To Work or Watch Hockey? That is the Question

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Contents

Abstract

This paper analyzes the effects of Linder's Disease on attendance demand for the National Hockey League. Linder's Disease is the adverse effect on demand due to increases in wages. The analysis is composed of the two way fixed effect estimator and the Arellano Bond estimator. The impact of Linder's Disease was measure in two methods, by the impact of the price of leisure on demand and by the difference between the measure of full income and the measure of real personal income. The data is collected from the Bureau of Labor Statistics, the Bureau of Economic Analysis, the firm – Team Marketing Report and the National Hockey League website. The derived results from the Arellano Bond estimator confirmed that Linder's Disease does exist; a 1% increase in full income, which accounts for the price of leisure, results in a 0.1% increase in attendance. While a 1% increase in real personal income, which does not control for the price of leisure, results in a 0.04% increase in attendance. The difference between the two coefficients is attributed to the adverse effect of the price of leisure and rising wages – Linder's Disease. The impact of the price of leisure on demand also supports the hypothesis that hockey is adversely effected by Linder's Disease; a 1% increase in wages results in a 0.12% decrease in attendance.

Introduction

Economists have estimated attendance demand for various sports throughout the world; the literature is far reaching in both depth and breadth. However, there is very little research geared towards the effects that increased wages have on leisure activity, specifically with regard to the National Hockey League (NHL). The current consensus amongst economists is that the NHL is an inferior good and income inelastic, which means a rise in income results in a decrease in demand at a rate less than the rate of increase in income. However, previous research did not control for the adverse effect of rising wages on demand, otherwise known as Linder's Disease. This paper studies the impact of Linder's Disease on NHL hockey attendance and whether or not it has negatively (or positively) effected the income elasticity of demand.

Linder's Disease is an important factor to consider when studying demand for time-intensive leisure goods because the longer consuming said good takes, the greater the opportunity cost. However, Linder's Disease works in two different ways; if the good is inferior then rising wages will actually have a positive effect on demand, while the opposite is true for goods that are normal. According to the National Hockey League, the average game lasted approximately two hours and nineteen minutes in the 2013-2014 season. Although this is relatively less than the average game in the NFL, or MLB[1], NHL games are still a full evening's outing. Not only do they require a block of time for spectating, but they also require a block of time for travelling.

The NHL regular season consists of 82 games that span from early October to early April. The league consists of 30 teams that play half of their games at their home arena and half of them at an opponent's arena. When considering the number of days in the season – approximately 140 – and the

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[1] According to the New York times, in 2013, the average lengths of a National Basketball League game and the National Football League games were 2 hours 15 minutes and 3 hours 9 minutes respectively. According to ESPN, Major League Baseball games lasted 2 hours 58 minutes in 2013.

number of home games required to complete the season – 1230 – there is no feasible way to schedule every game on the weekends when opportunity costs are lowest. As a matter of fact, in the 2014-2014 season, 896 of the 1230 games are scheduled between Monday and Friday, which means that 73% of the total games are played when the opportunity cost of attending them is relatively higher.

With respect to the above factors and the absence of a variable that controls for Linder's Disease it is plausible that the income elasticities of demand derived in previous literature are bias, which is another reason that it is important to reexamine the topic. Furthermore, if NHL hockey is in fact an inferior good after controlling for Linder's Disease then the concerning issue for franchise owners and other NHL policy makers will be whether or not they are appealing to their desired target market.

Literature Review

Of all the professional sports in the United States, Hockey is the one least researched. Doing a simple search on EconLit[2] of the most popular sports in the United States – football, baseball, basketball and hockey – will yield results of 1015, 774, 346 and 163, respectively. That is not to say the research doesn't cover a large array of topics, but it does suggest that much is left to be discovered. Many of the more recent papers analyze topics such as the impact of momentum (Leard & Doyle, 2011), player productivity on attendance (Paul & Weinbach, 2011), betting (Woodland & Woodland, 2011) and home rink advantage (Leard & Doyle, 2011). In fact, there is a relatively small amount of literature that is focused mainly on the demand analysis of traditional, independent variables like own price and income.

