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The Effect of Relative Wage Per Hour on Labor Supply

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Abstract

This paper explores how ones labor supply is affected by their relative wage as compared to people in the same geographical region as them. The study finds the predicted negative relationship between relative wage per hour and hours of work. The paper expands on prior literature because it uses a different data set and examines it through different reference groups (the group in which a person compares themselves to). This finding is important because it may be beneficial for the government to understand people's labor supply choices when making policies that deal with labor supply. Furthermore, it would be helpful to understand more how people respond to their environment differently.

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I. Introduction

Many factors go into a person's decision to work. These factors include variables such as expected standard of living, family, or potential income. All of these factors are for the purpose of obtaining income. Economic theory suggests that as income increases, utility increases as well. This is because increased income allows more consumption. However, the reality of this relationship is not entirely clear. Easterlin (1974) found that despite rising incomes of countries from 1946 to 1970, reported utility levels did not have a corresponding increase. Therefore, despite the fact that people would be able to consume more, they did not have an increase in utility. The implication of this is that one's utility is not solely based off of absolute income. Instead, relative income has an effect on utility as well. In other words, the amount that someone is able to consume relative to others is important.

This has implications beyond one's individual utility. One's labor supply choices may be dependent on the given utility that they can achieve. The finding that relative income affects utility may also suggest that someone's labor supply choices will be dependent on relative income. This is because someone who has a low relative income may attempt to increase their income relative to others in order to increase their utility. Indeed, there has been a growing number of works examining the relationship between relative income and hours worked. This magnitude of this relationship is growing increasingly important as inequality in the United States rises. The U.S. Congressional Budget Office (2011) reports that the GINI index (a common variable that portrays income inequality with an index closer to 1 indicating more inequality within a country) has risen from .464 to .562 from 1979 to 2007. This statistic is important due to the findings of Bowles and Park (2005) who find that greater inequality has led to longer working hours. Thus, increased inequality might indicate an increased motivation for people to act depending on their relative wage. So as this inequality increases, one's relative wage may become increasingly important in their work-leisure decision.

This paper explores this by examining how ones labor supply is affected by their relative wage as compared to people in the same geographical region as them. The study finds the predicted negative relationship between relative wage per hour and hours of work. The paper expands on prior literature because it uses a different data set and examines it through different reference groups (the group in which a person compares themselves to). This finding is important because it may be beneficial for the government to understand people's labor supply choices when making policies that deal with labor supply. Furthermore, it would be helpful to understand more how people respond to their environment differently.

Many different factors from different directions may go into someone's decision to work. This paper will focus on this relationship through the lens of an individual's choice. This concept is clearly stated through the seminal work done by Cole, Mailath, and Postlewaite (1995) who show

that people respond differently to wage shocks depending on whether the wage shock affects the individual or the aggregate group. An individual wage shock is defined as something that only affects the individual's wage (such as the closing of a small firm). An aggregate wage shock is defined as a supply shock that affects all parties (such as a new tax). In response to an individual shock, the individual will give more effort in order to reach the relative position previously occupied. Depending on other agent's responses to an aggregate shock, an individual's response can take on multiple forms. If the other agents of a negative aggregate wage shock give more effort in order to reestablish themselves at the wage previously held, then the individual will give more effort as well. If none of the agents respond, there is no change in effort by the individual. In other words, changes in wage are not as important as the relative wage. People will only change their effort if their peers do disproportionately. This paper will use this reasoning to hypothesize that people with lower relative wages will give more effort towards work (as shown through work hours). This is because a person will try to respond to a lower wage by working more in order to change the relative position.

Change in work hours can come from other sources however. The problem with estimating labor supply choices is that one does not know whether a change is due to labor supply or demand. Summers (1988) shows how this change can come from the labor demand side. The theory of efficiency wage states that firms will pay workers higher than market equilibrium in order increase productivity. The theory behind this is that a higher wage will motivate workers to work harder. From an individual standpoint, this wage is not so much about the absolute value of it but rather how it compares relative to wages that are available outside a given company. Therefore, some of the predicted effect may come from this relationship.

