	-3.95	0.004	-0.021**	-2.37	0.009
GOV	0.248*	1.84	0.135	0.174+	1.04	0.167
Constant	-23.244***	-7.66	1.912	-28.998	6.08	-4.767
Overall R^2		0.6549			0.3515	
Observations		268			268	

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance.

German outbound FDI is also attracted to countries that are OECD members since the coefficient has a positive sign and is also statistically significant at the 10% level. With respect to the effect of environmental stringency we find that STRINGENCY in host countries has a negative statistically significant effect on German outbound FDI. The variable is statistically significant at the 5% level. This fact confirms the hypothesis that higher environmental regulations in host countries deter German outbound FDI in

those countries. Additionally, this result provides evidence for a "pollution haven effect" in German outbound FDI. To express the result in relation to each other and to show how important the result is economically, the result can be described as semi-elasticity. This means that, all else being equal, a change by one unit in environmental regulations by a certain country (e.g. from 3 to 4) will cause a decrease of approximately 15% of receiving German FDI. In summary, German companies investing abroad seem to take the costs through differences in environmental regulations across various countries into account. Consequently, German companies try to circumvent the additional costs in order to comply with environmental regulations in Germany by investing more in lower regulated countries and relocating production facilities towards these countries.

In order to support this result and to provide evidence for a "pollution haven effect" in the manufacturing sector the article will also outline FDI patterns on the industry level.

6.5.3 Empirical Results on the industry level

Since data on the industry level is very scarce in terms of country coverage and therefore the number of observations is relatively low, the study will apply a different empirical model for all regression analyses on the industry level. The results obtained from applying a random effects or fixed effects model did not show any significant results due to relatively low number of observations. All independent variables used in

the regressions were insignificant and could not be interpreted. Therefore, the data on the industry level will be analysed by using the OLS technique.[30]

The chemical industry is one of the industries defined as a "dirty" industry. This was outlined based on the industries expenditures for pollution abatement. Therefore, the chemical industry is the industry which is most likely to show a "pollution haven effect". Furthermore, the descriptive statistics indicate that the countries in the sample are on average more advanced economies.[31] The empirical results from the manufacturing industries are shown in Table 6-4.

The results from the regression analysis for the chemical industry confirm the previous results from the Total German outbound FDI sample. Again, GDP is highly significant at the 1% with a positive coefficient. The variable DIST and FLEX are both significant and also show the expected sign. INFL is significant at the 1% level and has a negative sign. This means that companies in the German chemical industry are attracted to secure markets with a low country risk. This is also confirmed through the KOF index which is statistically significant at the 1% level and shows a positive sign indicating that low trade barriers and openness towards globalisation is an important determinant for the German chemical industry.

[30] The major drawback of this technique is that it is not possible to control for unobserved heterogeneity and therefore the results may be biased as discussed earlier.

[31] The relatively high mean value on the globalization index shows that more advanced economies are included in the sample. In addition, data on the KOF index for Hong Kong as well as data on FDI flows to Romania and Slovakia for 2000 is not available. Moreover, there is no available data on labour costs in China for the years 2000, 2001, 2005 and 2006. For that reason, China was dropped for the years of missing data. Additionally, Hong Kong was completely dropped from the sample and Romania and Slovakia were dropped for the year 2000.Therefore, the total number of observations is 190 in the sample for the chemical industry.

Table 6-4: Determinants of German outbound FDI in the manufacturing industry

	Coefficients OLS			
Variable	Chemical	Automobile	Electric	Engineering
lnGDP	0.594 (6.29)***	0.898 (9.26)***	0.961 (9.77)***	0.904 (14.36)***
lnDIST	-0.225 (2.72)**	0.155 (1.43)+	-0.446 (-4.70)***	-0.338 (-3.57)***
INFL	-0.074 (-3.79)***	-0.034 (-1.32)	-0.005 (-0.26)+	-0.001 (-0.11)+
GOV	-0.340 (-1.71)*	-1.952 (-6.72)***	-0.066 (-0.31)+	-0.441 (-2.04)**
KOF	0.067 (4.98)***	0.104 (6.57)***	0.003 (0.29)+	0.047 (3.76)***
FLEX	-0.200 (-2.69)**	0.316 (4.02)***	0.274 (3.13)**	0.192 (3.93)***
STRINGENCY	-0.284 (-2.15)**	0.671 (4.02)***	0.317 (1.96)**	0.515 (4.00)***
WAGE	-0.016 (-1.48)+	-0.068 (-5.22)***	-0.086 (-6.27)***	-0.059 (-5.83)***
OECD	-0.202 (-0.82)+	0.978 (3.48)***	0.121 (0.54)+	-0.634 (-3.51)***
INNOVATION	0.002 (9.26)***	0.001 (3.48)***	0.001 (3.37)**	0.004 (2.61)**
Constant	-18.446 (-6.39)	-42.878 (-10.37)	-37.416 (-7.59)	-38.141 (-12.85)
R^2	0.7299	0.6803	0.6742	0.6522
Observations	187	180	169	180

