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The Role of Team Success, Fighting, and Other Factors in Southern Professional Hockey League Attendance

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Abstract

An Ordinary Least Squares regression model was specified to estimate the determinants of Southern Professional Hockey League (SPHL) attendance. The SPHL is a professional hockey league that is not directly affiliated with National Hockey League teams, but does consistently provide players to ECHL teams who serve as the AA-affiliates for NHL teams. SPHL hockey attendance was shown to be positively influenced by winning teams and teams that fight more often. Other significant independent variables found to be statistically significant were weather conditions, weekends, and demographic factors such as population, income, married percentage, and average age of the city population.

The Southern Professional Hockey League (SPHL) is a professional hockey league in North America, located primarily in the Southeastern United States. The SPHL has no formal partnership in the development chain with specific NHL teams, but does serve as a source of player development for the ECHL, the AA-level of the minors for NHL teams. The season studied in this paper, 2016-17, was the 13th season in the history of the SPHL, during which 59 players earned a call up to the ECHL. The biggest success story to come out of the SPHL is goaltender Scott Darling, a former player in the league, who served as backup goaltender for the NHL's Chicago Blackhawks and signed a contract in 2017-18 with the Carolina Hurricanes to serve as their primary goaltender.

In the 2016-17 season, there were ten teams in the SPHL across nine U.S. states. For the 2016-17 campaign, teams were in Florida (Pensacola), Georgia (Macon and Columbus), Alabama (Huntsville), Mississippi (Southaven), Tennessee (Knoxville), North Carolina (Fayetteville), Indiana (Evansville), and Illinois (Peoria). A map of these cities is provided in Appendix I. Although some of these cities do have a hockey history, they would most likely be considered non-traditional hockey markets due to their relatively warm climate and lack of ice during the winter months to play and become familiar with the sport.

Given the league's location and its non-traditional status, it is informative to know what city and team attributes allow box office success for an SPHL franchise. With more rinks being built in warmer U.S. climates and players being drafted from places such as California, Arizona, and Florida, it is possible that hockey's popularity could expand and modeling attendance for this league could help to identify key demographics and game attributes which would allow hockey to serve as a successful form of entertainment within a city.

Therefore, the goal of this research is to model attendance for the SPHL. An Ordinary Least Squares regression model was specified with per game attendance as the dependent variable. The model focused on determinants such as team performance, weekday and monthly effects, and city demographics. Key points of interest included estimating the importance of fighting to attendance for this league, as fighting is often a "calling card" as a unique aspect of the sport which can be popular in attracting fans in non-traditional (as well as traditional) hockey markets. Beyond fighting, the role of winning was also investigated to see how important team success is to attracting fans. The role of weather conditions on the day of the game was also investigated to determine if it has any discernable impact on attendance. City demographic factors included in the model consisted of population, per capita income, male percentage, minority percentage, married percentage, and average age of the population of the city. Through these factors we aimed to identify the statistically significant determinants of attendance to help teams in the league improve their figures and identify key city attributes where other franchises could be successful.

The paper is structured as follows. Section I provides a literature review of studies of hockey attendance in the economic literature. Section II describes the regression model, shows the results, and explains the findings. Section III summarizes the findings and concludes the paper.

I. Prior Research

Much of the previous research on hockey attendance has focused on the role fighting plays in attracting crowds. The role of fighting in the NHL has been studied previously in Jones (1984), Jones, et al. (1993), Jones, et al. (1996) and Paul (2003). In each study, fighting was shown to have a positive and significant effect on attendance. The impact of fighting on attendance was seen in both Canadian and American cities.

Although fighting is not allowed in the DEL league in Germany, evidence was found that penalty minutes, a proxy for physical play, increased attendance in this league (Coates, et al., 2012). Although found in Germany, penalty minutes as a proxy for physical play was not found to significantly impact attendance in the SM-Liiga in Finland (Coates, et al., 2012). Fighting was not shown to have an impact on attendance in junior hockey in the Quebec Major Junior Hockey League (Paul and Weinbach, 2011).

Fighting and physicality may play a role in attendance in some leagues, but it does not appear to influence success for teams on the ice. Leard and Doyle (2011) studied fighting success, determining winners and losers of individual fights in the NHL, and did not find a statistically significant relationship between winning fights and winning games. Coates, et al. (2012) found a negative relationship between fighting and team success in the NHL.

In terms of the North American minor hockey leagues which serve as farm teams for the NHL, fighting has been found to increase attendance in both the American Hockey League (Paul, et al., 2013) and in the ECHL (Paul, et al., 2015). At both the AAA-level (AHL) and AA-level (ECHL) fighting had a positive and statistically significant effect on attendance. Other factors that were found to influence attendance in these studies of minor league hockey were weekends, city demographic effects, and various promotions.

Surveys of fans have also been used to analyze what factors are likely to influence attendance at hockey games in the literature. Zhang, et. al (1996) found that hockey knowledge was important in forecasting game attendance and level of ticket purchases for International Hockey League games. Zhang, et al (2001) studied social factors influencing minor league hockey attendance and found that health-promoting, achievement seeking, and stress & entertainment factors should be part of the marketing strategies of minor league teams. In another survey of hockey fans, this time for the Southern Professional Hockey League (SPHL), violence was found to be important in explaining why fans attended games, although results differed by both gender and the level of ticket purchase (Damon, et. al, 2009).

Attendance at minor league games have also been studied in various capacities by Rascher, et al. (2009) and Hong (2009). Rascher, et al. (2009) studied the impact of the NHL lockout in 2004-05 and found increases in attendance for minor league hockey while the NHL was not in play. Hong (2009) focused on marketing of minor league hockey and discovered that teams with success at the gate had winning teams, star players, good fan relations, affordable prices, and substantial community involvement.

II. Attendance Model and Results

The dependent variable in the regression model was attendance for each SPHL game during the 2016-17 season. The data on attendance was gathered from the box scores of SPHL games on www.SPHL.com. The results are shown in levels, although an alternate specification was tried using logs without much change in the overall results.

The independent variables were ordered and arranged in different categories. The first category of independent variables were dummies for the day of the week, with Monday used as the reference category. Weekend days were expected to be more popular than weekdays due to the opportunity cost of fans' time. The second category was monthly dummies, with October as the reference category. We would expect greater attendance as the year progresses with possible additional increases during the holidays in December and January due to the opportunity cost of fans' time. Additionally, a dummy variable for the home opener was included to account for traditionally higher attendance figures which occur on opening night of the season for each team.

The third category of independent variables were related to team performance. These variables consisted of the points per game earned in the season heading into the current game and the number of fights per game heading into the current game. The SPHL uses a points-based ranking system for teams, like other hockey leagues, with two points earned for a win, one point earned for an overtime or shootout loss, and zero points earned for a regulation loss. If fans of SPHL teams care about team quality, we would expect this variable to have a positive and significant coefficient. Fighting is a unique attribute to hockey as a team sport and could be a selling point to fans, especially in non-traditional markets for hockey such as SPHL cities. If fans enjoy fighting in the sport, we would expect this variable to have a positive and significant effect on attendance.

Weather-related variables were included in the regression model to account for conditions which may influence fans to attend games. Although, like other hockey leagues, SPHL games are played indoors, weather factors could influence attendance as poor weather may discourage traveling to games and/or great weather could lead to alternative sources of entertainment activities (i.e. doing something outside) as opposed to attending a hockey game. The weather-related variables included in the model were temperature, humidity, barometric pressure, and the amount of precipitation (in inches) on the day of the game. This information was gathered from www.weatherunderground.com.

To account for differences across cities, a variety of fixed-effect demographic data is included in the regression model. Population and Population squared were included to account for differences in city sizes. Presumably, larger metro areas would have more potential hockey fans to attract and, therefore, would likely lead to higher attendance figures. It is possible, however, that bigger cities may have many more entertainment options and lower-level minor league hockey may not be much of a draw in these cities. To account for differences in income across cities, the per-capita income of each city was included in the model. The square of this variable was also tried in an alternative specification, but was not found to be statistically significant. If SPHL is a normal good, this variable should have a positive sign; if it is an inferior good, it would have a negative sign.

Other demographic variables included in the regression model were the percentage of the population that is male, the percentage of the population that is a minority, the percentage of the population that is married, and the average age of the population. This information on city demographics was obtained from www.city-data.com.

The last category of independent variables included in the model were road dummy variables. Different teams, based upon history, geographic considerations, or team success may have an impact when they are the road team. If any team attracts a higher following on the road than others in the SPHL, the dummy variable for this team will be statistically significant.

The following table shows the summary statistics for the key non-binary variables in the regression model of SPHL attendance. The table shows the variable name, mean, median, and standard deviation.

Table 1: Summary Statistics of SPHL Variables: 2016-17 Season

Variable	Mean	Median	Standard Deviation
Attendance	2,967.38	2872.00	1,418.36
Population	129,281.80	118,087	54,672.02
Per Capita Income	25,016.00	23,244.00	3,956.85
Male %	47.82	48.45	1.43
Age	35.08	34.05	2.90
Minority %	42.69	40.50	15.05
Married %	39.08	39.30	5.43
Points Per Game	1.16	1.13	0.19
Fights per Game	0.77	0.79	0.36
Temperature	52.14	53.00	12.14
Humidity	62.73	62.00	13.16
Barometric Pressure	30.15	30.17	0.29
Precipitation (in)	0.04	0	0.15

The following table presents the regression model results. Due to heteroskedasticity and autocorrelation being present in the initial regression run, the results are shown using HAC standard errors and covariances using the Newey-West method for correction. The coefficient, standard error, t-statistic, and probability value for each independent variable is shown.

Table 2: Regression Model Results for SPHL Attendance: 2016-17 Season - Dependent Variable: Per-Game Attendance

Variable	Coefficient (t-stat)

Intercept	-16,516.90 (-1.12)
Sunday	764.33** (1.95)
Tuesday	1,587.23*** (3.20)
Wednesday	1793.87*** (3.89)
Thursday	518.89 (1.27)
Friday	1460.83*** (4.34)
Saturday	2,172.74*** (5.75)
November	762.95*** (2.98)
December	1,128.28*** (4.66)
January	1,785.79*** (6.35)
February	1,195.51*** (4.58)
March	1,076.49*** (4.09)
April	1,286.63*** (3.87)
Points Per Game Average	50.04*** (6.24)
Fights Per Game Average	300.23* (1.79)
Home Opener	971.95*** (2.83)
Temperature	13.91** (1.94)
Humidity	-15.90*** (-2.65)
Barometric Pressure	-31.86 (-0.08)
Precipitation (in)	260.83 (0.57)
Population	0.07*** (6.40)

Population^2	-0.0001***
	(-5.71)
Per Capita Income	0.24***
	(13.42)
Male %	160.19
	(1.25)
Minority %	9.00
	(1.23)
Married %	-105.98***
	(3.79)
Average Age	96.56***
	(3.26)
Visiting Team Dummy Variables	Included
R-squared	0.61

Statistical significance is noted by *-notation. Rejection of the null hypothesis that the coefficient is equal to zero is noted at the 10 percent (*), 5 percent (**), and 1 percent (***) levels.

In terms of the days of the week, weekend days (Friday, Saturday, and Sunday) each revealed statistically significant and positive results compared to the reference day, Monday. Saturday had the highest attendance, with over 2,000 more fans attending games on Saturdays compared to Mondays. In a surprising result, both Tuesday and Wednesday were also found to have positive and significant results compared to Monday. Tuesdays had nearly 1,600 more fans, while Wednesdays had nearly 1,800 more fans per game than Mondays. Tuesday and Wednesday each had a greater coefficient than Friday or Sunday, which may be a reflection of alternative sports entertainment options on the weekend in these cities. Fridays during the fall are days typically associated with high school football, Saturdays with college football, and Sundays are associated with the National Football League. Given the status of hockey compared to other sports in these states, Tuesday and Wednesdays do not appear to be bad options for scheduling of home games for the SPHL.

The monthly dummy variables in the regression model revealed mostly anticipated results with early season attendance being lower than later in the season (with the exception of opening night, which was found to increase attendance by approximately 972 fans and was found to be statistically significant at the 1% level). With the playoffs months away, the early season games do not often feel as important and do not attract as many fans to the games. Although attendance rose steadily throughout the season, the one exception was a relatively large increase in attendance in January. This could be due to special events involving the New Year or could be a result of increased travel during this time frame to the area from northern "snowbirds", who may attend hockey games in January when escaping the cold and snow.

In terms of on-ice performance, fans of the SPHL were found to positively respond to both home team success and fighting. The points per game average, representing team success, was found to have a positive and significant effect on attendance at the 1% level. More success on the ice led to more fans in the seats. In relation to fighting, the fights per game average of the home team was also found to increase attendance at the 10% level of significance. For each additional fight per game a team averaged, the number of fans increased by about 300 people. Fans of the SPHL appear to enjoy the fighting element of the sport and this contributed positively to attendance.