In this type of paper, one can run into problems because it deals with endogenous variables. In this case, both income and hours worked have an effect on one another. There are some issues that can arise when one deals with reference groups (how relative wage will be determined in this paper) or endogenous social effects as explanatory variables. Manski (1992) explains that an issue occurs when one tries to define reference groups in this manner without having prior knowledge. The way to fix this is to have data that provides prior knowledge (such as panel data). This problem can be fixed through the description by Aronsson, Blomquist, and Sacklen (1999). They argue that panel data or repeated cross-section data satisfies the problems that Manski (1992) lays out. With this method Aronsson et al (1999) explains that one can "separate preference variation across groups from preference interdependence if only cross-section data are available". This paper will take this into account. Thus, this paper will follow more closely to the methods of Aronsson et al (1999) by looking at cross sectional data. Additionally, there are other similar papers that deal with similar data structures.

Numerous existing papers deal with the topic of relative wage. Many of these deal with the relationship that it has with utility. However, this paper argues that less utility will create a response of more effort (as measured by more hours worked). McBride (2001) uses the General Social Survey and finds that a higher relative wage has a positive effect on utility. Similarly, Pérez-Asenjo (2010) finds that there is an inverse relationship between labor supply and relative income using the same data set. Both of these use cross-sectional data. Other papers use panel data which follows the guidelines laid out by Manski (1992). Neumark and Postlewaite (1998) use the National Longitudinal Survey of Youth to find that women joining the labor force decreases the reservation wage (the minimum wage someone is willing to work for) because utility is gained through common choices among stay at home mothers. Clark, Kristensen, and Westergard-Nielsen (2009) use the European Community Household Panel and find that there exists a posi-

tive correlation between a workers happiness and co-workers wage. Due to availability of data, this paper will use a data structure that is similar to McBride (2001) and Pérez-Asenjo (2010). However, in order to deal with the problem of interdependency of the data, this paper will use wage per hour to simulate income. The prior literature uses relative income as the explanatory variable. However, due to the more interdependent relationship between hours of work and income, it would make more sense to use a variable that is not so dependent on hours of work, specifically wage per hour. This will allow the paper to distance it from some of the interdependencies.

Papers examining this subject have found similar results. Neumark et al (1998), Pérez-Asenjo (2010), and McBride (2001) all have results that correspond with the hypothesis of this paper. Clark et al (2009) has a contrasting result though. Since increased wages of co-workers provides a signal of increased future earnings, one's relative wage (with co-workers as a reference group) is positively related to utility. To explain using the theory of Cole et al (1995), increased wages in a firm is an individual shock rather than an aggregate shock. This distinction is important because it illustrates how data in the paper is to be organized, specifically the reference groups. Clark et al (2009) results would indicate that co-workers are not the best reference group as there are other influences. Neumark et al (1998) conclude that friends and family could be used as reference groups. Pérez-Asenjo (2010) uses reference groups of age, gender, race, and religion. Furthermore, relative wage does not affect each group uniformly. Relative wages' effect is more concentrated on those with higher incomes and white males (McBride 2001), (Pérez-Asenjo 2010). This paper will expand on the reference groups used by prior papers. It will focus on geographic area in order to define the reference group. Luttmer (2005) uses geographical area to find a relationship between utility and relative income. Thus, this paper tests that relationship one step further.

The rest of the paper is organized as follows: Section II describes the data across the complete sample; Section III regresses the models and explains the findings of the effects on Relative Hours Worked, estimation results are presented and discussed here; finally, Section IV presents our conclusions. Tables and Figures can be found in the Appendix at the end of the paper.

II. Data/Methods

Data was collected from the Integrated Public Use Microdata Series (IPUMS) which has data collected from the United States Census and the American Community Survey. The data focuses on individuals with many variables specifically coded to a given person. It is not panel data which means that a year by year comparison cannot be made. This leads to problems as referenced by Manski (1993) above. However, this paper tries to remedy this in a number of ways. The uses of wage per hour being used to proxy income because wage per hour is unaffected by the amount of hours someone works, there is no interdependency problem as there would be with income. Another way the interdependency problem is combatted is by looking at results from multiple years. The survey results were collected for the years 2005, 2007, 2009, and 2011. These dates were chosen because they spread across a business cycle. By looking across multiple years of data, the results might provide additional strength if the coefficients have the same signs through different years.