Nevertheless, the general consensus is that hockey is an inferior good. Jones & Ferguson (1988) derived an income elasticity equal to -0.38 using a panel data set of NHL teams. Noll (1974) did not find any statistical significance with regard to the impact of income on hockey attendance. The -0.38 income elasticity derived from Jones & Ferguson (1988) says that for every 1% increase in income the demand

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[2] EconLit stands for Economic Literature; it is a database designed to provide the user with economic research papers that correspond to their query.

for hockey decreases by -0.38%. Not only is this evidence of an inferior good, but it also implies that hockey is income inelastic. The negligent results derived from both Jones & Ferguson (1988) and Noll (1974) are potentially a result of not including the variables associated with Linder's Disease – wages, the price of leisure and unearned income.

In light of the lack of literature specifically focused on estimating the impact of Linder's Disease on hockey attendance, it seems reasonable to consider other studies on leisure activities relatively analogous with attending an NHL game. For example, both attendance at a hockey game and attendance at a theatre place are time intensive and consumed during one's own leisure, which suggests that demand for such goods will be influenced somewhat similarly. It is also plausible that attending a soccer game, baseball game or even participating in a sport are similar in how their income elasticities of demand are estimated because they are all time intensive as well. Following the economic theory that people are rational beings, the opportunity cost of attending such activities must be accounted for, which includes the cost of forgoing labor and other leisure activities.

Burger and Walters (2011) estimated the income elasticity of demand for the baseball World Series using an interaction term combining income and the duration of the televised broadcast; their dependent variable was the Nielson Rating, which is the metric that tracks the proportion of viewers on any given channel at a specified time. As the broadcast time of the World Series grew longer, they discovered that it had reached the status of an inferior good. A 10% increase in come reduced World Series viewership by 1.8 million households (Burgers & Walters, 2011). Forest et al., (2002) also factored time intensity into the computation of the full consumer price for attending English soccer games. They discovered that 18 of the 20 teams had positive income elasticities, implying they were normal goods.

Kesenne & Butzen (1987) took a different approach in estimating the demand for sports than Forrest et al., (2002) and Burgers & Walters (2011) did. Rather than studying the explicit effects of time intensity on attendance they focused on the effects of the shadow costs on participation demand, otherwise defined as the full consumer cost of participating in sport. Accounting for that, they derived a range of income elasticities of demand between (0.5 and 0.9), suggesting that for every 10% increase in income, participation in sport increased by 5% to 9% - categorizing sport participation as a normal good.

Loyland & Ringstad (2009) and Withers (1980) used Gary Becker's time-allocation model to estimate the demand for sports participation-attendance and theatre, respectively. Becker's time-allocation model required the calculation of a variable for full income – hourly wages, hours of work, hours of leisure, unearned income and the price of leisure. By controlling for the price of leisure through the full income variable, Withers (1980) was able to show the biased results of using the standard income variable in estimating the demand for theatre – disposable income in his case. He derived income elasticities, using the full income variable, of 2.74, 1.43 and 2.78. While using disposable income Withers (1980) derived income elasticities of 1.08, 0.64, and 1.55. The difference between the elasticities of the full income variable and the disposable income variable exemplify the omitted variable bias that is a result of omitting the price of leisure. Withers (1980) also included the price of leisure in his analysis, which resulted in coefficients of -1.61, -0.59 and -1.03. The negative signs imply that an increase in wages and therefore an increase in the opportunity cost of leisure, does have adverse effects on leisure activities. Loyland & Ringstad (2009) did not have data on wages so they were unable to provide such a concise demonstration of the bias, but they did develop an innovative solution.

First, they confirmed that wages were increasing over the time-span covered in their data, then they estimated the income elasticities of demand in 1986 and 2002. They argued that the negative bias on the income elasticity of demand for sports participation-attendance would increase as wages did. In 1986 they calculated an income elasticity of demand of 1.39 and in 2002 they calculated one of 0.96. The cause of the shift of sport participation-attendance from income elastic to income inelastic, argued Loyland & Ringstad (2009), was from Linder's Disease.

Based on these findings it is obvious that the price of leisure increases as wages increase, which changes the price of the demanded good. Without separating the various variables – including the price of leisure – when calculating full income there will be a bias that is directly due to the changes in the price of leisure.