The weather-related variables were found to have some statistically significant results. Both temperature and humidity were shown to significantly influence attendance for the SPHL. Temperature was shown to have a positive effect, with more fans attending games on days with higher temperatures. Humidity, on the other hand, was shown to negatively influence attendance. The oppressive feeling of humid days, common in this area of the country, likely leads to fewer people deciding to venture out to hockey games (and other events) leading to fewer game day sales and fewer fans in the seats. Barometric pressure and levels of precipitation were not shown to impact hockey attendance in the SPHL.

In terms of the demographic variables, certain city attributes were favorable for success at the gate. In general, more populated areas were shown to have higher attendance at SPHL games. However, this was not universally true, as population squared was shown to have a negative and significant effect. For the biggest metro areas of the SPHL, more entertainment options are likely to be available, both in relation to sports and otherwise. Therefore, with this level of hockey being a lower tier on the professional scale and the general popularity of hockey not being as intense in these areas, the biggest cities in this area of the country may not be well-suited to SPHL hockey.

Per capita income was shown to have a positive and significant effect on attendance as the SPHL was shown to be a normal good. Higher income levels were associated with more fans in attendance in SPHL cities. The percentage of males in the city was shown to positively impact attendance, but it was not found to be statistically significant. The minority population was found to have a positive effect, which may be somewhat surprising as hockey is less often played by minority populations, but it was not statistically significant. These results illustrate, however, that having a greater minority population in a city in the American south does not appear to be a detriment for hockey attendance.

Both the percentage of the population that was married and the average age of the population of a city were shown to have statistically significant impacts on attendance for SPHL contests. Married percentage was shown to have a negative effect on attendance, which could imply that a higher percentage of married people in a city may lead to lower attendance at SPHL games due to more time commitments or a larger monetary commitment necessary for families to attend games, limiting this part of the population's ability to frequently attend games. The average age of the population was shown to have a positive effect on attendance as this may have to do with the opportunity cost of time and fewer time constraints for an older audience (i.e. fewer activities involving the children), leading cities with an older population to attend more games on the average.

None of the opposing team dummies were found to be individually statistically significant. An F-test of their joint significance could also not be rejected. Fans of the SPHL appear to care much more about the home team as opposed to the visiting team in this league.

III. Conclusions

The Southern Professional Hockey League (SPHL) is a professional hockey league located in the American Southeast. Although the teams of the SPHL do not have official affiliations with NHL teams or their AAA (American Hockey League) or AA (ECHL) affiliates, the SPHL does regularly provide players for call-up to ECHL team and some players, such as Carolina Hurricanes goaltender Scott Darling, have progressed all the way to the NHL.

Given the location of the teams in many “non-traditional” hockey markets, the goal of this research was to identify the determinants of attendance demand for teams in this league. An Ordinary Least Squares regression model was specified with per-game attendance as the dependent variable and an assortment of team performance, city demographics, game timing, and weather variables as independent variables.

The results of the regression model revealed some important results for teams within the league and for any owners/cities which may be considering having a SPHL franchise in the future as hockey continues to expand across the southern United States. Weekday results revealed that Fridays and Saturdays, as expected, were popular nights to attend SPHL games, but mid-week games on Tuesday and Wednesday were also quite popular. Tuesday and Wednesday games were played much less frequently than other days, but these games had rather high attendance figures for this league. Monthly results showed that October had the lowest attended games (other than opening night) and attendance did improve as the season approached its end and the start of the playoffs. An interesting monthly result, however, was the popularity of attending games in January. Perhaps due to the presence of snowbirds from the north or due to the availability of time around the holiday season, January had the highest attended games, month-wise, in the SPHL during 2016-17.

In terms of team on-ice performance, fans of the SPHL appear to enjoy both teams that win and teams that have players who are willing to drop the gloves and fight. Both the points-per-game (team success in terms of winning) and fights-per-game variables had a positive and statistically significant effect on attendance.

Weather-related variables were shown to have a limited effect in this league, likely due to the relatively nice weather experienced in this part of the country. Temperature did have a positive and significant effect on attendance and humidity had a negative and significant effect. This illustrates that nicer days (higher temps and lower humidity) led to more fans to venture out to see games in this league.

In terms of city demographics, population was shown to have a non-linear impact on attendance. Attendance was shown to increase with population up to a point and then decrease as the square of population variable was shown to have a negative effect (as opposed to the positive and significant effect of population). Therefore, there are cities that will be too large to attract much interest in SPHL hockey, but apart from these large metro areas, a larger population does lead to more fans. Income per capita was shown to have a positive and significant effect on attendance as there was no evidence that SPHL hockey is an inferior good.

Beyond population and income per capita effects on attendance, both married percentage and average age of the population were both shown to have significant effects on attendance. Married percentage was found to be negative, suggesting that cities having a larger percentage of single people fared better, attendance-wise, in the SPHL. The average age was shown to have a positive effect, leading to an outcome of a slightly older crowd appears to be more optimal for attendance than a city with a lower average age. Overall, it appears that SPHL hockey attracts more fans in generally more populated cities with an older, unmarried population with higher per capita income.

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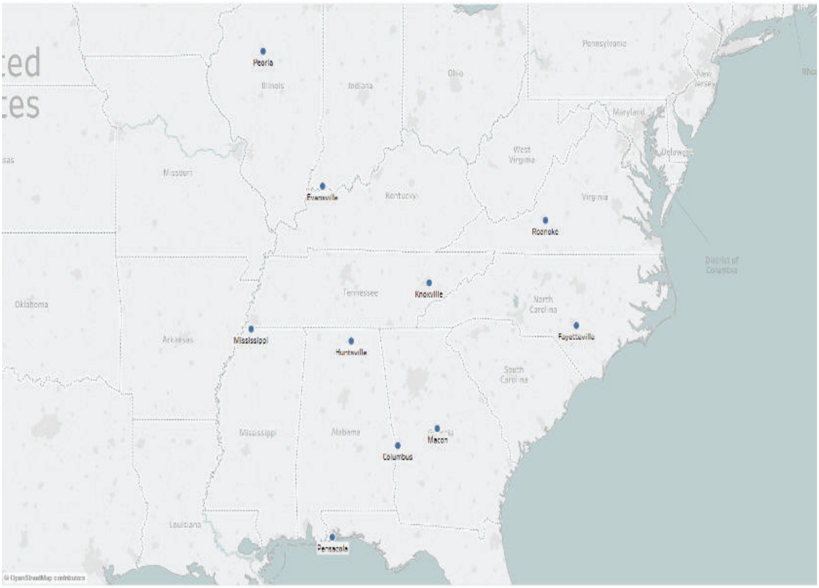
Appendix I

Map of SPHL Teams – 2016-17 Season



The Moneyball Effect: Incentives and Output in the NBA Three Point Shootout

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Abstract

The purpose of this study is to empirically test whether skilled professionals are susceptible to "choking under pressure." Prior research of this phenomenon has been largely limited to laboratory environments and real world settings that feature direct strategic interaction. Our research examines a real-world setting in which highly-trained professionals compete amidst varying incentives and without direct strategic interaction. This paper utilizes a novel data set that includes performance metrics from highly skilled professional basketball players participating in the *NBA Three Point Shootout* from 2001-2010 (which is a non-strategic setting). The resulting data set includes data on 2,150 three point shots attempted by a collection of 33 contestants. The goal of each contestant was to maximize their total points scored each round given twenty shots worth 1 point each and 5 shots worth 2 points each. The shots worth 2 points each are called *moneyballs*. Traditional economic theory suggests that players would expend relatively more time/effort on the moneyballs and hence perform better on moneyball shots compared to regular shots. However, our findings suggest the opposite, as players fared relatively *worse* on moneyballs. This result was statistically significant and robust to several econometric models. Our findings call into question the orthodox economic model that performance hinges primarily (and predictably) on incentives.

I. Introduction

A body of experimental evidence suggests that performance incentives can increase task pressure and, in so doing, decrease performance level. Such a process—typically referred to in the literature as “choking under pressure” or “performance decrements under pressure”—runs counter to standard economic theory. The efficiency wage hypothesis, for example, holds that stronger wage incentives induce greater effort levels and increased worker output. There is a great deal of experimental evidence that such relationships may not hold in performance settings, however. The notion that higher stakes may lead to decreased performance has long been noted in the psychology literature (see, e.g., Baumeister (1984), Lewis and Linder (1997), Beilock and Carr (2001)). In an important paper, Ariely et al. (2009) conducted a series of experiments in the U.S. and rural India. In the experiments, participants were given the opportunity to win substantial sums of money relative to income. Payouts were directly linked to performance in several games. As stakes increased, performance level often fell. The authors attribute this outcome to counterproductive processes that occur as an involuntary response to increasing stakes (performance pressure). These processes include distraction and self-monitoring of overlearned skills. Sanders and Walia (2012) demonstrate within a contest-theoretic environment that distraction and self-monitoring can erode not only performance but also efforts under stakes-based pressure.

Despite the empirical credibility of “choking under pressure” in experimental settings, there have been relatively few real world tests of the phenomenon. This is partly due to the difficulty of obtaining real world data that reveals the relationship between incentives and performance. Dohmen (2008) notes, “It is generally difficult to obtain the kind of real world data that are required to test whether choking matters in real world working conditions.” As another obstacle, the amount of pressure associated with a real-world action is typically difficult to measure. This is because multiple processes involving pressure (e.g., stakes, difficulty of task) may change at the same time. Real world tests of “choking under pressure” are also valuable in that they (often) allow us to study professionals behaving in professional environments. Economist Gary Becker has suggested that while some people might choke under certain circumstances, paid professionals might not be susceptible to choking (see Becker’s interview with Stewart in 2005). To address this concern, several papers have studied professional athletes. It is important to ascertain whether professionals are largely immune to the processes that cause performance decrements under pressure (either by self-selection or through experience). If this is the case, then perhaps “choking under pressure” does not have large ramifications upon labor market incentives.

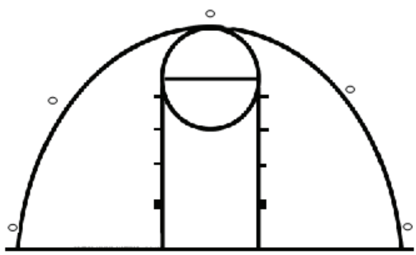
In real world tests that have been conducted, evidence of "choking under pressure" is mixed. It is clear that the necessary and sufficient conditions for performance decrements under pressure can be motivated within an experimental laboratory. The extent to which said conditions apply in real-world settings remains unclear, however. Worthy et al. (2009) provide a real-world test of "choking under pressure." They find evidence that NBA players are typically less proficient in free throw shooting when a game's outcome hangs in the balance. In an analysis of penalty kicks in soccer, however, Dohmen (2008) finds no evidence that higher stakes penalty kicks (i.e., ones that decide the game or are crucial to the team's season) induce performance decrements. In fact, he finds that "choking rates tend to fall when more is at stake." Paserman (2007) finds that professional tennis players perform worse (have an elevated error rate) as the importance of a point increases. Kamenika (2012) argues that the relationship between incentives and performance may be confounded in strategic settings.

Thus, prior research has been limited largely to laboratory environments and real world settings that feature direct strategic interaction. Our research examines a real-world setting in which highly-trained professionals compete amidst varying incentives and without direct strategic interaction. Namely, the present study tests for the existence of counterproductive incentives by analyzing ten years of *NBA Three Point Shootout* data (2001-2010; prior to rules changes that diluted individual incentives in the contest). This contest is an ideal setting in which to test the relationship between incentives (stakes-driven pressure) and performance in that it features variable shot values (clear incentive variation), no direct strategic interaction, and an objective metric for success.

II. Data and Description of *Shootout*

This study is based on an analysis of ten years of *NBA Three Point Shootout* data (2001-2010). The *Shootout* is an annual event within *NBA All-Star Weekend*. Among the set of active players, the NBA chooses six or more proficient three point shooters each year to participate in the contest. Players have one minute to navigate the three point arc and attempt 25 three-point shots. Specifically, players shoot five shots from each of five locations. Figure 1 below provides an approximate depiction of these shooting locations.

Figure 1: An Approximate Depiction of Shot Locations



At each location, four balls are standard in color and are worth one point if made. The remaining ball or "moneyball" is red, white, and blue in color and is worth two points if made. Contestants can shoot the five balls on a given rack in any chosen order (i.e., may order the "moneyball" shot such that it will have the most impact). The top three scoring contestants in round one of the contest advance to a second and final round that is identical in structure. The winning shooter receives $35,000, a trophy, and an awards ceremony. Thus, there is a clear incentive for a shooter to maximize his number of points and therefore a higher reward to making the marginal "moneyball" shot as compared to the marginal standard shot.