Other variables are altered in order to allow better comparison and fit to the model. Rather than just using hours worked as the dependent variable, this paper will use Relative Hours Worked. This allows the magnitude of hours worked to be normalized between different reference groups. Now, a geographical region that works much more than average will not disproportionately affect the results. The reference groups used also differ from prior studies. It focuses on a geographic reference group. This is measured through the reported Metropolitan Statistical Area (MSA) of each observation. An

MSA is an area with a large center population with surrounding communities that rely economically on it . The number of MSAs provide an advantage of having a lot of different groups. Ideally, the geographical region would be smaller (such as a neighborhood or school district) but data availability necessitates that the wider MSA be used. For each of the relative variables (hours worked, wage per hour, and income), the variable will be calculated by dividing the variable by the average for the MSA and year in which they reside. Thus, someone who has the same wage per hour as the average in their MSA would have a Relative Wage per Hour of 1. If their relative Wage per hour is below the average, the Relative Wage per Hour would be between 0 and 1.

The main purpose of this paper is looking at how Relative Wage per Hour determines Relative Hours Worked. Other variables will be used as controls. One of these is Relative Income. Although this may seem redundant with Relative Wage per Hour, it helps control for the income of the person. Other demographic control variables are used as listed in Table 1 of the appendix. When all of this comes together, the final regression equation comes out to:

$$\text{Relative Hours Worked} = \beta 0 + \beta 1 * \text{Relative Wage per Hour} + \beta 2 * \text{Relative Income} + \beta 3 * \text{Age} + \beta 4 * \text{Female} + \beta 5 * \text{High school} + \beta 6 * \text{College} + \beta 7 * \text{Married} + e$$

This equation will be analyzed using OLS regression on STATA. This is the same method used as Pérez-Asenjo (2011). Expected values of all the variables are listed in Table 1 of the appendix. Consistent with literature, Relative Wage per Hour and Relative Income are expected to have a negative relationship with Relative Hours Worked. This is consistent with prior literature- Pérez-Asenjo (2011), McBride (2011), and Neumark et al (1998). The reason for this is people will give more effort towards work if their relative earnings are less than their reference group.

III. Results

Before any tests were run, transformations of the data were conducted. Dummy variables were created for gender (with a 1 indicating female), highest education finished (either high school or college), and marriage status. Next, a measure of ways to construct the relative variables for hours worked, income, and wage per hour were created . Consistent with McBride (2001) and Luttmer (2005), relative income was calculated by dividing the individuals' income by the average for the reference group (metropolitan statistical area). This process was repeated for hours worked and wage per hour. For example, someone who works 30 hours per week that lives in a metropolitan statistical area in which people work an average of 40 hours of week would have a relative hours of work of 0.75 (30/40). Cases in which reported income or hours worked were missing or zero were omitted in order to try to limit bias of the data. Additionally, there are four models, one for each year of data (2005, 2007, 2009, and 20110). The results are run this way because there is not expected to be a linear trend across the years.

The final regression equation is modified slightly from before. As explained earlier, hours worked is transformed into relative hours worked to be used as the dependent variable. This is done in order to make the values of relative income and relative wage more comparable. Thus, the final regression equation is:

$$\text{Relative Hours Worked} = \beta 0 + \beta 1 * \text{Relative Wage per Hour} + \beta 2 * \text{Relative Income} + \beta 3 * \text{Age} + \beta 4 * \text{Female} + \beta 5 * \text{High school} + \beta 6 * \text{College} + \beta 7 * \text{Married} + e$$

The results of all the regressions are shown in Table 4 of the appendix. Relative Wage per Hour had significant results to the .01 level in all four models. Respectively, the coefficients are -0.0337, -0.0216, -0.0167, and -0.0172 for the respective models. The negative sign was expected. This sign means that as ones relative wage per hour increases, that person will work less

compared to their reference group. In real terms, using the 2005 coefficient, if one's Relative Wage per Hour increased from one to two (the person's wage doubles relative to the reference group), that person's Relative Hours Worked would decrease by about 3.3% of the average work hours in the person's metropolitan statistical area. Thus, in a metropolitan statistical area in which the average worker works 40 hours per week, the person would work 1.35 more hours per week. This magnitude is not that great. This indicates that while Relative Wage per Hour has a significant impact, the effect is not that large. This could be because people do not have a complete choice on how many hours that they work. Additionally, this scale favors those whose wage is closer to the average. This is because one's wage per hour does not have to increase as much for Relative Wage per Hour to increase as one's wage per hour gets further from the relative position (assuming the effect of someone's wage per hour change has a negligible effect on the average). The magnitude of the coefficients was greatest during 2005 and 2007. In 2005, the magnitude was 202% greater than 2009.