Theoretical Model

The method of estimating attendance demand for NHL hockey in this study is based off the standard demand theory as stated in Andreff & Szymanski (2006). The quantity demanded is a function of the price of the good, the price of substitutes, the income level, tastes and preferences. The lagged team winning percentage will be included to control for the quality of the team. It is relevant in the case of estimating NHL attendance demand because it is thought that team success in time $T - 1$ will result in an increase in fan loyalty in time T.

In addition to the traditional demand model above, Linder's Disease will be analyzed on the basis of the time-allocation model introduced by Becker (1965). According to his model, the household produces and consumes a vector of goods: $Z = (Z_i), i = 1, \ldots.., n$. Each one of these goods corresponds to different levels of time intensity and production intensity – leisure activity, household labor, child-rearing, etc. Utility maximization is a function of the goods:

$$U(Z_1, \ldots., Z_n)$$

Furthermore, the household faces the traditional budget constraint and a time constraint (Becker, 1965). Becker (1965) shows that the household faces one budget constraint that is constructed by the consumption of $Z_1, \ldots., Z_n$ in which Z encompasses all goods that require time, including the consumption of leisure (attending a hockey game), where the price of leisure is w. The demand for the goods $Z_1, \ldots., Z_n$ are a function of their time intensity and the amount of goods that are required to consume or produce them – in the case of attending a National Hockey League game this would be driving the car to and from, going on-line to purchase the tickets, organizing the trip with others, etc.

Furthermore, Becker explains that the maximum amount of income that can be earned by the household is full income:

$$FULLINC = w\ (\ h + l) + \ I_0$$

Where full income is composed of labor income, non-labor income and the price of leisure. Including the price of leisure is necessary because the household must factor in what they are forgoing by consuming a good that is time-intensive. Therefore, the marginal price of time dictates the household's choice. Deduced from this, we get the equation:

$$Z_i = g_i(w\ (\ h + l) + \ I_0, p, w)$$

Where the decision to attend an NHL game (Z_i) is a function of full income, a vector of prices and the price of leisure. Originally, the demand for (Z_i) was thought to be a function of the above equation less the price of leisure, however this assumes that households do not factor in time-intensity when deciding what they will consume. By omitting the price of leisure and therefore a time-intensity income variable, there is an omitted variable bias that is captured by the traditional income variable. By including the price of leisure the effects of Linder's Disease can be derived in two ways – the coefficient on the price of leisure and the difference between the coefficients of personal income and full income. The price of leisure in the above equation is the wage rate; as it marginally increases the opportunity cost of consuming leisure increases until it is rational to switch from leisure to work. Therefore we derive the testable hypothesis:

$$H_0: Price\ of\ Leisure \geq 0$$

$$H_a Price\ of\ Leisure < 0$$

$$H_0: Full\ Income = Personal\ Income$$

$$H_a: Full\ Income > \beta_3 Personal\ Income$$

Methodology

Building off of Gary Becker's Time-Allocation Model, this paper will implement the theoretical strategy emphasized in Withers (1980) because the data utilized in this study is aggregated, which requires an approach that complements it. The empirical model is as followed:

$$AVGATT_{it} = f(AVGTKT, FULLINC, PLEI, PBASK, WINPCT, SELLOUT, NEWARENA)$$

Where:

$AVGATT$ Is the average attendance of the franchise (i) in time (t)

$AVGTKT$ Is the weighted, average ticket price based on the percentage of each level of seating for franchise (i) at time (t)

$WINPCT$ Is the winning percentage of the franchise (i) at time $(t-1)$

$PBASK$ Is the weighted, average ticket price of the NBA franchise in the corresponding municipality of the NHL franchise.

$SELLOUT$ is a dummy variable that is equal to one when the capacity of the franchise's arena is 100% or more

$NEWARENA$ is a dummy variable that equals one when a new arena was built in time (t)

$PLEI$ Is the price of leisure in the municipality (i) that hosts an NHL team at a given time (t)

$FULLINC$ Is the full income of the given municipality (i) at time (t)

$PLEI$ & $FULLINC$ are derived from:

$$PLEI = w(1 - UR)$$

$$FULLINC = T_c PLEI + PI$$

Where:

$PI =$ Personal income, which is labor and non-labor income in municipality (i) at time (t)