As Dohmen (2008) notes, economists generally agree that stronger incentives will lead to harder work and more output. [1] Thus, the standard economic model would predict shooters to exhibit increased accuracy for "moneyball" shots as compared to regular shots. However, research has shown that incentives do not always change behavior in the way that the standard economic model would suggest. Ariely et al (2009) note that "increased incentives can cause people, involuntarily, to consciously think about the task, shifting control of behavior from "automatic" to "controlled" mental processes even

[1] Worthy et al (2009) avoid any problems involving strategic interactions by investigating free throw percentages by professional basketball players at the end of close games. They find evidence that players do worse than their career average when the point differential is -2, -1, 1 and 3. However, players perform at their career average when the score is tied or when their team is winning by 2 points. However, it is not clear which situations give a player an incentive to shoot better. Thus, the incentive structure is not clearly defined.

though it is well documented that controlled processes are less effective for tasks that are highly practiced and automated (Langer and Imber, 1979; Camerer, Loewenstein and Drazen, 2005)."

The unique data set for this study was developed by watching video footage of each *Shootout* between 2001 and 2010 (National Basketball Association, 2001-2010) and recording each observation manually. The resulting data set includes data on 2,150 three point shots attempted by a collection of 33 contestants.

III. Model and Results

In our analysis, we compare "moneyball" shots to one-point shots not taken as the first shot on a rack. Such a reference group was chosen because players are much less proficient when transitioning to a new location, *ceteris paribus*. Within the sample, "moneyball" shots were never taken as the first shot on a rack. This stands to reason, as players wish to use their valuable shot for a given rack when they are not shooting relatively poorly. Moreover, "moneyball" shots did not always come as the last shot on a rack. Below are summaries as to the relationship between proficiency and ball type.

Table 1: Summary Data in Regards to Performance

	Non-Moneyballs	Regular Balls (excepting 1st on rack)	Moneyballs
% made	0.535	0.567	0.512
Observations	1720	1290	430

Table 1 demonstrates that contestants are less proficient within the sample on "moneyball" shots. Figures 2a and 2b demonstrate this point visually.

Figure 2a: Box Plots of Predicted Shot Proficiency for Non-Moneyball and Moneyball Shots

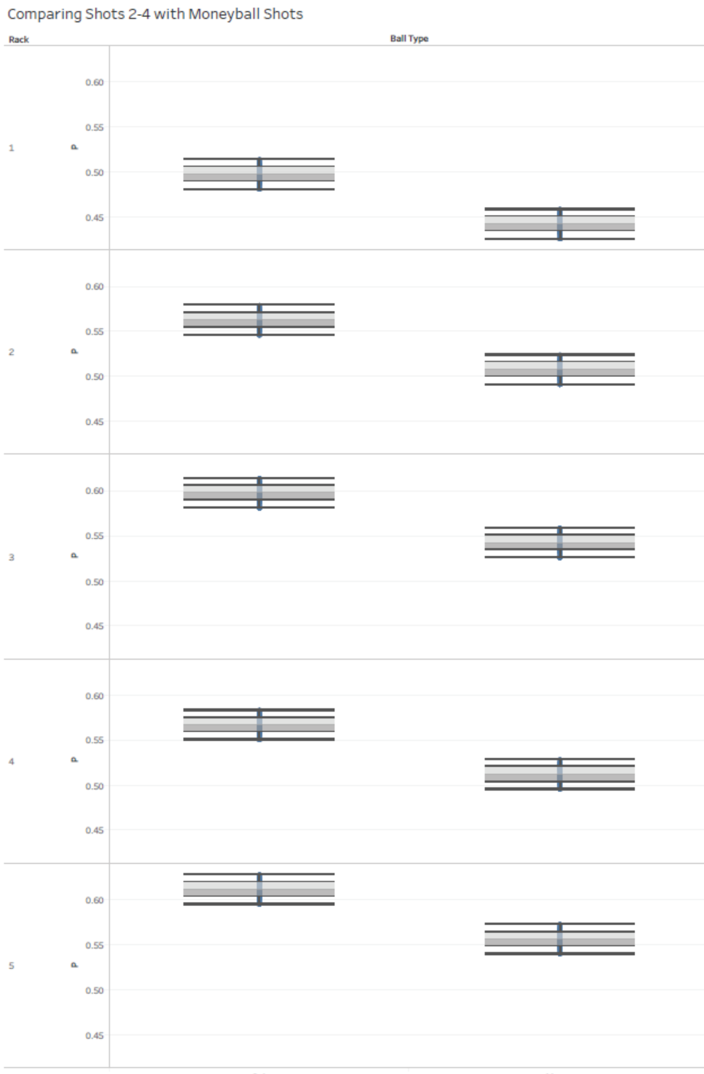
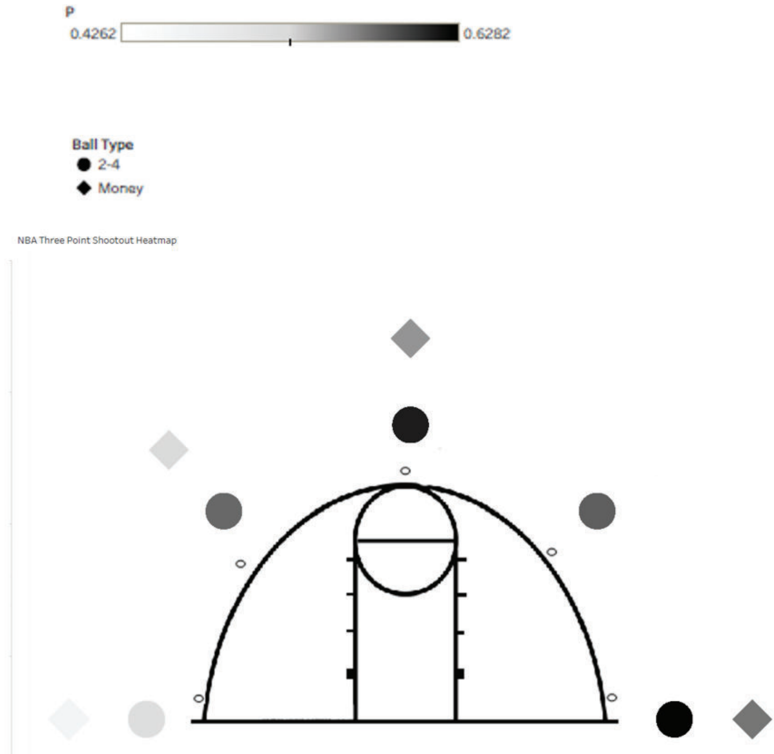


Figure 2b: A Texture-Coded Map of Predicted Shot Proficiency for Moneyball and Non-Moneyball Shots



We use regression analysis to determine whether this difference is statistically significant. Specifically, we employ logistic regression, which is appropriate when there is a binary dependent variable; in this case, the dependent variable is *made* and is equal to 1 when the shot is made and equal to 0 when the shot is missed. The independent variable of interest is *moneyball* which is equal to 1 when the shooter shoots a moneyball and equal to 0 when the shooter shoots a ‘regular’ ball. In order to isolate the “moneyball effect,” we employ the following controls.

Ball 1 is a dummy variable that controls for when the shooter is shooting the first ball from a given rack; we use this variable to account for the relatively difficult task the shooter has of taking the first shot from a new location. One reason that the first shot is relatively more difficult is the shot’s distance may fluctuate from station to station; for example, moving from rack 1 to rack 2, the shot's distance changes from 22 feet to 23 feet 9 inches while moving from rack 4 to rack 5 the distance changes from 23 feet 9 inches back to 22 feet. These changes in distance make the first shot of a given rack more difficult since the shooter is forced to adjust to these changes in distance. Another point of note is that each time a shooter shoots the first ball from a given rack, the shot's angle is different from that of the previous shot-- this also serves to increase the difficulty of the first shot from each rack.

Next, we have a categorical variable that accounts for the rack the shooter is shooting from. With *rack 1* serving as the reference group, we use variables *rack 2*, *rack 3*, *rack 4*, and *rack 5* to account for any relative differences in difficulty from shooting from the various racks on the floor. The variable 'year' is a time trend treats time in a chronological manner. This controls for the possibility that shooters got better over time. We use the variable *round* to control for any differences in the ability of a shooter to make shots in the second round compared to the first round. One reason that there may be a difference is a learning effect where players learn from their experiences from the first round in order to improve their performance in the second round.

Finally, we use the dummy variable *guard* that is equal to 1 when the player is a guard and equal to 0 when the player is a forward or center. Traditionally, guards are more frequently used as three point specialists while forwards and centers typically play closer to the basket (although there are exceptions to this rule). Thus, the *guard* variable attempts to pick up any differences in shooting ability between players from these different positions.[2]

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[2] We would like to thank an anonymous referee for inquiring about the difference in three point shooting ability and attempts between guards and forwards. To test for such a difference, we first looked at the top 100 guards (who played at least 41 games) by three point attempt rate for the 2010-2011 season (where three point attempt rate is defined by the percentage of total field goal attempts from three point range). From these 100 guards, the average number of three point attempts per game was 3.1. We then looked at the top 100 forwards (who played at least 41 games) by three point attempt rate for the 2010-2011 season. From these 100 forwards, the average three point attempts per game was 1.6. From this sample, guards shot nearly twice as many 3pt shots as forwards. In another test from the same sample, the average guard shot made 35.5

Table 2: Regression results[3]

Variable	Logit (1)	Logit (2)	FE (3)	FE (4)	RE (5)	RE (6)
moneyball	-0.225** (0.048)	-0.223** (0.048)	-0.229** (0.044)	-0.229** (0.044)	-0.229** (0.044)	-0.229** (0.044)
Ball 1	-0.518*** (0.000)	-0.515*** (0.000)	-0.527*** (0.000)	-0.527*** (0.000)	-0.527*** (0.000)	-0.527*** (0.000)
Rack 2	0.265* (0.054)	0.264* (0.055)	0.270* (0.052)	0.270* (0.052)	0.270* (0.052)	0.270* (0.052)
Rack 3	0.408*** (0.003)	0.406*** (0.003)	0.416*** (0.003)	0.416*** (0.003)	0.415*** (0.003)	0.415*** (0.003)
Rack 4	0.284** (0.039)	0.283** (0.040)	0.289** (0.038)	0.289** (0.038)	0.289** (0.038)	0.289** (0.038)
Rack 5	0.466*** (0.001)	0.464*** (0.001)	0.475*** (0.001)	0.475*** (0.001)	0.474*** (0.001)	0.474*** (0.001)
year	0.004 (0.786)	0.006 (0.727)	0.009 (0.769)	0.011 (0.715)	0.018 (0.413)	0.021 (0.348)
round	0.241*** (0.002)	----	0.065 (0.449)	----	0.160* (0.058)	----
guard	-0.122 (0.166)	-0.152* (0.083)	----	----	-0.003 (0.983)	0.001 (0.996)
constant	-9.280 (0.779)	-11.478 (0.728)	----	----	-35.488 (0.409)	-41.625 (0.347)
Obs.	2150	2150	2150	2150	2150	2150
Chi-squared p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

To ensure that our results are robust, we utilize three different types of logistic models: logit with robust standard errors, (contestant) fixed effects logit, and (contestant) random effects logit. In each of these models, the dependent variable is *made* and is equal to 1 if the shot is made and equal to 0 if the shot is missed. Each shot counts as an observation in each of our three econometric models and we employ the same set of controls in each model as well. Since each contestant has at least 25 observations, our data allow us to use panel data models (i.e. fixed effects logit and random effects logit) in addition to the standard logit model. We use the fixed effects models because the fixed effects model tends to be less vulnerable to omitted variable bias by having individuals serve as their own controls (see Williams 2013). However, since fixed effects models can suffer from high standard errors, we also use a random effects logit model in order alleviate any

percent of their three point attempts while the average forward made percent. This is further evidence that guards are more specialized than forwards at shooting three point shots.

3 Where *made* is the dependent variable and is equal to 1 if the shot is made and equal to 0 if the shot is missed.

concerns over efficiency. On the other hand, although random effects logit models tend to have smaller errors, they are also prone to having biased estimates (see Williams 2013). Thus, using both the random effects and fixed effects models allow us to eliminate any concerns relating to efficiency *and* biasedness. For completeness, we report regression results from each of the three models; as seen in table 2, results across models are nearly identical.

The primary independent variable of interest is called *moneyball*, and is equal to 1 if the observation includes a shot where the moneyball is used and is equal to 0 if a regular ball used. Recall that moneyballs are worth 2 points if made while regular balls are worth 1 point if made (and the object of the contest is to score as many points as possible). Table 2 reveals that contestants are significantly less proficient (at the .05 level) in shooting the "moneyball" compared to regular balls, *ceteris paribus*. This result holds across different models and model specifications. To put this into context, we calculate that a player shooting a moneyball has 4/5th the estimated odds of making the shot a player shooting a regular ball. In other words, a player shooting a regular ball is 1.2 times more likely to make the shot than a player shooting a moneyball.[4] We conclude evidence of "choking under pressure" herein.

One potential concern of trying to isolate a "moneyball effect" is that the money ball is differently colored (red, white, and blue) than the other balls, which are orange in color. We think this concern is not relevant because players are trained to look at the rim when shooting. In other words, when a player shoots, they are looking at the rim and not the ball. For example, Stephen Curry (current NBA 3 point shooting specialist) encourages shooters to look at the hooks in front of the rim while shooting.[5] For this reason, we are not concerned that the "moneyball" has a different color.