Relative Income had unexpected results. All the coefficients for relative income are significant (at the .01 level) and positive with respective values of 0.1693, 0.1582, 0.1724, and 0.1897. It was hypothesized that this variable would have a negative relationship with relative hours worked. A reason for this could be that people who work more generally have larger incomes.

The control variables had their predicted signs. Age was positive and significant in all four models with coefficients of 0.0009, 0.0011, 0.0011, and 0.0011 respectively. As people get older, they tend to work more. However, the low coefficient of age would indicate that it is not very important. The relationship between gender and relative hours worked was much stronger. For all four models, being female lowers ones relative hours worked by -0.1468, -0.1504, -0.1401, and -0.1513 respectively (with all garnering significant results at the .01 level). This can be explained because Neumark et al (1998) state that females tend to work less than males (at least in the formal labor market). Higher education also has a negative effect on relative hours worked. Both high school and college education had negative and significant coefficients. High school education has coefficients of -0.0522, -0.0423, -0.0402, and -0.0467, respectively for each model. Similarly college education has coefficients of -0.0474, -0.0393, -0.0349, and -0.0572. As one's education increases, there might not be as much of a need to work as constantly in order to subsist. Marriage had a positive and significant coefficient in all four models. A person's relative hours worked increases 0.0490, 0.0549, 0.0600, and 0.0702 with marriage, respectively for each year. Someone that is married often has more people that rely on their income. Thus they must work more.

The overall goodness of fit variables is not as high as the statistical significance of the variables would suggest. A reason for this is due to the large number of observations for each model; it is not difficult to find a significant relationship between variables. The R2 values are 0.1937, 0.1845, 0.1924, and 0.1943 for each of the respective models. The R2 term is given instead of adjusted R2 because robust standard errors are used. Thus, the F-statistic is probably more meaningful to look at to determine if the coefficients do a good job of explaining the dependent variable as a whole. As shown in Table 4, the F-statistic values, 24098.13, and 24528.28, and 24165.04, and 24906.39, show that the models do a good job overall of explaining usual hours worked.

Due to the nature of the data, the regression is susceptible to heteroscedasticity. The Breusch-Pagan Test for homoscedasticity was run. For each model, we failed to reject h0 of no heteroscedasticity. As shown in Table 3, the $\chi 2$ value was 569987.51, 191796.47, 180632.95, and 210220.45 for each of the models. As a result of this, the regressions are run using robust standard errors.

IV. Conclusions

Data was collected from the Integrated Public Use Microdata Series. It came from the American Community Survey was collected for years 2005, 2007, 2009, and 2011. The cross sectional structure of the data was similar to prior work done by McBride (2001) and Pérez-Asejo (2011). The model was run using Ordinary Least Squares with robust standard errors (since Breusch-Pagan Test failed to reject the h0 of heteroscedasticity).

This study expands on prior literature by using a slightly different explanatory variable of Relative Hours Worked. By describing hours worked as a proportion of average hours worked, this study avoids bias that comes from the different structures across reference groups. The slightly different methodology however still gets the similar results to prior literature. Furthermore, running a different regression for each year shows how the relationship might change depending on the business cycle. The magnitude of the effect of relative wage per hour was significantly less during the recession (2009). Prior literature does not show how relative income may change over time.

As compared with prior papers of McBride (2001) and Pérez-Asejo (2011), this study uses Relative Wage per Hour in order to avoid problems of interdependency. Wage per hour is not affected by usual hours worked. As one works more hours, their income will increase but their wage per hour will remain constant. As predicted, Relative Wage per Hour has a negative relationship with Relative Hours Worked. The sign for this variable (negative) was consistent throughout all four models. These results largely confirm existing literature.

Luttmer (2005) uses geographic areas as reference groups to find a negative association between relative income and utility. Although the independent variable is different, someone that has less utility as a result of lower relative income might work more to change that. This is strengthened by the results of Pérez-Asejo (2011) who finds that there is a negative correlation between relative income and hours worked. Studies by Neumark and Postlewaite (1998) and McBride (2001) also find results that follow this trend. However, the result of a positive relationship of relative income and relative hours worked is different than the prior literature.

Consistent signs are also found with many of the control variables. A negative relationship with relative hours worked is found (with significant results) for Female, High School, and College. The social implications for negative values of high school and college are interesting because it means that higher educated people are working less than those with less education. Thus, the people with less human capital put in more hours. A positive relationship with relative hours worked is found (with significant results) for relative income, age, and marriage status.