***, ** and * denote statistical significance at the 0.01, 0.05 and 0.1 level, + denotes insignificance; Note: t values in brackets

In addition, the variables INNOVATION and GOV are both significant and show the expected positive sign. Furthermore, the variable WAGE is not significant but shows the expected negative sign. But most importantly, the measure of STRINGENCY is statistically significant at the 5% level and also shows a negative sign. The coefficient indicates that, all else being equal, a country changing its environmental regulations by one unit will cause a decrease of 28.4% in receiving German FDI. Therefore, the hypothesis that the chemical industry, defined as a "dirty" industry, is attracted to

countries with low environmental regulations is statistically confirmed. This further supports the existence of a "pollution haven effect".

The second industry defined as "dirty" in the sample is the automobile industry. The descriptive statistics are very similar compared to the sample of the chemical.[32] The results show several surprising effects. First of all, the variable GDP, the proxy for market size, is again highly statistically significant in this regression. The variable DIST is not significant in this regression. On the other side, the variable FLEX in labour markets is statistically significant at the 1% level and shows the expected sign. The variable WAGE shows the expected sign and is highly significant. The variable GOV is highly significant and reports a negative sign. The results show that companies in the automobile industry are attracted to countries with closer distance, lower inflation rates, less institutional quality but more flexible labour markets. In general, all these determinants indicate cost savings, especially in the production process. Furthermore, companies in the automobile industry are attracted to host countries with low trade barriers as well as openness to globalisation, indicated through the positive and statistically significant relationship between German FDI and the KOF index. Since the automobile industry is defined as "dirty" in this study it was expected to find a negative statistically significant relationship between German FDI and the STRINGENCY in host countries. As the results show, there is a significant relationship but it does not show the expected sign. Consequently, the second proposed hypothesis in this study cannot be confirmed for the automobile industry. In fact, the results indicate that companies in the automobile industry are attracted to countries with high environmental

[32] Data for Luxembourg was not available for the automobile industry and is therefore not included in this sample. Hence, the number of observations is reduced to 180.

regulations. This could possibly reflect a turnaround in German automotive industry's strategically environmental consciousness with regard to future market potential. In particular, consumers of environmental stringent countries have developed a strong demand for environmentally efficient products, i.e. hybrid fuel technologies which will continue to rise in the future. An explanation provided by Rauscher (2009) states that everything else being equal, tighter environmental standards retard rather than accelerate long-term economic growth despite potentially substantial spill-overs in the green R&D sector. In addition, the variable INNOVATION, highly significant and positive, supports the result. Hence, our results give support for the Porter hypothesis which states that environmental regulation causes cost reducing innovation and promotes competitiveness (Porter & van der Linde, 1995).

The electric industry is the first defined as a "clean" industry in the sample. Therefore, the paper does not expect to find a negative relationship between German outbound FDI and environmental regulations in the host country. The results of the regression analysis are presented in Table 6-4.[33] The variable for market size GDP is again statistically significant at the 1% level. Also the variable DIST in this regression is significant at the 1% level and shows a negative sign. In contrast to the defined "dirty" industries, DIST or close proximity to Germany has an influential impact on receiving German FDI in the electric industry. The variables INFL and GOV are not statistically significant for the electric industry. The KOF index also shows the expected sign but slightly fails to be significant at the 10% level. Additionally, the variables WAGE, INNOVATION and FLEX show the expected signs and are highly significant.

[33] Due to data constraints for German FDI flows to Romania (2000, 2003, and 2005), Slovakia (2000, 2002), Ireland (2002) and Norway for all years in the sample period, the number of observations is reduced to 169.