We employ a robust set of controls in order to isolate the effect that *moneyball* has on the likelihood of making a shot. Our first control variable is called *Ball 1* and is a dummy variable equal to 1 if the ball is the first shot taken from the rack and is employed to control for the

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[4] We would like to thank an anonymous referee for suggesting that give an interpretation on the magnitude of the moneyball effect. We calculated this effect as follows: $\frac{odds\ when\ moneyball=1}{odds\ when\ moneyball=0} = e^{-0.229} = 0.795$. We rounded to 0.8 in the explanation above to 4/5.

[5] https://www.forbes.com/sites/hunteratkins/2014/08/26/shooting-tips-from-n-b-a-all-star-stephen-curry-2/2/#3e3cad345af4

relative difficulty of the first shot on a rack (there are 5 racks and each rack has 5 balls); the reason for this being that players likely use the first ball to help calibrate their expectation of the distance and shooting angle to the basket. Thus, the coefficient of *Ball 1* has the expected negative sign and is statistically significant.

Next, we use dummy variables to control for the rack from which a shot is taken; in this case, we have four dummy variables (*Rack 2*, *Rack 3*, *Rack 4*, *Rack 5*); shots taken from the first rack therefore serves as the reference group. We expected rack 1 to be the most difficult rack to shoot from, since it is likely that players need time to warm up (and hone) their shot when beginning a round. As expected, the coefficients for racks 2-5 are all statistically significant and positive-- thereby providing evidence that the first rack is indeed the most difficult to shoot from.

We also control for the year in which a shot took place. This serves to control for any factors that differed by year (e.g. shooting backdrop, fan attendance, etc.) that could potentially affect shooting percentages. However, the coefficient for *year* was not statistically significant in any of the specifications.

Round is a dummy variable equal to 1 for shots taken in the second round and equal to 0 for shots taken in the first round. The *round* variable was used in order to control for any differences between shooting in the first round versus the second round. For instance, shooters could learn from round 1 in order to increase their performance from round 2. However, in some model specifications, the *round* variable is not featured. This omission was made due to concern that characteristics allowing a contestant to reach round 2 might be related to characteristics that cause the individual to perform differently on “moneyball” shots. The *round* coefficient was typically positive and statistically significant, although the *moneyball* coefficient (or any other coefficient) did not appreciably change based on the inclusion or exclusion of the *round* variable.

The *guard* variable was included to control for differences in shot making ability between guards (who are typically shorter) and forwards/centers (who are typically taller). Guards are typically thought to have better 3 point accuracy since they are more likely to specialize in long distance shots. However, the results show that the *guard* coefficient is typically statistically insignificant.[6]

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[6] The *guard* variable is not included in the fixed effect (FE) specifications because such models—by design—do not include any characteristics that are invariant for a given

IV. Conclusion

Although previous research has explored the link between incentive variation and performance in the laboratory or sports setting, this type of research has typically suffered because research participants have either been 1) unskilled novices playing unfamiliar skill games or 2) professional athletes in strategic situations (i.e. facing an opponent). Conversely, this paper utilizes a novel data set that includes performance metrics from highly skilled professional basketball players participating in the *NBA Three Point Shootout* from 2001-2010 (which is a non-strategic setting). The goal of each contestant was to maximize their total points scored each round given twenty shots worth 1 point each and 5 shots worth 2 points each. The shots worth 2 points each are called moneyballs. Traditional economic theory suggests that players would expend relatively more time/effort on the moneyballs and hence perform better on moneyball shots compared to regular shots. However, our findings suggest the opposite as players fared relatively *worse* on moneyballs. This result was statistically significant and robust to several econometric models. Our findings call into question the orthodox economic thought that performance hinges primarily (and predictably) on incentives. In fact, our results suggest that performance—even by highly skilled professionals—can actually *decrease* in the face of positive incentives.

Relatedly, CEO Nathan Kontny writes in a Forbes article that he choked under pressure during his role as the CEO of Highrise. He draws a parallel to his experience to that of golfer Jordan Spieth

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individual/contestant. An anonymous referee was also curious in regards to players at the '3' position (e.g. a player that could be listed as a guard or forward depending on the offensive system of their team). This was a very good point. When coding the data, we relied on the position classification from nba.com. However, there were some players in our sample (like Kyle Korver) that do not fit the classic guard/forward classification. This is a limitation of the data. It should be noted that our fixed effects model does account for this issue.

choking in the Masters.[7] Meanwhile, in a study on performance pressure and math performance, Beilock and Carr (2005) find that "performance pressure harms individuals most qualified to succeed by consuming the working memory capacity that they rely on for their superior performance." In a theoretical study, Bannier and Feess (2010) presume that "high ability workers choose steeply-incentivized contracts" even though these workers anticipate a choking effect; they do this to avoid "being mistaken for (and paid like) low ability employees." Given these findings, we believe empirical research should be extended to investigate the link between pressure and the performance of skilled business professionals. If bonuses do indeed tend to increase the pressure faced by high ability business professionals, then choking under pressure might also be relevant.

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[7] https://www.forbes.com/sites/nathankontny/2016/05/12/choking-under-pressure-what-we-can-learn-from-those-who-have-and-how-we-can-avoid-it/2/#1fb2d5ac10af

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Improved Evidence on the Effect of Organizational Factors on the Sensitivity of Donations to Inefficiency

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Abstract

Many studies find a significant negative relation between donations to nonprofit organizations (NPOs) and an accounting measure of NPO inefficiency – the "price of giving". Tinkelman (1999) is the first paper to propose and test the impact of numerous organizational factors on the relation between donations and price. However, he tests these factors one at a time, using an arbitrary single dichotomous threshold for each factor, thereby testing a "high" and "low" subsample for each factor. The only other paper to test numerous organizational factors, Marudas and Petherbridge (2016), apply a similar methodology, testing each factor, one at a time, using a dichotomous threshold, but they test a range of thresholds for each factor to establish the "best" threshold for each factor. We provide improved evidence on the effects of organizational factors by using a better methodology: testing all factors in a single model as interaction terms with price, testing factors that are continuous as continuous variables, and avoiding sample-specific thresholds. We find the following factors to be significant: implausible data, size, age, and reliance on indirect donations. We provide quantitative estimates of the marginal effects of these factors, which can be used to estimate the sensitivity of donations to price for a particular NPO, based on its particular organizational characteristics. These estimates may be useful to NPO management in assessing the impact of operational decisions, which affect price, on donations to their NPO and to researchers studying the determinants of donations.

Introduction

Many studies examine the relation between nonprofit organizational (NPO) inefficiency and donations at the organizational level. Inefficiency is typically specified as the "price" of giving, which is an accounting ratio defined as total expenses / program expenses. There is a preponderance of evidence that donations are significantly negatively associated with price (e.g., Calabrese & Grizzle, 2012; Harris & Ruth, 2015; Jacobs & Marudas, 2012; Kitching, 2009; Petrovits, Shakespeare, & Shih, 2011). NPO managers can use the quantitative estimates reported in the literature of the relation between price and donations to estimate how operating decisions that impact price would affect donations. For example, NPO management may contemplate implementing a new financial system, which would increase the portion of total spending on administration, thereby increasing price, which would be expected to decrease donations. In making its decision, management would want to incorporate the expected decrease in donations and may look to results in the literature to estimate the expected decrease. However, there is some evidence (Marudas & Petherbridge, 2017; Kitching, 2009; Tinkelman, 1999; Yetman & Yetman, 2013) that certain characteristics of an NPO can significantly affect the sensitivity of donations to price.

Tinkelman (1999) is the first paper to systematically investigate organizational factors affecting the relation between price and donations[1]. Tinkelman tests each factor one at a time and specifies all factors, including those that are inherently continuous, as dichotomous variables; for example, for NPO age, he classifies NPOs four or fewer years of age as "young" and NPOs older than four years of age as "old". He also states that he set the thresholds "arbitrarily" (which is reasonable considering that he was investigating the qualitative significance of each factor). Furthermore, some factors he tests are specified as a relative ranking and, therefore, are sample-specific; for example, NPOs with total

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[1] Two other papers investigate the effect of particular organizational factors on the relation between price and donations. Kitching (2009) examines the effect of type of auditor and NPO size on the sensitivity of donations to price. Yetman & Yetman (2013) examine the sensitivity of donations to NPOs that report zero fundraising expenses.

assets below the 25^{th} percentile of total assets in the sample and NPOs with total assets at or above the 25^{th} percentile.

Marudas & Petherbridge (2017) use a methodology similar to Tinkelman's, testing each organizational factor separately, but instead of arbitrarily setting each threshold, they use a range of thresholds to identify the threshold for each factor that maximizes significance. Their methodology has limitations similar to those of Tinkelman (1999): each factor is tested one at a time, which does not control for all other factors, is tested as a dichotomous, not continuous, variable, and some factors are specified as a relative ranking and, therefore, are sample-specific.

We advance the literature on determinants of donations by providing improved evidence on the effects of various organizational factors on the sensitivity of donations to price, stemming from testing all factors as interactions terms with price in a single model and specifying factors that are continuous variables as continuous variable interaction terms with price. This also avoids specifying any factors as a relative ranking so that no factors are sample-specific. This evidence provides the first quantitative estimates of the marginal effect of each factor on sensitivity of donations to price, which is not provided by Tinkelman (1999) or Marudas & Petherbridge (2017). NPO management could use these quantitative estimates to better estimate the effect of a change in price for their particular organization on donations to their organization.

The results of this paper should be interesting to NPO managers, who would have more relevant parameter estimates of the sensitivity of donations to price for their particular NPO. Additionally, knowing the factors that have a large impact on the sensitivity of donations to price would allow researchers to provide more targeted measures of the relation between donations and price and other measures of NPO inefficiency.

Literature Review

Tinkelman (1999) is the first paper to test the effects of numerous organizational characteristics on the sensitivity of donations to the principal proxy for organizational inefficiency, price of giving (defined as total expenses / program expenses). Based on the concept that information that is less reliable or relevant is less likely to affect users of such information, he proposes and tests, in dichotomous form, seven factors that may affect the sensitivity of donations to the price of giving. These factors are: organizational size, age, degree of dependence on direct donations, degree of dependence on indirect donations, implausible data, organizational type, and location. His results are mixed. He finds donations to NPOs that are young (four years old or younger), have low reliance on direct donations (direct donations / total revenue less than 0.20), that report implausible data (zero fundraising or administrative expenses), or that have not had a financial statement audit, are significantly less sensitive to price. He does not find significant differences in sensitivity of donations to price for small NPOs (with total assets below the 25th percentile), NPOs with low reliance on indirect donations (indirect donations / total revenue less than 0.33), or local NPOs. Furthermore, he does not find significant differences in sensitivity of donations across types of NPOs after controlling for whether the NPO has a financial statement audit, reliance on direct donations, and implausible data. When he defines small NPOs as those with total revenues below the 30th percentile, he finds the perverse result that donations to such small NPOs are significantly more sensitive to price.

Kitching (2009) finds donations to NPOs that have an audit conducted by a Big 5 firm are significantly more sensitive to price than NPOs that have an audit conducted by a non-Big 5 firm. Kitching also tests total assets, a proxy for size and reputation, as a continuous interactive variable with price, and finds that total assets increase the sensitivity of donations to price. Yetman & Yetman (2013) find donations to NPOs that report implausible data (zero fundraising expenses) to be significantly less sensitive to price.

Marudas & Petherbridge (2017) test numerous factors, similar to those tested in Tinkelman (1999) and use a methodology similar to Tinkelman's. However, unlike Tinkelman (1999), they test a range of thresholds for each factor to identify the threshold, for each factor, that maximizes significance. They also test a much larger data set of NPOs – the NCCS SOI database. They find that donations to NPOs that report implausible data, do not have audits of their financial statements, are smaller (at the 20th percentile or lower with respect to total assets or at the 5th percentile or lower with respect to total revenues), are younger (13 years old or younger), and whose reliance on donations (donations / total revenues) is below 90 percent, are significantly less sensitive to the "price" of giving.

Data

Data are from the National Center for Charitable Statistics (NCCS) SOI database for 2010 and 2011. Descriptive statistics are shown in Table 1.

Table 1: Descriptive Statistics

Variable	Mean	Standard Deviation
DON	9,679	55,284
FREXP	954	4,297
PRICE	2.21	71.9
GOV	7,189	75,267
PREV	79,251	507,679
OTHREV	6,494	38,432
AGE	54.5	43
TASSET	199,345	1,025,252
DONREL	0.26	0.31
INDONREL	0.10	0.25
NOAUDIT	0.43	0.50
IMPLAUSIBLE	0.36	0.48

All figures are in thousands of dollars, except for DONREL, INDONREL, NOAUDIT, and IMPLAUSIBLE.