$w =$ Median, hourly wages at a given time in a given municipality

$UR =$ Annual, municipal unemployment rate at a given time

T_c = Hours of consumption

Consumption time is assumed to be biologically fixed at 80 hours per week (Withers, 1980). The price of leisure is a reflection of the opportunity cost of not working, which is what is given up when leisure is chosen over work. Theoretically, it is assumed that individuals could work instead of choosing leisure, which is why the median hourly wage is included in the analysis (Withers, 2015). Although, there is a chance that employment is not available at the median hourly wage, which is why it is discounted by the probability of unemployment $w(1 - UR)$ (Withers, 2015).In other words, this reflects the uncertainty of obtaining employment at the stated wage (Withers, 2015). The full income variable is differentiated from the personal income variable through the addition of the price of leisure. Although, the difference between them is subtle it allows for the inclusion of a work-leisure dynamic that can be compared to a variable, personal income, that only reflects work.

In addition to income variables, attending an NHL game is also a function of tastes and preferences. Holding income constant, there is an idiosyncratic dimension associated with the individual that determines whether or not they will attend a hockey game, or participate in some other activity, be it work or leisure related. It is important for the franchise owners to recognize exactly what they are competing against – not only the choice to work, but also the choice to participate in some other leisure activity. Included in those activities might be watching a televised game, or attending junior hockey, minor league hockey, or another professional sporting event. In the case of this analysis, the price of basketball is included as a control variable for substitutes. If it is a substitute then an increase in its price will result in an increase in NHL attendance.

Variables, Data

Variable	Sign	Definition	Source
The Natural log is taken for the dependent variable and all of the regressors			
$\boldsymbol{LAVGATT_{it}}$		Dependent variable = average attendance of the franchise (i) at time (t) – derived by dividing the sum of game attendance in season (t) by the number of games in the regular season and it is logged.	ESPN Database
$\boldsymbol{Lag(LAVGATT_{it})}$	$B > 0$	The dependent variable in time $(T - 1)$	ESPN Database
$\boldsymbol{LAVGTKT_{it}}$	$B < 0$	Derived by computing the average ticket price, weighted by the percentage of different seating categories and it is logged.	Team Marketing report
$\boldsymbol{LFULLINC_{it}}$	$B \neq 0$	Full income is the measure of dividends, interest, rents, median hourly wages, and the price of leisure and it is logged.	BLS & BEA
$\boldsymbol{LPLEI_{it}}$	$B \neq 0$	The price of leisure is the opportunity cost of not working. It is derived by multiplying the median hourly wage by $(1 - UR_{it})$ and it is logged.	BLS
$\boldsymbol{LPI_{it}}$	$B > 0$	Real Personal income derived by the Bureau of Economic Analysis	BEA
$\boldsymbol{WINPCT_{i,t-1}}$	$B > 0$	The lagged winning percentage is derived by dividing the number of wins in season $(T - 1)$ by the total number of games in the season.	HockeyDB.com
$\boldsymbol{LPBASK_{it}}$	$B > 0$	The average ticket price of NBA basketball weighted by the percentage of different seating categories	Team Marketing Report
$\boldsymbol{NewArena}$	$B > 0$	A dummy where $1 = a$ new arena was constructed in time (t) and $0 =$ no new arena was constructed in time (t)	HockeyArenas.Net
$\boldsymbol{Sellout}$	$B > 0$	A dummy variable where $1 =$ an average attendance that is 100% of the seating capacity in the stadium. $0 =$ an average attendance that is less than 100% of the seating capacity.	Hockeyattendance.com

The data set contains 358 observations, which consists of the 24 teams that are or have been located in the United States between the time-period of 1998-1999 to 2012-2013. The season of 2004-

2005 is excluded from the analysis because a lock-out occurred. All of the relevant variables are discounted by the Consumer Price Index into real 1983 United States Dollars. The panel data set will first be analyzed by the two way fixed-effect estimator and then the Arellano Bond estimator because the dependent variable is a function of itself in time $(T-1)$. First, I will estimate a model in which consumer income is measured by real personal income (LPI_{it}):

$$LAVGATT_{it} = \beta_0 + \beta_1 Lag(LAVGATT_{it}) + \beta_2 LAVGTKT_{it} + \beta_3 LPI_{it} + \beta_4 WINPCT_{it-1} + \beta_5 NEWARENA_{it} + \beta_6 SELLOUT + \varepsilon_{it}$$