As expected, the variable STRINGENCY does not show a negative sign and therefore supports the second hypothesis. In fact, the coefficient shows a positive sign and is highly significant. As a consequence, German companies in the electric industry prefer to invest in countries that have high environmental regulations. The second defined "clean" industry in the sample is the engineering industry. Regarding the second hypothesis, we expect the same findings as for the electric industry. The results are similar to those obtained from the electric industry with the exceptions that the variables KOF and OECD are statistically significant. The variable DIST is statistically significant and reports a negative sign. Surprisingly, this result regarding DIST differs from the regression results obtained from the defined "dirty" chemical industry. This indicates that DIST is an important determinant for the "clean" industries, whereas the contrary applies for the "dirty" industry in the sample. Consequently, it can be maintained that firms engaged in "clean" industries prefer investment destinations close to their home market as they move both consciously and physically up their environmental value-added chains. One may argue, occasioned *inter alia* by rising living standards and possible market enlargement effects - and partly due to changes in their production and marketing strategies, that the DIST variable effects may now rest more upon spatial optimization of an interrelated set of value-added activities in the "clean" industries. In contrast, firms engaged in "dirty" industries appear to be still adhering to more traditional motives of superficial myopic cost minimization strategies without taking into account the mid- and long term strategic asset effects of sustaining a "dirty" image.

The variable INNOVATION shows the expected sign and is also significant. In addition, the variables KOF and FLEX are significant. Also firms in the engineering

industry are attracted to countries with lower wages compared to Germany. Concerning the measure of STRINGENCY, the results show a positive significant relationship between environmental stringency and German outbound FDI. Consequently, the results confirm the second proposed hypothesis that there is no negative relationship between German FDI and environmental regulations in host countries across "clean" industries.

6.6 Discussion

The study proposed two hypotheses in order to provide evidence for a pollution haven effect in German outbound FDI. Therefore, the study applies an empirical model to detect a relationship between environmental regulations and German outbound FDI. The novelties in this study are the application of customized FDI determinants for the source country Germany as well as the assembly of the variables in connection with the environmental variable. The environmental variable, taken from the GCR, is a subjective measure of environmental stringency determined by leading decision makers who decide on FDI flows. Consequently, the environmental variable does not suffer from potential endogeneity. In addition, the data for the GCR environmental stringency index is available for the investigated sample period from 2000 until 2006. Therefore, the index can be included in a panel data set and can overcome the drawbacks of unobserved heterogeneity.

The results of the regression analysis for Total German outbound FDI are multifarious. The results show a negative statistically significant relationship between environmental regulations and German outbound FDI. This indicates that German FDI is attracted to countries with lower environmental regulations. More precisely, all else being equal, an increase by one unit in environmental regulations by a certain country

will cause a decrease of approx. 15% of receiving German FDI. This finding strongly supports the first hypothesis and provides evidence for a pollution haven effect in German outbound FDI. Consequently, the difference in environmental regulations across countries can be seen as an important determinant in explaining German outbound FDI. Therefore, it can be argued that German companies try to circumvent the costs related to severe environmental regulations in Germany by investing more in countries with lower environmental regulations and possibly shifting production facilities towards these countries.

A major contributor of FDI in Germany is the manufacturing sector. The sector accounts for 18% of total German outbound FDI. In order to provide further evidence for a pollution haven effect the study also investigates German outbound FDI in various industries in the manufacturing sector. Based on the data for the share of pollution abatement investment in total investment, the study defines "dirty" and "clean" industries that are included in the sample. Consequently, the second hypothesis states that there is a negative statistically significant relationship between German outbound FDI in "dirty" industries and environmental regulations in destination countries, whereas the "clean" industries do not show the effect. This hypothesis is confirmed for the chemical industry but has to be rejected for the automobile industry. An explanation for this outcome is that the share of pollution abatement investment in total investment in the chemical industry is approximately 3.5 times (6.15% vs. 1.72%) higher compared to the automobile industry. This fact supports the assumption that costs related to comply with environmental standards influence decisions on investments. This fact can only be confirmed if the costs represent a significant fraction of the total costs. Another explanation would be a turnaround in the demand for environmentally efficient products

in the automotive industry. In contrast, the defined "clean" industries do not show a negative statistically significant effect, which further confirms the second hypothesis. Additionally, the results support the assumption that German outbound FDI is attracted to countries with large domestic markets as well as to countries with significantly lower labour costs. Furthermore, in almost all regression analyses, the openness to globalisation of a certain country is an important determinant for German outbound FDI.

The limitation of the study is the shortage of data. Firstly, data on hourly compensation rates or an equivalent measure of labour costs has not been significantly published or reported by various countries. Furthermore, data on German FDI flows is only published for a limited number of industries and countries. Due to the data limitation, it is not possible for the study to apply an empirical model that controls for unobserved heterogeneity on the industry level. The limited size of the data and the imperfect coverage of the labour costs data suggest that future studies should concentrate on expanding the data set and industries covered. It would also be appropriate to investigate other methods of collecting FDI data, for example, to apply firm-level data on investment decisions.