DON is total direct donations
FREXP is fundraising expense
PRICE is price of giving defined as total expenses / program spending expenses
GOV is government support
PREV is program service revenue OTHREV is other revenue defined as TOTREV – (GOV + PREV+ DIRDON + INDIRDON)
AGE is years since first filing a tax form
TASSET is total assets at beginning of the year
DONREL is direct donations / total revenue
INDONREL is indirect donations / total revenue
NOAUDIT takes the value 1 if not having had a financial statement audit; zero otherwise
IMPLAUS takes the value 1 if reporting implausible data, usually zero FREXP; zero otherwise

The initial sample is 12,820 NPOs, which have data for both 2010 and 2011. Following Tinkelman, we clean the data by deleting the following NPOs: 50 NPOs with zero total revenue, 4 NPOs with zero or negative total assets, 396 NPOs with no year of formation (used to calculate age), 630 NPOs with negative other revenue, 2,418 NPOs with zero or negative direct donations, 4 NPOs with negative program service revenue, and 63 NPOs with zero program expenses, implying an infinite price of giving. This leaves a usable sample of 9,255 NPOs. Because the log of zero is undefined, we also add one dollar to variables, such as government support and program service revenue, which are plausibly zero. Furthermore, 3,349 of these NPOs report zero FR, an indicator of implausible data.

No significant multicollinearity was noted based on condition indices and variance proportions and using Cook's distance, no significant outlier observations were noted.

Methodology

To the Tinkelman (1999) model of donations, we add interaction terms with price for each factor that Tinkelman proposed, specifying each factor that is continuous as a continuous variable interaction term2. Furthermore, we include all interaction terms in one model. Therefore, the model we test, using OLS with fixed industry effects, is:

$$\begin{aligned} lnDON_{i,t} = b_0 &+ b_1 lnFREXP_{i,t-1} + b_2 lnPREV_{i,t} + b_3 lnPRICE_{i,t-1} \\ &+ b_4 lnAGE_{i,t} + b_5 lnTASSET_{i,t} + b_6 lnGOV_{i,t} + \\ &b_7 lnOTHREV_{i,t} + b_8 lnDONREL_{i,t} + \\ &b_9 lnINDONREL_{i,t} + b_{10} IMPLAUS_{i,t-1} + \\ &b_{11} NOAUDIT_{i,t-1} + b_{12} IMPLAUS_{i,t-1} * \\ &lnPRICE_{i,t-1} + b_{13} NOAUDIT_{i,t-1} * lnPRICE_{i,t-1} + \end{aligned}$$

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[2] We do not test Tinkelman's factor "location" because we are unsure of how to specify this factor. Tinkelman specifies this factor as an indicator variable taking the value of one if the reported address of the NPO is in New York state and zero if it is not in New York state. He finds mixed results for this factor, finding no significant effect for the "generally larger organizations of the audited sample". Since our data is not specific to a particular state and the NPOs we test are much larger than even those in Tinkelman's "audited sample", we did not include location in our model.

$$b_{14}lnTASSET_{i,t-1} * lnPRICE_{i,t-1} + b_{15}lnAGE_{i,t} * lnPRICE_{i,t-1} + b_{16}lnDONREL_{i,t} * lnPRICE_{i,t-1} + b_{17}lnINDONREL_{i,t} * lnPRICE_{i,t-1} + u_{i,t}$$

where DON is direct donations, FREXP is fundraising expenses, PREV is program service revenue, PRICE is total expenses / program expenses, AGE is years since first filing a tax return, TASSET is total assets at the beginning of the year t, GOV is governmental support, OTHREV is other revenue (total revenue – (DON + GOV + PREV)), DONREL is reliance on direct donations (direct donations / total revenues), INDONREL is reliance on indirect donations (indirect donations / total donations), IMPLAUS is an indicator variable that takes the value of one if the NPO reports zero fundraising or administrative expenses and zero otherwise, and NOAUDIT is an indicator variable that takes the value of one if the NPO's financial statements were not audited and zero otherwise[3].

Results and Discussion

As shown in Table 2, the interaction terms of price with total assets (size), age, reliance on indirect donations, and implausible data are significant at the 10% level or better. Since the inherent relation between price and donations is negative (e.g., Calabrese & Grizzle, 2012; Kitching, 2009; Petrovits et al., 2011), age and size, which have negative parameter estimates for their interactions with price, augment the sensitivity of donations to price. Similarly, reliance on indirect donations and implausible data, which have positive parameter estimates for their interactions with price, dampen sensitivity of donations to price. Some of our results from using an improved methodology are consistent with prior studies, and some are not. Tinkelman (1999) finds size not significant, when specified as total assets, and a perverse significant relation between size and sensitivity, when specified as total revenues. Our result, that size significantly increases sensitivity, is consistent with theory and with the results of Kitching (2008) and Marudas & Petherbridge (2017). Furthermore, Tinkelman (1999) and Marudas & Petherbridge (2017) finds reliance on indirect donations not significant, whereas we find it significantly decreases sensitivity, consistent with theory.

[3] The factor "industry" is not tested directly, but rather is controlled for using OLS with fixed industry effects.

Tinkelman (1999) and Marudas & Petherbridge (2017) find reliance on direct donations significantly increases sensitivity, whereas we find this factor to be not significant. Our result that donations to NPOs that report implausible data are less sensitive to price is consistent with the results of Tinkelman (1999) and Marudas & Petherbridge (2017). Surprisingly, unlike Tinkelman (1999) and Marudas & Petherbridge (2017), we find no significant difference in the sensitivity of donations to NPOs that report on their Forms 990 having a financial statement audit. This could be because NPOs are not accurately reporting on their Forms 990 whether they have had a financial statement audit or that donors are not aware of whether NPOs have a financial statement audit.

Table 2: Results of Testing Tinkelman (1999) Model with all Factors as Interactive Terms with Price

	β	T-statistic
lnFREXP	0.32***	21.3
lnPRICE	1.88***	3.2
lnGOV	0.04***	5.7
lnPREV	0.03***	3.3
lnOTHREV	0.05***	2.9
lnAGE	0.14***	3.7
lnTASSET	0.43***	13.9
DONREL	4.47***	19.9
INDONREL	-2.22***	-7.6
NOAUDIT	-0.17***	-4.6
IMPLAUS	2.49**	14.2
DONREL * lnPRICE	-0.44	-1.4
INDONREL * lnPRICE	0.14***	3.9
NOAUDIT * lnPRICE	0.09	0.4
IMPLAUS * lnPRICE	0.41**	2.2
lnAGE * lnPRICE	-0.16*	-1.9
lnTASSET * lnPRICE	-0.14**	-2.8

R-squared = .71
*, **, and *** indicate significance at the .10, .05, and .01 level or better, respectively.
See Table 1 for variable definitions.

Our results provide quantitative estimates of the marginal effect of each factor on the sensitivity of donations to price. As described below, an NPO manager could incorporate these estimates, shown in Table 2, to better estimate the sensitivity of donations to the manager's particular NPO from a one percent change in price. The better estimate stems from not simply using the parameter estimate on the price variable in a model that includes only price and no interaction terms, but rather incorporating the effects of size, reliance on indirect donations, and whether the NPO reports implausible data. In other words, the NPO manager could include the size and reliance on indirect donations of her particular NPO, and whether her NPO reports implausible data, to more accurately estimate the effect of a one percent change in price on donations to her particular NPO. The formula for this more accurate estimate is:

$$b_3 + IMPLAUS_i * b_{12} + lnTASSET_i * b_{14} + lnAGE_i * b_{15} + INDONREL_i * b_{17}$$

where b3, b12, b14, b15, and b17 are the parameter estimates for lnPRICE, lnIMPLAUS*lnPRICE, lnTASSET*lnPRICE, lnAGE*lnPRICE, and lnINDONREL*lnPRICE, respectively, as shown in Table 2. IMPLAUS takes the value one for NPOs with implausible data and zero otherwise, and lnTASSET, lnAGE, and INDONREL are the values for the particular NPO. For example, an NPO reporting not implausible data, and with total assets of $2 million (lnTASSET of 14.5), age of 20 years (lnAGE of 3.0), and reliance on indirect donations of 0.1, would have an estimate of the change in donations from a one percent change in price of:

1.88 + 0 * 0.41 + 14.5 * -0.14 + 3.0 * -0.16 + 0.1 * 0.14 = -0.62

In other words, this NPO could expect a 0.62 percent decrease in donations from a 1 percent increase in price.

Limitations and Future Research

One limitation of this paper is that effects of NPO "industry"; for example, arts, education, international relief, are not tested explicitly but rather are controlled for using a fixed effects model. Future research could test separate homogenous industry subsamples of NPOs to estimate the effects, for each industry, of the various factors that might affect the sensitivity of price on donations. Additionally, we find that having a financial statement audit does not affect sensitivity of price on donations. Future research could examine whether NPOs report accurately, on their Forms 990 which is the underlying source of publicly-available data on NPOs, whether they have a financial statement audit. Such research could also examine whether NPOs having a more involved Single Audit (audit of Federal funding to NPOs) would affect sensitivity of donations to price.

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Tax Reform in Alabama: The Case of Taxing Groceries

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Abstract

In this paper, a general equilibrium model is used to evaluate the economic impact of exempting groceries from sales taxes in Alabama. Specifically, two revenue neutral tax reforms are considered; one replacing grocery sales taxes with an increase in the income tax and the other making an identical replacement with an increase in the property tax. Given Alabama's current tax structure with low income and property taxes and high sales taxes relative to other states, results are as expected. High tax rates create larger levels of excess burden than do small taxes and Alabama can improve tax system efficiency with small changes to income or property taxes and elimination of the high sales tax rate on groceries. An added benefit of exempting groceries is a reduction in Alabama's tax system regressivity, which is one of the highest in the United States.

Background

Alabama's tax system, like the federal tax system and the majority of state tax systems, is no stranger to tax reform proposals and debate. In fact, according to Couch et. al. (2015), initial calls for tax reform in Alabama date back to 1918 when various reform alternatives were suggested in a report completed by the Russell Sage Foundation. Discussion regarding proper development of Alabama's tax system continued during the 1930s, when the framework of the current tax system was developed. Since this time, the tax system has continued to be the subject of significant discussion and the basic structure has been amended numerous times to alter tax rates, refine the tax base, add additional taxes, etc. Such debates naturally generate the most interest and discussion during economic downturns when it is occasionally necessary for the state to prorate the education and/or general fund budgets to maintain a balanced budget in the face of declining state revenues. On one such occasion, during 2003, Governor Bob Riley proposed a significant tax reform plan designed to generate $1 billion in additional tax revenue as well as address the fairness of Alabama's tax system. This broad plan, requiring voter approval, was not well received amid lingering economic uncertainty generated by the 2001 recession and was soundly defeated.

During 2006, however, Governor Riley and the Alabama Legislature were successful in reforming Alabama's income tax law by increasing the standard deduction and dependent exemption for low-income individuals and households. Specifically, the 2006 reforms were designed predominately to benefit Alabama taxpayers earning less than $20,000 per year. The bill increased the standard deduction by 87.5 percent, from $4,000 to $7,500, and more than tripled the dependent exemption, from $300 to $1,000, for these taxpayers. The increase in the standard deduction was gradually phased out for incomes between $20,000 and $30,000 and the increase in the dependent exemption increased slightly, from $300 to $500, for taxpayers earning between $20,000 and $100,000. Governor Kay Ivey signed the latest income tax reform into law in March 2018, increasing the income threshold for all taxpayers. This tax reform, projected to save taxpayers approximately $4 million per year, increased the income tax threshold from $20,000 to $23,000 for all household types except for married households filing separately. The threshold for these household types increase from $10,000 to $10,500.

Compared to Riley's 2003 plan, aimed at generating $1 billion in additional tax revenue, the 2006 and 2018 reforms were designed as revenue reducing reforms during a period of economic stability and health. While these plans only needed approval from Alabama's Governor and Legislators, the next recession will likely result in renewed interest regarding revenue enhancing tax reform. However, since Alabama's major tax revenue sources are each applied at the maximum rate allowed by the state constitution, such tax reform will require voter approval, which Governor Riley has found difficult to obtain. Lottery gaming in Alabama is another example of revenue enhancing tax reform, which has not been approved by the voters in the past. In fact, the debate over lottery gaming in Alabama returned during 2015 and persisted through the 2018 election cycle. Proponents of lottery gaming have centered much of the debate around potential tax revenues as a major benefit of allowing such gaming in the state. No lottery vote is currently scheduled but the topic is expected to be discussed during the 2019 legislative session.

As a contrast to the revenue enhancing or revenue reducing reforms typically deliberated in Alabama, this current research seeks to develop a revenue neutral tax reform plan to test the efficiency of Alabama's current tax system. This type of tax reform requires that any tax revenue lost by amending or eliminating a current tax will be replaced by increasing a different tax. Comparing economic activity before and after the tax reform will allow us to examine how Alabama's tax system unduly burdens residents and identify areas for improvement. The focus of this research is to determine how taxing groceries impacts Alabama's residents and its overall economy.