Then I will estimate a model in which consumer's income is measured as full income $(FULLINC_{it})$, but controlled for the price of leisure $(PLEI_{it})$, which will account for Linder's Disease:

$$LAVGATT_{it} = \beta_0 + \beta_1 Lag(LAVGATT_{it}) + \beta_2 LAVGTKT_{it} + \beta_3 LFULLINC_{it} + \beta_4 LPLEI_{it} + \beta_5 WINPCT_{it-1} + \beta_6 NEWARENA_{it} + \beta_7 SELLOUT + \varepsilon_{it}$$

It is expected that the ticket price is endogenous in the model because not only does it affect attendance, but attendance also affects it. The double log was taken to account for the non-linear nature of the independent variables on the dependent variable. However, win percentage is excluded from the natural log because it is already formatted in percentages; new arena and sellout are also excluded from the natural log because they are dummy variables.

The variables of interest are the income variables, including the price of leisure. It is expected that including the price of leisure in the analysis will reflect the negative bias on personal income that results from omitting it. Therefore, the price of leisure should have a negative coefficient, which will support the presence of Linder's Disease and there should also be a notable difference between real personal income and full income. That difference will also support the presence of Linder's Disease as the coefficient for full income should be greater than the coefficient of real personal income because real personal income does not account for the price of leisure.

Two Way Fixed-Effects & Arellano Bond Estimator Results

The results of the two way fixed effect analysis and the Arellano Bond analysis are provided in tables 1. The R-squares and the T-values are included to display the general fitness of the model and whether or not the coefficients are statistically significant. The T-values are located beneath the coefficients with either one, two, or three asterisks adjacent to them. They represent the statistical significance of the coefficients. One asterisk is equal to a 90% confidence level, two asterisks is equal to a 95% confidence level and three asterisks is equal to a 99% confidence level.

In the two way fixed effect analysis all of the income variables are statistically insignificant, which is expected because the error term in the lagged variable is still correlated with the error term of the total equation. This produces results that are consistent but statistically biased (Naveed & Rabas, 2011). As a result of their statistical insignificance the effects on attending NHL games are inconclusive. However their corresponding signs do align with the hypothesis, which suggests that hockey is subject to Linder's Disease. The remaining variables are statistically significant and with the exception of the price of basketball.

The results derived from the Generalized Method of Moments estimator are much more robust than those of the fixed effect estimator. The income coefficients align with the hypothesis that rising wages do have an adverse effect on demand and that personal income is negatively biased. This provides evidence that Linder's Disease is affecting National Hockey League attendance. For every 10 percent increase in wages there is a 1.2 percent decrease in attendance, which implies that as the opportunity cost of leisure increases the cost of attending hockey increases and therefore it is less attended. It also implies that hockey is wage inelastic.

The personal income coefficient in the traditional model and the full income coefficient in the time-allocation model also support evidence that we can reject the null hypothesis that personal income and full income are equal. The price of leisure has a significant effect on the demand for hockey; it is also correlated with full income and personal income. By definition, when a variable is correlated with a regressor, it has an effect on the dependent variable and it is omitted, the model is subject to omitted variable bias. Therefore, the traditional model is subjected to omitted-variable bias, which is why there is a noticeable negative bias on the personal income coefficient relative to the full income one.

Table 1

RESULTS				
	Two-Way Fixed Effect		**GMM Two-Step**	
	Traditional	**Time Allocation**	**Traditional**	**Time Allocation**
Observations	207		207	
R-Squared	0.7896	0.7900		
INTERCEPT	4.947737 3.15***	3.459999 0.92		
LAVGATT_1	0.41596 6.93***	0.414984 6.89***	0.508403 27.40***	0.391157 15.51***
LAVGTKT	-0.07702 -1.78*	-0.07931 -1.82*	-0.03027 -5.85***	-0.03897 -6.65***
LPBASK	-0.01956 -0.62	-0.02064 -0.66	-0.03065 -5.57***	0.010232 1.02
LPI	0.085916 0.60		0.046668 2.81***	
LFULLINC		0.274966 0.70		0.106412 2.04**
LPLEI		-0.30188 -0.83		-0.12187 -3.58***
WINPCT	0.327181 4.62***	0.332389 4.65***	0.345891 42.57***	0.412693 23.50***
NEWARENA	0.105844 2.80***	0.105194 2.77***	0.096503 38.07***	0.087312 35.93
SELLOUT	0.040978 2.32**	0.042574 2.38**	0.025799 12.37***	0.032606 12.27***
99% Confidence = *** **95% Confidence = **** **90% Confidence = ***				