7 Conclusion and Outlook

Modern professional sport teams are complex businesses, intrinsically concerned with matters of economics and finance (Morrow, 2003). This dissertation extracts some managerial decisions and regulations that influence this complexity. Beginning with a key element of the industry, namely, the league structure that is essential to the production of the sport product, Chapter 2 demonstrates the influence of sport's governing bodies and the ways in which they arrange league structures. In a bid to increase the attractiveness of the game for spectators and generate additional revenues, European basketball leagues adopted a shorter shot clock in 2000. My empirical analysis revealed that though this rule change may have enhanced attractiveness in terms of scoring, it simultaneously led to decreased competitive balance, thus establishing a trade-off between two desired outcomes. To evaluate and generalize these results, comparable research in other sports that have adjusted their rules would be helpful.

The next two chapters emphasize the financial performance of professional sport teams. I first addressed whether the introduction of a new CBA improved managerial technical efficiency, in terms of maximizing team values and revenue generation. The average efficiencies increased by up to 9 percentage points, compared with before the new CBA was established for the NHL, and the ten least efficient teams benefited even more, in that their average efficiency improved up to 14 percentage points. To explicate the surprising result that sporting performance influenced neither team values nor team revenues, I then presented an empirical study of the differences in motives between North American and European team sports. Athletic achievement had significant influences on financial performance only among EPL clubs, not for teams in North

American major leagues, which supported the results from the previous chapter. In addition, the DEA efficiency analyses indicated a predominant sporting focus among EPL teams, whereas North American major league franchises tended to be more business-oriented organizations. Further research might extend and confirm these findings by analyzing whether other European sport leagues exhibit similar results with regard to their sport and financial performance.

Beyond these insights into the impacts of decisions by governing bodies and team owners, Chapter 5 spotlights individual players and the determinants of their remuneration. Specifically, I tested whether performance consistency is rewarded. This initial application of a longitudinal data set revealed findings that contradicted the results of previous research: I found strong evidence of a salary premium for players who perform inconsistently. Controlling for individual player characteristics and performance indicators, a one standard deviation increase in inconsistency earned the player a salary surplus of up to 92%, depending on the econometric model. Studies of performance consistency are very rare, so manifold research opportunities arise from this analysis. For example, as a robustness check, a cross-sport evaluation would be helpful. Panel data from professional basketball, football, and hockey players could offer a revealing comparison to determine if inconsistent player evaluations improve salaries across the board, or if sports-related differences appear in the results.

One of the most promising research streams for sports economics relies on the increasing availability of vast amounts of new data, as connected with the still poorly defined term “big data.” Such data come from various sources and may not be publicly available. For example, the NBA has equipped every arena with a data collection system called SportVU that measures each player’s every move by analyzing optical

tracking data, recorded through several cameras throughout the arena. In one of the first studies to analyze these data, Cervone et al. (2014) propose a new metric to measure performance value in the NBA, in which each possession takes a value. Then the derived value is based on the probability of a made basket, which is equal to the total number of expected points that will result from a possession, or expected possession value (EPV). Because the EPV assigns a point value to every tactical option available at each moment of a possession, it can reveal the decisive moment that led to an open shot, instead of merely capturing the open shot, a current box score metrics do. The EPV also quantifies a player's combined offensive value, taking into account every single action over a given time span and summarizing it as a single value. Comparing this value across players in turn offers a more accurate estimate of performance that might help explain wage dispersions. For European soccer, similar data are collected by Opta Sports. Yet a major limitation remains, in that these big data demand considerable resources to be analyzed, and few professional sports teams employ sufficiently well-equipped statisticians. This gap might be why Manchester City FC publicly released all the data collected about it by Opta Sports for the entire 2012–13 season. With a crowdsourcing model, Manchester City FC is seeking to learn how to use its data more effectively and efficiently.

Finally, professional sport teams likely include various data sources in their decision-making processes as they seek to optimize their operations, maximize game day revenues, and earn more from their sponsorships and merchandise operations. Experts and team owners highlight the benefits of WiFi-equipped arenas, which allow teams to collect personalized, real-time data about their attendees, for segmentation and profiling purposes. According to team owners, an average purchase includes three

tickets, which means that they collect purchase data from only about one-third of the attendees in the arena; the other two-thirds are virtually anonymous. Data gathered from WiFi operations could help optimize waiting queues for food and beverage vendors or even reducing waiting times for restrooms. By exploiting such information and data, teams can enhance the fans´ experience and increase game day revenues. An embedded social media strategy within organizations, to collect data about fan behavior, similarly appears increasingly imperative as a means to increase fans' engagement.

Eventually, those professional sport teams that use data and derive analytic insights from available data sources in the most efficient way will gain a competitive advantage—one that ultimately might lead to superior sport and business performance.

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