According to a 2018 report from the Tax Foundation[1], Alabama is one of only seven states that currently subjects groceries to the full sales tax rate. Groceries are taxed at a reduced rate in six additional states and are exempt in thirty-three states. Additionally, five states currently do not have a state sales tax. New Mexico, in 1933, became the second state to institute a state food tax as a temporary, emergency measure in response to the Great Depression. Some seven decades later, in 2005, the legislature repealed the food tax. Since that time, numerous attempts have been made to modify or repeal the tax. One of the most noted was the attempt in 2009 to reintroduce a tax on food (dubbed the Tortilla Tax) in response to revenue shortfalls during the recessionary period in the U.S. economy. A similar attempt was made in 2017 but was defeated in part due to a legislature-funded study by Ernst and Young, which concluded that the largest impact of the food tax would be on incomes between $15,000 and $39,000. So, even when food taxes are repealed, they are still attractive targets for recovering revenue during shortfalls. However, this paper will attempt to show that such actions may be shortsighted.

The remainder of the paper is organized as follows: section one examines characteristics of Alabama's tax system and potential reforms, methodology is discussed in section two, results in section three, and the final section offers conclusions and extensions.

Alabama Characteristics and Reform Alternatives

When designing a tax revenue system, governments inevitably modify one or more key aspects or characteristics of the economic system prevailing in the tax jurisdiction. Such modifications will result in expected or planned changes to the economic structure, while others are unintended. Economic characteristics of concern to government officials when implementing a tax system can be broadly classified into *equity*, *efficiency*, *revenue adequacy* and *economic stability*. In brief, equity refers to fairness in the distribution of tax burdens relative

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[1] From Table 1, "Sales Taxes on Soda, Candy, and Other Groceries, 2018."

to income or wealth. Efficiency encompasses all influences and actions that affect economic behavior and the allocation of resources in the taxing jurisdiction. The behavioral response of taxpayers to new or changing taxes is an aspect of the efficiency effects of taxes. Revenue adequacy refers to the ability of a tax system to consistently generate sufficient revenues to support programs to which the government is committed. Stability refers to the macroeconomic and cyclical effects of taxes across time. The economics of taxation studies one or more of these four broad characteristic of tax revenue systems.

As noted above, taxation can be studied a number of distinct ways; however, a thorough understanding of the current tax system is necessary. Malone, Adler and Joiner (2011) provide insight into Alabama's tax system. They note that Alabama is like many U.S. states in that it is constrained by a balanced budget mandate and has been subject to budget shortfalls on numerous occasions, the most recent extending from 2007 to 2012. Funding shortages were so severe during 2012 that Alabama held a special election on September 18th of that year in which residents approved a transfer from the 'Rainy Day' fund to prop up Alabama's general fund budget. Furthermore, as noted by Malone et. al., Alabama's tax revenue system experiences additional complications in that taxes in Alabama are earmarked more than any other state. Specifically, Alabama earmarks almost ninety cents of every tax dollar collected.

As is the case in most states, Alabama's tax revenue system provides a majority of the revenue available for the state. Federal funds also contribute a significant amount of revenue to the state with fees and various other royalties and severance fees providing the remainder of funds. In fact, federal funds are the second largest source of funds for the state, comprising, on average, 42.7 percent of total state funds over the period from 2007 – 2017 as calculated from *State of Alabama Comprehensive Annual Financial Report* from those years. Malone et. al. site that Alabama levies many different types of taxes, and the tax system has several intriguing characteristics; numerous constitutional issues which govern maximum rates, earmarking, minimum thresholds for paying taxes, etc. Furthermore, they offer five qualities that make Alabama an interesting candidate for tax reform. From Malone et. al., the qualities are:

- "The distribution of Alabama's state and local tax burden is among the most regressive in the United States.

- Alabama has relatively low state and local taxes compared with regional states and the U.S. average. This is true even after adjusting for the fact that Alabama is among the poorest states.
- Income taxes in Alabama are lower than in most states.
- Property taxes in Alabama are lower than any other state.
- Sales taxes in Alabama are above the national average."

Sales taxes in Alabama are of particular interest as these taxes represent the second principal source of tax revenue for the state. In 2018, the Alabama Department of Revenue Annual Report indicates that the state collected in excess of $2.378 billion in sales tax revenue, representing 21.66 percent of total state tax revenue collected. It is important to note that sales taxes are levied by both state and local jurisdictions. Malone et al. notes that the general state sales tax rate is capped at four percent; however, Alabama also applies sales tax to other items such as automobiles and farm machinery, which are taxed at lower rates. The Tax Foundation indicates that general local sales taxes add an additional 5.10 percent on average, bringing the total average state and local general sales tax rate to 9.10 percent.[2] Given this combined rate, Alabama has the fifth highest combined state and local sales tax rate in the United States. The Tax Foundation adds that the maximum local general sales tax rate in Alabama is seven and one-half percent bringing the total general sales tax rate in that jurisdiction to eleven and one-half percent.

Alabama's tax treatment of groceries, discussed in the introduction, coupled with high sales tax rates, yields a sixth interesting characteristic of Alabama's tax system. Combining the characteristics of relatively high sales tax rates, relatively low income tax rates, the lowest property taxes in the nation and taxing groceries at the full sales tax rate, likely generates a significant excess burden in the Alabama economy. It is well understood that all taxes have some impact on the decisions of residents with some taxes impacting residents more than others. As stated by Henry George, and reported by the Tax Foundation (2008 p.1),

"*As a small burden badly placed may distress a horse that could carry with ease a much larger one properly adjusted, so a people may be impoverished and their power of producing wealth destroyed by taxation, which, if levied in any other way, could be borne with ease.*"

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[2] See Tax Foundation, *State and Local Sales Tax Rates 2018*

Given the characteristics of Alabama's tax system, the purpose of this paper is to investigate if such a distressful condition (excess burden), as described by George, currently exists in Alabama.

Couch et. al. (2015) discuss the theory regarding efficiency and excess burden of taxation and note that not much is known regarding the total excess burden of state tax systems. They continue, citing Conover (2010) – who places the excess burden of federal taxes at $0.44 – and apply that rate to Alabama's 2012 tax collections to estimate excess burden for Alabama's tax system. Applying Conover's rate of federal excess burden to Alabama's tax revenue, totaling in excess of $10.9 billion in 2018, the excess burden is estimated to be more than $4.8 billion. If altering the tax structure results in economic expansion, then it follows that the current tax structure exhibits an excess burden which can be reduced as by altering the tax structure. However, if the new tax structure results in economic contraction the opposite is true and the tax reform would increase excess burden. Specifically, the following tax reform alternatives are considered to determine if it is possible to improve the efficiency of Alabama's current tax system.

Proposed Reforms for Investigation

Relative to other states, Alabama's low income and property taxes and high sales taxes allow for myriad tax reform alternatives which have a potential to diminish the economic burden of the current tax system while maintaining or improving current tax revenue collections in the state. While the focus of these reforms is revenue neutral, reduction of economic burden present in the current system will foster economic growth generating a secondary effect of increased tax collections. This research focuses on two reform alternatives to investigate the economic impact of removing the state sales tax on groceries and replacing lost revenue by increasing other relatively lower taxes. Specifically, we consider:

Reform A: We investigate the efficiency effects of enacting a revenue neutral tax reform, which eliminates the state and local sales tax on groceries in Alabama and replaces lost revenue by increasing the state income tax.

Reform B: We investigate the efficiency effects of enacting a revenue neutral tax reform, which eliminates the state and local sales tax on groceries in Alabama and replaces lost revenue by increasing the property tax.

These reforms are constructed based on fundamental principles from the literature and basic economic theory. First, Hawkins (2002) finds that sales taxes with high rates and broad exemptions impose significant excess burdens on the economy. Hawkins measures the burden at 17 to 39 percent higher as the rate continues to increase along with the number of exemptions. Hawkins concludes that such high tax rates with broad exemptions are "roughly as damaging" as average income taxes. Additionally, Muthitacharoen and Zodrow (2008) find that efficiency costs of property and sales taxes are relatively the same utilizing a partial equilibrium model. Given the relationships between sales, income and property tax efficiency, we seek to determine if efficiency can be improved in Alabama's case based on the basic economic principle that lower tax rates generate lower tax burdens. This is a significant question given the history of tax reform in Alabama, and the potential to increase economic activity and reduce Alabama's tax system regressivity[3] via eliminating the sales taxes on groceries.

The first step in studying these reforms is to estimate a dollar amount of grocery sales taxes collected in Alabama during 2018. This is necessary to allow for an increase income or property taxes respectively to maintain the revenue neutrality of the tax reform. Lacking specific data on grocery sales taxes, we estimate these taxes using average state and local sales tax rates along with data from consumer expenditure survey (CEX) and Census QuickFacts. CEX data reveals that consumer units, basically households, in the southern region of the United States spend an average $3,892 annually on groceries. U.S. Census Bureau QuickFacts for Alabama specify 1,856,695 households in the state. Combining these figures yields total grocery spending of $7.22 billion during 2018. Applying the average state and local sales tax rate of 9.10 percent, we estimate grocery sales taxes in excess of $657 million with approximately $289 million flowing into state coffers and the remaining $368 million representing local grocery tax revenue.

Thus, to facilitate *Reform A* requires increasing income tax collections by $657 million while *Reform B* requires an identical

[3] Alabama's tax system is one of the most regressive tax systems in the United States with sales taxes responsible for a large portion of the regressivity. See Formby (2013) for Alabama's precise regressivity ranking.

increase in property taxes. While the state portion is small relative to total state revenues in excess of $10 billion during 2018, sales taxes are the primary revenue source of local counties and cities. If the state is now collecting these funds via income or property taxes, it is necessary to have some mechanism to remit tax revenue back to local communities to maintain their budgets. Fortunately, Alabama already collects and remits sales taxes and other taxes for many counties and cities, therefore, the system to remit these taxes is already in place. Therefore, all that would be needed is to add cities and counties not currently participating in the system.

Methodology

Regional econometric software will be utilized to evaluate the net efficiency effects of *Reform A* and *Reform B*. A single region general equilibrium model of Alabama constructed by Regional Econometric Models Inc. (REMI) is used to estimate the short- and long-term benefits (encompassing the direct, indirect and multiplier effects) of alternative reform scenarios. For each year of the time horizon, 2019 – 2028, the model estimates how each reform impacts various economic variables of interest to policy makers and Alabama residents alike. The efficiency effects are revealed as changes to employment, gross regional product, real disposable personal income, and population, among others. The REMI model has been chosen to investigate the economic impact of our suggested reform alternatives as Bluestone and Bourdeaux (2015) highlight sixteen states[4] which utilize REMI models for dynamic scoring of tax policies. Bluestone (2016) also uses a REMI model to investigate the economic impact of tax reform in Georgia. Next, a brief overview of a general REMI Model is discussed.

REMI builds proprietary models available for lease and are founded on two foundational economic theory assumptions taught in almost all principles of economics courses: households maximize utility and producers maximize profits. Model construction then begins via the construction of a national forecast. Next, data specific to Alabama is incorporated to facilitate a regional specific forecast applicable to the region of study. The regional model is built utilizing

[4] States utilizing REMI models in 2015 according to Bluestone and Bourdeaux include: Texas, Arizona, New Mexico, Arkansas, Louisiana, Wyoming, Kansas, Minnesota, Iowa, Illinois, Kentucky, Ohio, Michigan, New York, Massachusetts, and Rhode Island.

Alabama state and county level data derived from a variety of public sources – including the Bureau of Labor Statistics, Bureau of Economic Analysis and Census Bureau, among many others.

In addition to the fundamental economic modeling assumptions mentioned above, REMI models apply other basic canons of economic theory. REMI models are constructed under the precept that businesses produce goods for sale to various customers within and outside the region. Furthermore, goods and services are produced using the primary factors of production - land, labor, and capital – and various intermediate inputs. Demand for individual factors of production in Alabama is based on relative costs in the region, with the model substituting cheaper factors for more expensive factors as prices change. Labor supply is determined by the population of Alabama as well as Alabama's labor force participation rate. Economic migration is also included in REMI model, allowing the model to capture changes in population and labor force participation as wages, employment opportunities and other regional economic factors change as the result of tax reforms as we investigate in this research or business expansion or contraction in the region.

REMI models also include various feedback mechanisms to capture the circular flow of economic activity and allow variable values to be estimated for future years. For example, future wage rates and other costs of production in the model are determined in a standard fashion via the interaction of supply and demand for every industry in the model. As costs rise, businesses face increasing prices or a reduction in profits. Built in feedback mechanisms also allow for interaction between market share inside and outside the region, coupled with demand inside Alabama determine supply produced by Alabama firms. Substitution between output produced inside and outside the region indicates that increasing prices within the Alabama study region would then result in Alabama consumers purchasing more and more output produced outside the region. Major equation structure for the model is provided in *Appendix A*. See Treyz *et al.* (1992) for an in-depth analysis of the full REMI estimation methodology, including all equations and appropriate feedback mechanisms.

Once all of the national and region specific data has been built into the Alabama model, the REMI model determines a baseline forecast based on the initial data and feedback equations. The baseline forecast assumes no changes to current economic structure or public policy. Baseline forecast projections are located in Table B.1 in *Appendix B*. Changes in economic structure or policy are input directly into the model by changing relevant variables and a new forecast is generated and compared to the baseline. Differences between the baseline and alternative forecasts reveal expected economic benefits or costs of a given change in the region. Given that the focus of this research is tax reform, changes to the tax structure are entered directly into the model and then the alternative simulation is run and compared to baseline to determine if the selected reforms offer any benefits to Alabamians.