In the Time-allocation model the coefficient for full income can be interpreted as for every 10 percent increase in full income there is a 1 percent increase in NHL attendance. This implies that hockey is a normal good, but its income elasticity of demand is inelastic. In other words, if an arena can seat 20,000 fans and that arena is sold out, holding everything else constant, if full income increases by 10 percent than attendance will decrease by 200 fans. If those fans consist of 50 families of 4 and they pay approximately $300 at the game in concessions, tickets and memorabilia[3] then the franchise will lose approximately $15,000 in revenue. This might be a non-material amount when marginally considering what it would take to avoid losing those fans.

Conclusion

Based on the results of the Generalized Method of Moments it is evident that hockey is a normal good – as income increases, so does attendance; this is in both the traditional and the time-allocation model. Not surprisingly, this is contrary to the findings of Jones & Ferguson (1988) and Noll (1974). It is not surprising because the traditional model is subjected to omitted-variable bias, which is reflected in the income coefficient. Had they taken into account the importance of the price of leisure then their conclusion about the nature of hockey as a good would have likely been different. The only way to confirm this though is to implement this method on their datasets.

Given that hockey is a normal good, but subjected to Linder's Disease, it is reasonable for the NHL's board to review the portion of regular season games that were scheduled during the week this season – 73 percent. Although the revenue loss due to increases in wages may be non-material, it is still marginally more than the revenue gained from an equal increase in income.

The findings also provide a broader insight into human behavior. As Becker (1965) explained, the household has a myriad of choices that vary in time-intensity and inputs. Increases in wages increase the opportunity cost of time, which makes goods that are time-intensive, especially leisure goods, more expensive. Whether or not it is attending a hockey game, a theatre play, or going on a vacation, people will factor in the cost of their time. What are they forgoing to consume that leisure and is it worth it?

[3] The approximate average cost for a family of four that attends a National Hockey League game

There might be some point where someone has made so much money that the price of leisure no longer applies, but for most people it does and when wages increase they are more obliged to earn those wages.

Finally, the small coefficient corresponding to the price of leisure is likely inaccurate because the regressions were applied to 5 consecutive years, which happened to be during and after the “Great Recession.” Wages did not vary a great amount during that period, which did not enable the coefficient on the price of leisure to reflect the behavior that might result if wages were to increase by 50 percent or double. That would truly impact the cost of time, which is why the next step in strengthening this paper is to gather wage data that has a greater range. By doing this, a more accurate reflection of the impact of Linder’s Disease can be derived.

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Appendix A

Simple Statistics

Label	N	Mean	Std Dev	Minimum	Maximum
Average Attendance	207	9.7038911	0.1339496	9.3109999	9.9885178
Average Attendance in T-1	207	9.6968195	0.1363316	9.3109999	9.9773419
Average NHL Ticket Price	207	3.1169372	0.2100462	2.4826424	3.7159857
Average NBA Ticket Price	207	3.9003337	0.3462204	3.1333179	4.8139714
Personal Income	207	9.9094651	0.1476186	9.5085208	10.2869128
Full Income	207	10.8388062	0.1321529	10.5734659	11.1891021
Price of Leisure	207	2.0015578	0.1358256	1.6945201	2.3367913
Win Percentage in T-1	207	0.5480193	0.0945386	0.3170000	0.7560000
1 = NEWARENA if a new arena was built	207	0.0193237	0.1379937	0	1
1 = SELLOUT if Capacity ≥ 100%	207	0.1159420	0.3209315	0	1