Specifically, the baseline REMI forecast is built utilizing current Alabama tax law. Alternative forecasts are then generated after changes for *Reform A* or *Reform B* have been introduced into the model. Increasing income taxes to maintain revenue neutrality is a direct and straightforward process as income taxes are explicitly included in the substructure of the REMI model. Property and sales taxes are also included in the model structure; however, property and sales tax rates cannot be changed directly in the model. Without a direct method of altering these taxes in the model, it is necessary to enter these changes into the model indirectly. Consultations with REMI developers/programmers and REMI documentation recommend changing the regional price level to reflect any alteration to the property and sales tax structure.[5] After tax alterations have been entered into the model, REMI estimates an alternative forecast for the region that is iterated for convergence.[6] Comparing the alternative forecast with the baseline forecast, we are able to forecast the economic impacts of each tax reform over a ten-year time period. Alternative forecast projections for *Reform A* and *Reform B* are located in Table B.2 and B.3 respectively in *Appendix B*. If Alabama were to make this reform in 2019, the estimated results would be expected over the period from 2019 to 2028.

[5] For example, with a 9.10 percent state and local sales tax rate, $100 of groceries in Alabama would cost a total of $109.10. Eliminating sales tax on food in Alabama necessitates that $100 of groceries now cost only $100, representing a 8.34 percent decrease in the price of groceries. This change is then entered into the model as a 8.34 percent decrease in the price of food and beverages in the region. Property taxes are increased in the model in analogous fashion.

[6] It is possible that an alternative forecast does not converge; in such cases, the REMI model returns an alternative forecast with a warning that the forecast lacks convergence.

Results

Once the tax changes associated with *Reform A* and *Reform B*, discussed in Section II, have been entered into the REMI model, the simulations are run and then compared with the baseline forecast. Alternative forecasts for *Reform A* and *Reform B* each converge without impediment and initial efficiency results associated with each reform are located in Tables 1 and 2. All estimates presented in Table 1 are differences between the baseline forecast and the alternative forecast associated with *Reform A*, while estimates in Table 2 are differences between the baseline forecast and the *Reform B* alternative forecast. Specifically, based on the structure of the REMI model and economic intuition, potential efficiency effects of each reform are explored by investigating estimated changes in *Total Employment*, *Private Non-Farm Employment* (*PNFE*), *Real Gross State Product* (*RGSP*), *Real Disposable Personal Income* (*RDPI*), and *Changes in Population*. Changes in *Real Disposable Income Per Capita* (*RDPIC*) are also included to estimate how the average resident of Alabama would be impacted by the reform alternatives. Columns 1 and 2 provide estimates for changes to *Total Employment* and *PNFE*, respectively, while *Changes in Population* is located in column 6. Estimates for each of these variables is expressed in thousands. Columns 3 through 5 provide estimated variations in *RGSP*, *RDPI* and *RDPIC*. *RGSP* and *RDPI* are both reported in billions of 2012 dollars while *RDPIC* is expressed in 2012 dollars.

These output variables are directly and indirectly affected by numerous economic variables including taxes. *RGSP* is calculated in standard fashion via the summation of consumption, investment and government spending with an adjustment for regional exports and a regional purchase coefficient. *RDPI* obviously increases as employment increases in the region and changes with wages as the supply and demand for labor change in the region. *RDPI* also changes as prices change in the region. *Total Employment* and *PNFE* are impacted by changes in labor force participation, wage rates and population changes. *Changes in population* are driven by birth and death rates and migration into or out of the region. RDPIC understandably changes with population and/or real disposable income.

Decreasing the sales tax on food reduces food prices in the region, reducing the consumer price deflator and increasing real disposable income and alters the regional purchase coefficient. Increasing income taxes, to maintain revenue neutrality for *Reform A*, reduces real disposable income and impacts *RGSP* via the consumption component. If the impact associated with decreasing the sales tax is larger than the impact of increasing the income tax, then increases in *RDPI* yields increases in *RGSP* and intuitively increases the demand for labor in the region. Increasing demand for labor puts upward pressure on wages, which in turn alters labor force participation and migration in the region. Impacts associated with *Reform B* work through the economy in a similar fashion; however, the starting point is different as the decrease in the price of food is offset by an increase in housing prices. If the impact of the decrease in the price of food is greater than the impact of the increase in the price of housing, *RDPI* increases and effects spillover into the remaining variables.

The initial revenue neutral tax reform, classified as *Reform A*, removes state and local sales tax on food and replaces lost revenue by increasing the income tax. Table 1 illustrates that such a tax reform in Alabama would generate efficiency benefits. *Total Employment* is projected to increase by 25,210 jobs while *RGSP* increases by $1.31 billion in the initial year of the tax change. *RDPI* expands by $2.4 billion while *RDPIC* increases by $452.68. Population is also expected to increase by 10,820. With many states already exempting groceries from sales taxes, it is unlikely that the population increase results from the tax change itself, rather from the economic expansion that occurs as the tax change improves the efficiency of the tax system. As depicted in Table 1, efficiency results associated with *Reform A* persist across the ten-year time horizon investigated.

Examining years two through ten allows us to examine if the tax reform plan exerts a continual impact on the economy or only offers temporary benefits. As expected with any policy change, the majority of benefits are generated in the initial year of the tax reform. However, Alabama's economy experiences continued, smaller growth over the time horizon investigated. By the tenth year, *Total Employment* is projected to be 29,910 above baseline with just under 25,000 additional employees in the private non-farm sector.

Although *Total Employment* expands each year over the time horizon, *Private Non-Farm Employment* declines slightly from year ones impact during the second and third year after tax reform is implemented. *PNFE* increases again slightly during year four and declines slightly in year five. *PNFE* then expands in years six through ten. *RGSP* and *RDPI* are projected to expand by $1.88 billion and $3.53 billion respectively. *RDPIC* declines in years two through ten as the model predicts population to expand faster than *RDPI* in those years. In the tenth year, *RDPIC* is only $150.18 above baseline with projected population increase of just under 72,000.

Table 2 presents efficiency results associated with *Reform B*, and similar to *Reform A*, the replacement of state and local sales tax on groceries is expected to generate various economic benefits. *Total Employment* is estimated to be 26,500 jobs above the baseline with just under 97 percent of employment growth (25,700 jobs) existing in the private non-farm sector. *RGSP* is expected to increase by $1.39 billion and *RDPI* increases by $2.57 billion. *RDPIC* is projected to grow by $475.59 and population increases by 11,380. Positive impacts of the tax reform again continue in years two through 10. In the tenth year after reform implementation *Total Employment* is 31,260 above baseline and *PNFE* increases by 25,970. Changes in *PNFE* are similar to those discuss with *Reform A*, having periods of growth and decline in years two through 10. In the tenth year, *PNFE* is only 270 jobs above the estimate from year one. In year ten, *RGSP* and *RDPI* are projected to be $1.98 billion and $3.70 billion respectively. *RDPIC* falls from $475.59 to $155.91 by the tenth year as the population change increases from 11,380 to 75,640.

Such efficiency gains, shown in Table 1 and 2, are somewhat unexpected given the literature previously discussed. Recall that typically, efficiency can be improved by switching from income to sales taxes. However, in Alabama's case, as projected by the REMI model, the existing tax structure employing a relatively low income tax rate, extremely low property tax rate and relatively high sales tax rate have burdened residents in such a manner that shifting away from sales taxes can improve efficiency. These results coincide with basic economic theory relating high tax rates and high tax burdens. Obviously, increasing the income or property tax rates will increase the economic burden associated with those taxes; however, the REMI model predicts that the decrease in the sales tax burden that results from exempting groceries is larger than the increase in economic burden associated with increasing income or property taxes.

Comparing the results of each reform simulation provides additional evidence of the economic burden imposed on residents by the current tax system. Given that property taxes in Alabama are lower than in any other state, economic theory suggests replacing sales taxes on groceries with a property tax should generate larger efficiency gains than replacing with an income tax. Comparing results presented in Tables 1 and 2, we see that *Reform B* generates slightly larger benefits than *Reform A*. Comparing differences between the baseline and year ten only, *Reform B* is expected to generate 1,350 more jobs in *Total Employment* than *Reform A*. *RGSP* for *Reform B* is $94 million larger and *RDPI* is $171 million higher. These results support the theory that low tax rates are associated with lower tax burdens.[7] However, since efficiency gains associated with *Reform B* are only slightly larger than *Reform A*, it can be concluded that the current tax burden associated with property and income taxes is relatively small relative to the burden of sales taxes which in turn generates the efficiency gains revealed by the REMI model and shown in Tables 1 and 2.

Conclusion and Extensions

According to simulations performed utilizing REMI methodology, Alabama can improve the efficiency of existing tax structure by replacing state and local sales taxes on groceries with an income or property tax. Replacing the sales tax on groceries with an income tax yields an estimated increase in *Real Gross State Product* by 0.68 percent ($1.31 billion) while replacing with a property tax yields an increase of 0.72 percent ($1.39 billion). While the reforms investigated in this paper were designed as revenue neutral reforms, resulting economic growth will yield additional tax revenue for the state. Although not included as part of this analysis, additional tax revenue could be used to fund any number of state services ranging from education, police, fire, health and hospitals to roads and bridges. Additional funding for these and other state services would likely generate supplementary economic benefits for Alabama's economy and should be considered as part of the total impact of these tax reform plans. Unfortunately, the method by which taxes are altered in the REMI model prevents the capture of additional tax revenues related to these reforms and therefore need to be estimated separately as part of a future study.

Imposing such reforms in Alabama will not be without difficulty given the constitutional constraints outlined by Malone et. al. (2011) and the fact that more than half of grocery sales tax revenue flows to local cities and counties. Thankfully, a mechanism to return the local portions of these taxes is already in existence and could be utilized should these or similar reforms be enacted. Another issue to be

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[7] As a further test of our theory regarding tax rates and tax burden in Alabama, a simulation was run where grocery sales taxes were replaced by increasing the sales tax on all other goods. Results for this simulation yielded an increase in economic burden, contracting Alabama's economy.

debated along with these reforms is how such reforms might alter tax revenue flows into the general fund and education trust fund. As income and sales taxes are earmarked almost completely for education, *Reform A* would have no impact on the general fund or education trust fund revenue flows. However, *Reform B*, shifts $0.42 from the education trust fund to the general fund for each dollar of tax revenue that is shifted from grocery sales taxes to property taxes. This result occurs because income and sales taxes are earmarked for education while the property tax also contains an earmark for the general fund. Of course, this shift would be at least partially offset by the supplementary effects of economic expansion as discussed above. The transfer could also be reversed by changing the property tax earmarks as part of the tax reform plan.

In addition to the economic benefits discussed in this paper, exempting groceries from sales taxation also has a secondary benefit of reducing the regressivity present in Alabama's current tax system. Baum (1998) found that eliminating the grocery tax exemption would increase regressivity and by extension would reduce the degree of regressivity in the current system if Alabama eliminates sales taxes on groceries. The degree of regressivity reduction is unknown for Alabama at this time because income distribution data for food expenditures in Alabama is generally unavailable. Despite not being able to measure changes in regressivity at this time, reforms presented here appear to offer both efficiency and equity benefits to Alabama residents and potentially additional revenue for the state and should be investigated further.

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Table 1: *Reform A* Results – Differences from Baseline

Year	Total Emp (Thous)	Priv Non-Farm Emp (Thous)	RGSP (Bil Fixed 2012$)	Real Disp Pers Inc (Bil Fixed 2012$)	Real Disp Pers Inc Per Cap (Fixed 2012$)	Population (Thous)
	(1)	(2)	(3)	(4)	(5)	(6)
1	25.21	24.45	$1.31	$2.41	$452.68	10.82
2	25.63	23.97	$1.37	$2.57	$384.13	23.65
3	26.17	23.87	$1.43	$2.71	$339.63	32.58
4	26.78	23.91	$1.51	$2.85	$300.53	40.64
5	27.25	23.88	$1.56	$2.97	$265.36	47.7
6	27.7	23.9	$1.62	$3.10	$234.93	53.85
7	28.22	24.04	$1.68	$3.21	$209.08	59.25
8	28.74	24.24	$1.75	$3.32	$186.18	64
9	29.3	24.52	$1.81	$3.43	$166.71	68.19
10	29.91	24.88	$1.89	$3.53	$150.18	71.98

Table 2: *Reform B* Results - Differences from Baseline

Year	Total Emp (Thous)	Priv Non-Farm Emp (Thous)	RGSP (Bil Fixed 2012$)	Real Disp Pers Inc (Bil Fixed 2012$)	Real Disp Pers Inc Per Cap (Fixed 2012$)	Population (Thous)
	(1)	(2)	(3)	(4)	(5)	(6)
1	26.5	25.7	$1.39	$2.53	$475.59	11.38
2	26.92	25.17	$1.45	$2.70	$403.27	24.9
3	27.45	25.03	$1.52	$2.84	$355.99	34.31
4	28.05	25.03	$1.59	$2.99	$314.44	42.78
5	28.52	24.97	$1.64	$3.12	$277.14	50.19
6	28.97	24.97	$1.70	$3.25	$245.07	56.65
7	29.5	25.11	$1.77	$3.37	$217.92	62.31
8	30.04	25.31	$1.83	$3.48	$193.70	67.29
9	30.62	25.59	$1.91	$3.59	$173.42	71.67
10	31.26	25.97	$1.98	$3.70	$155.91	75.64

Appendix A: REMI Equation Structure

The REMI model is constructed utilizing a five-block structure, each containing numerous equations to facilitate feedback loops within and between each block. Additionally, these feedback loops are structured to allow information to flow in both directions (into and out of) blocks and various sub-equations as necessary to facilitate the alternative forecasts of interest. The five blocks that provide the foundation of the model are the output block, the factor demand block, the population and labor supply block, the wage, price, and profit block and finally the market share block. What follows is a brief discussion of each block and major equations utilized by REMI. All equations and notation are derived from Treyz et al. (1992) and Treyz (1997).

Output Block

The output block forms the core of the model and contains numerous connections with the remaining blocks. This block is built utilizing standard gross domestic product components calibrated for the region. Specifically, the components of the output equation are consumption, investment, government spending and net exports. The equation for the forty-nine-industry utilized in this research is:

$$Q_i = \sum_{j=1}^{49} R_i a_{ij} Q_i + R_i (C_i + I_i + G_i) + X_i, \quad \text{(A.1)}$$

where Q_i represents output for a given industry, R_i is a regional purchase coefficient denoting local demand supplied by local industry i, a_{ij} is a technical coefficient derived from national input-output data and estimated forward assuming a constant change in technology, and C_i, I_i, G_i, and X_i denote personal consumption, investment, state and local government spending, and regional exports respectively. Furthermore, Treyz et al. (1992) and Treyz (1997) indicate that it is not necessary to explicitly include imports in the equation as a_{ij} is regionalized by R_i. The output block contains numerous additional equations related to consumption, investment and government spending sub-sectors.

Factor Demand Block

The factor demand block is built to estimate optimal levels of capital and labor as the two primary factors of production. Specifically, the REMI model estimates optimal levels for these factors utilizing a cost minimized, Cobb-Douglas production function with constant returns to scale of the following form:

$$Y = (A)(E^{a})(K^{d})(F^{c}), \text{ where } a + d + c = 1 \qquad \text{(A.2)}$$

where *A* represents average factor productivity, *E* denotes employment/labor demand, composite capital factors/demand for capital and fuel factors are signified by *K* and *F* respectively. Also, *a*, *d* and *c* are indicators for factor output shares. Allowing for standard substitution between *E* and *K*, an internal linkage among sub-equations in this block allows factor usage to be calculated from factor demand equations and specified factor prices. This block also contains internal and external connections. This block also contains external linkages with the output block and the wages, prices and profit block. As expected, factor demand is directly linked to total output in the output block and wages in the wages, prices, and profit block.

Population and Labor Supply Block

Population in the REMI model is based on the natural population of the region and current migration patterns. Obviously, the natural population increases when births exceed deaths in the region and decreases if the opposite is true. Population also increases when net migration (migration into the region – migration out of the region) is positive. Current population is estimated by the following equation:

$$N_t = N_{t-1}\left[\frac{N_t^u}{N_{t-1}^u}\right] + MIG, \qquad \text{(A.3)}$$

where N_{t-1} represents population in the previous time period the ratio (N_t^u / N_{t-1}^u) is the growth rate of the natural population which is estimated based on fertility and survivability rates in the region. *MIG* denotes net migration and consists of international migrants, retired migrants, former military personnel and their dependents and economic migrants. The first three components are driven by historical data while economic migrants are determined within the model varying with expected income and regional amenities, both of which vary via linkages to the other blocks within the model.

Labor force participation/labor supply is also determined within this block by the equation:

$$NLF = \sum_{k} NPR_k (COH_k), \qquad \text{(A.4)}$$

where NPR_k is the projected labor force participation rate for cohort k and COH_k is the size of the age and sex cohort k. In standard economics fashion, linkages between this block and the four other blocks in the REMI model yield increases in the labor supply when wages or the probability of employment increases.

Wages, Prices and Profit Block

This block combines the various supply and demand equations from the entire model to determine wages, prices and profits in the region. Prices and profits are directly dependent upon wage rates as the wage rate linkages influence relative costs of production and other price and profit measures. Wages are determined by the supply and demand for labor which in turn are derived from linkages to population and labor supply and factor demands. First, REMI employs a standard total cost equation based upon the Cobb-Douglas production function as shown in equation A.2. Specifically, total cost is based on factor input costs weighted by usage and defined as follows:

$$TC_i = w_i E_i + c_i K_i + f_i\ F_i + \sum_{j} sp_j Q_{j,i}\ , \qquad \text{(A.5)}$$

where E, K, and F, and previously defined Q_{ji} represents units of intermediate goods used in production in sector j and sp_j represents the relative cost of intermediate goods in sector j. Finally, w_i, c_i, and f_i represent the wage rate, relative cost of capital and relative fuel cost respectively.

Specifically, wages rates are determined by projection of labor demand in each industry, changes in wage rates due to changes in demand and supply of labor, changes in the consumer price deflator during the previous period and a variable to capture changes in wages that are not already included in the model. Relative capital costs are determined by the relative costs of structures, equipment, inventory, land and housing all weighted the proportion of each type of capital to total capital. Relative fuel costs are the relative costs of electricity, natural gas and residual fuel oil, again weighted by usage in a specific industry.

Next, the model estimates regional sales price (SP_R) on a relative marginal cost basis via the equation:

$$sp_R = \left[\frac{W}{W^u}\right]^a \left[\frac{c}{c^u}\right]^d, \qquad \text{(A.6)}$$

where (W / W^u) is the relative marginal cost of labor and (c / c^u) represents the relative marginal cost of capital. Exponents a and d represent the labor share and capital share of output respectively.

The final component of this block in the model pertains to profit. The REMI model directly links relative profits to relative productivity and inversely related to relative input costs utilizing the equation:

$$\pi_i = 1 - \frac{a_{fi}(RLC_i)^{\alpha_i}(RCC_i)^{\beta_i}(RFC_i)^{\gamma_i}}{RFPROD_i} + \sum a_{i,j}\left(1 - sp_j\right), \qquad \text{(A.7)}$$

where a_{fi} is relative value added, RLC_i is relative labor cost, RCC_i is relative capital cost and RFC_i is relative fuel cost all for industry i. $RFPROD_i$ is relative factor productivity, a_{ij} is relative output and sp_j is as defined previously. Finally, α, β, and γ represent relative factor usage.

Market Shares Block

As noted in the output block, regional industries sell products within the region and to the national market while firms outside the region sell products within the region. This fifth and final block of the REMI model estimates the regional purchase coefficient (RPC_i) from equation A.1 and an export share coefficient. Specifically, the market shares block examines the regional and national market share accounted for by industry i within the region. RPCi is estimated by equation A.8 below while the export share coefficient is estimated as shown in A.9:

$$R_{i,t} = R_{i,T}\,(SVA_t^{\mu 1})(SVA_{t-1}^{\mu 2})(SPA_{i,t} \,/\, SPA_{i,T})^{\mu 3}, \qquad \text{A.8)}$$

$$S_{it}^{ku} = S_{iT}^{Ku}\,(SPA_{it} \,/\, SPA_{iT})^{\xi}, \qquad \text{(A.9)}$$

where R_i and S_i represent relative competitiveness of industry *i* in the region. $R_{i,T}$ the *RPC* for the last history year, *SVA* denotes the regional share of total U.S. gross domestic product and *SPA* is the average selling price for industry *i*. μ_1, μ_2, and μ_3 represent the effects of relative profitability in the region while ζ captures the elasticity of response to price changes. Finally, μ_3 and ζ are constrained to be equal as linkages in the model affect *RPC* and export share in a proportional fashion.

Appendix B: REMI Baseline and Alternative Forecast Results

This appendix contains three tables for the examination of the baseline and alternative forecast results. All tables shown in this appendix are set up as detailed in Tables 1 and 2. Recall, column 1 reflects projected *Total Employment* and *Private Non-Farm Employment* is found in column 2. *Total Real Gross State Product* is found in column 3 while *Real Disposable Personal Income* and *Real Disposable Income Per Capita* are located in columns 4 and 5 respectively. Finally, projected population growth (*Changes in Population*) is shown in column 6. Table B.1 provides the baseline forecast and shows Alabama's projected economic expansion with no policy or other economic changes. Table B.2 reflects total values for all economic variables assuming *Reform A* is imposed on Alabama's Economy. Table 1 is calculated by subtracting Baseline forecast projections from projections associated with *Reform A*. Finally, Table B.3 provides forecast values for *Reform B* and Table 2 is again calculated by subtracting the Baseline forecast estimates from *Reform B* estimates. All table values presented in this appendix are level values.

Table B.1: Baseline Forecast - Levels

Yea r	Total Emp (Thous)	Priv Non-Farm Emp (Thous)	RGSP (Bil Fixed 2012$)	Real Disp Pers Inc (Bil Fixed 2012$)	Real Disp Pers Inc Per Cap (Fixed 2012$)	Population (Thous)
	(1)	(2)	(3)	(4)	(5)	(6)
1	2,696.79	2,233.80	$193.69	$173.65	$35,538.78	4,886.60
2	2,741.92	2,266.69	$194.73	$179.30	$36,610.84	4,898.47
3	2,787.80	2,300.06	$195.77	$185.14	$37,715.25	4,910.37
4	2,834.45	2,333.93	$196.82	$191.16	$38,852.96	4,922.31
5	2,881.88	2,368.30	$197.87	$197.38	$40,025.00	4,934.27
6	2,930.10	2,403.17	$198.93	$203.80	$41,232.40	4,946.26
7	2,979.13	2,438.56	$200.00	$210.43	$42,476.21	4,958.28
8	3,028.98	2,474.47	$201.07	$217.28	$43,757.55	4,970.33
9	3,079.66	2,510.90	$202.14	$224.35	$45,077.54	4,982.40
10	3,131.19	2,547.88	$203.23	$231.64	$46,437.35	4,994.51

Table B.2: Alternative Forecast *Reform A* - Levels

Year	Total Emp (Thous)	Priv Non-Farm Emp (Thous)	RGSP (Bil Fixed 2012$)	Real Disp Pers Inc (Bil Fixed 2012$)	Real Disp Pers Inc Per Cap (Fixed 2012$)	Population (Thous)
	(1)	(2)	(3)	(4)	(5)	(6)
1	2,722.00	2,258.25	$195.01	$176.06	$35,991.46	4,897.42
2	2,767.55	2,290.66	$196.10	$181.87	$36,994.98	4,922.12
3	2,813.97	2,323.93	$197.21	$187.84	$38,054.88	4,942.95
4	2,861.23	2,357.84	$198.32	$194.00	$39,153.50	4,962.95
5	2,909.13	2,392.18	$199.43	$200.35	$40,290.36	4,981.97
6	2,957.80	2,427.07	$200.55	$206.89	$41,467.33	5,000.11
7	3,007.35	2,462.60	$201.68	$213.64	$42,685.29	5,017.53
8	3,057.72	2,498.71	$202.81	$220.60	$43,943.73	5,034.33
9	3,108.96	2,535.42	$203.96	$227.77	$45,244.25	5,050.59
10	3,161.10	2,572.76	$205.11	$235.18	$46,587.53	5,066.49

Table B.3: Alternative Forecast *Reform B* - Levels

Year	Total Emp (Thous)	Priv Non-Farm Emp (Thous)	RGSP (Bil Fixed 2012$)	Real Disp Pers Inc (Bil Fixed 2012$)	Real Disp Pers Inc Per Cap (Fixed 2012$)	Population (Thous)
	(1)	(2)	(3)	(4)	(5)	(6)
1	2,723.29	2,259.50	$195.08	$176.18	$36,014.37	4,897.98
2	2,768.84	2,291.86	$196.18	$182.00	$37,014.12	4,923.37
3	2,815.25	2,325.09	$197.29	$187.98	$38,071.24	4,944.68
4	2,862.50	2,358.96	$198.40	$194.14	$39,167.40	4,965.09
5	2,910.40	2,393.27	$199.51	$200.50	$40,302.14	4,984.46
6	2,959.07	2,428.14	$200.63	$207.05	$41,477.47	5,002.91
7	3,008.63	2,463.67	$201.76	$213.80	$42,694.13	5,020.59
8	3,059.02	2,499.78	$202.90	$220.76	$43,951.25	5,037.62
9	3,110.28	2,536.49	$204.05	$227.94	$45,250.96	5,054.07
10	3,162.45	2,573.85	$205.21	$235.35	$46,593.26	5,070.15