Appendix B

SAS Code

```
PROC IMPORT out = work.hockeydata
datafile        = "E:\Senior Project\2nd Draft\final_data.csv"
DBMS            = CSV REPLACE;
GETNAMES        = YES;
DATAROW         = 2;
Run;

data work.hockeydata1;
set  work.hockeydata;

/*Cleaning Data.
  The 2004-2005 season did not exist because there was a lockout that year.
Team Marketing Report, the company that provided the data on
  the National Hockey and Basketball Leagues did not have National Basketball
League data for every year of the data set. Win percentage observations
  could not be derived because an entire year of National Hockey League data
was missing.*/

   if yearend = 2005 then delete;
   if pbask   = "."  then delete;
   if winpct  = "."  then delete;

/*Creating income variables.*/

   PLEI       = medwge*(1-natur);
   FULLINC    = (tconsum*plei)*52 + pi;

Label PLEI    = "The Price of leisure"
```

```
        MEDWGE  = "The median hourly wage"
        NATUR   = "The unemployment rate"
        FULLINC = "Full Income = Annual price of leisure + Labor & Non-Labor
Income"
        TCONSUM = "Consumption Time"
      PI      = "Personal Income = Labor Income & Non-Labor Income";


/*Creating Sellout Variable*/

   CAP        = avgatt/capacity;
   SELLOUT    = 0; if cap = 1 or cap > 1 then sellout = 1;

Label CAP     = "Percentage of Stadium that is occupied by paying fans"
      SELLOUT = "If 100% or more of stadium is occupied then sellout = 1";

/*Discounting variables by CPI - Base year = 1983. CPI data is by region -
Northeast, Midwest, South and West - and it is from the Bureau of Labor
Statistics*/

   RPLEI      = (plei/cpi)   *100;
   RFULLINC   = (fullinc/cpi)*100;
   RPBASK     = (pbask/cpi)  *100;
   RAVGTKT    = (avgtkt/cpi) *100;
   RCONCES    = (conces/cpi) *100;
   RPI        = (pi/cpi)     *100;

/*Logging all variables to form double log models*/

   lplei      = log(rplei);
   lfullinc   = log(rfullinc);
   lpbask     = log(pbask);
   lavgtkt    = log(ravgtkt);
   lconces    = log(rconces);
   lavgatt    = log(avgatt);
   lpi        = log(rpi);

Label lpi      = "Personal Income Logged"
      lplei    = "Price of Leisure Logged"
      lfullinc = "Full Income Logged"
        lpbask   = "NBA Average Ticket Price Logged"
        lavgtkt  = "NHL Average Ticket Price Logged"
        lconces  = "Average NHL Concession Price"
        lavgatt  = "NHL Average Attendance Logged"
      WINPCT   = "Percentage of Games Won"
      NEWARENA = "New Franchise Arena";

run;

/*Sorting data by the year and the city*/

proc sort data = work.hockeydata1;
    by city yearend;
run;

/*Lagging the dependent variable one year*/
```

```
proc panel data = work.hockeydata1;
    id city yearend;
    lag lavgatt(1) / out = work.hockeydata1_lag;
run;

/*Cleaning Data*/

data work.hockeydata1lag;
    set work.hockeydata1_lag;
    if lavgatt_1 = "." then delete;
label lavgatt_1 = "NHL Average Attendance in Time T - 1";

run;

/*Using the fixed effect estimator to measure Linder's Disease*/

proc panel data = work.hockeydata1lag;
title "Fixed Effect Estimators";
id city yearend;
       model lavgatt = lavgatt_1 lavgtkt lpbask lpi winpct newarena sellout
/ fixtwo;
         model lavgatt = lavgatt_1 lavgtkt lpbask lfullinc lplei winpct
newarena sellout / fixtwo;
run;

/*Using the Generalized Method of Moments estimator to analyze the effects of
personal income on NHL attendance*/

proc panel data = work.hockeydata1lag;
title "Arrellano and Bond Estimators - traditional model";
inst depvar exog = (lpi lpbask winpct newarena sellout);
       model lavgatt = lavgatt_1 lavgtkt lpi lpbask winpct newarena sellout /
gmm nolevels twostep maxband = 5;
id city yearend;
run;

/*Using the Generalized Method of Moments estimator to analyze the effects of
full income and the price of leisure on NHL attendance*/

proc panel data = work.hockeydata1lag;
title "Arrellano and Bond Estimators - Becker's model";
inst depvar exog = (lfullinc lplei lpbask winpct newarena sellout);
       model lavgatt = lavgatt_1 lavgtkt lpbask lfullinc lplei winpct
newarena sellout / gmm nolevels twostep maxband = 5;
id city yearend;
run;

/*Simple Statistics*/

Proc means data = work.hockeydata1lag;
       var lavgatt_1 lavgtkt lpbask lfullinc lplei winpct newarena sellout;
run;
```