This study has a variety of different policy applications. The government could take this into account when dealing with redistributive taxes. Redistributive taxes affect the relative income of a group. Thus, the relative relationship is affected. This means that besides the redistribution of income, work effort might change. This is something that would need to be taken into account. Furthermore, this study could help firms decide competitive wages of individuals. An individual's labor supply schedule is not solely determined by the individual's needs but also by rank within a reference group. Thus, a firm needs to take wages outside the company into account in order to get the highest productivity out of workers.

This research could be expanded by refining the reference group to smaller geographic areas, such as neighborhood or school district. This might allow for the results to show the effects from immediate acquaintances. Another way this could be expanded would be by using panel data. This could indicate how a person responds to impacts in the reference group. Another expan-

sion could look at how these relationships change during periods of expansions and recessions.

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Appendix

Table 1a: Descriptive Statistics: 2005

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
+ Age	1,542,367	41.8847	14.1531	16	95
- Female	1,542,367	.4802	.4996	0	1
- High School	1,542,367	.4393	.4963	0	1
- College	1,542,367	.5305	.4991	0	1
+ Married	1,542,367	.5762	.4942	0	1
				3.13E-	
- Relative Wage per Hour	1,436,426	1	2.2512	05	973.938
				7.22E-	
- Relative Income	1,436,426	1	1.1140	05	21.47168

Table 1b: Descriptive Statistics: 2007

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
+ Age	1,604,055	41.8926	14.4583	16	95
- Female	1,604,055	.4780	.4995	0	1
- High School	1,604,055	.4326	.4954	0	1
- College	1,604,055	.5376	.4986	0	1
+ Married	1,604,055	.5601	.4964	0	1
				4.84E-	
- Relative Wage per Hour	1,496,561	1	2.8517	05	1189.74
				7.41E-	
- Relative Income	1,496,561	1	1.1486	05	21.26528

Table 1c: Descriptive Statistics: 2009

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
+ Age	1,587,858	42.5015	14.5330	16	95
- Female	1,587,858	.4813	.4997	0	1
- High School	1,587,858	.4094	.4917	0	1
- College	1,587,858	.5604	.4963	0	1
+ Married	1,587,858	.5585	.4966	0	1
				4.08E-	
- Relative Wage per Hour	1,484,747	1	3.4978	05	1660.408
				6.34E-	
- Relative Income	1,484,747	1	1.1346	05	19.6085

Table 1d: Descriptive Statistics: 2011

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
+ Age	1,553,049	42.7653	14.8193	16	95
- Female	1,553,049	.4811	.4996	0	1
- High School	1,553,049	.4049	.4909	0	1
- College	1,553,049	.5642	.4959	0	1
+ Married	1,553,049	.5352	.4988	0	1
				4.023E-	
- Relative Wage per Hour	1,452,286	1	3.6424	05	2089.761
				6.03E-	
- Relative Income	1,452,286	1	1.1433	05	17.68726

Table 2: Breush-Pagan Test

Variable	2005	2007	2009	2011
X^2	569,987.5	191,765.5	180,633	210,220.5

Table 3: Dependent Variable: Relative Hours Worked

	2005	2007	2009	2011
Relative Wage per Hour	-0.0337*** (-6.23)	-0.0216*** (-5.96)	-0.0167*** (-4.83)	-0.0172*** (-4.16)
Age	0.0009*** (22.15)	0.0011*** (29.95)	0.0011*** (27.74)	0.0011*** (26.65)
Female	-.01468*** (-182.11)	-0.1504*** (-192.78)	-0.1401*** (-176.8)	-0.1513*** (-172.09)
High School	-0.0522*** (-23.2)	-0.0423*** (-18.77)	-0.0402*** (-17.32)	-0.0467*** (-18.22)
College	-0.0474*** (-20.49)	-0.0393*** (-17.11)	-0.0349*** (-14.79)	-0.0572*** (-21.9)
Married	-0.0490*** (61.63)	0.0549*** (67.91)	0.0600*** (72.51)	0.0702*** (76.5)
Relative Income	0.1693*** (43.85)	0.1582*** (59.28)	0.1724*** (69.02)	0.1897*** (65.73)
Sample Size	1,436,426	1,496,561	1,484,747	1,452,286
R Sqaured	0.1937	0.1845	0.1924	0.1943
F-Statistic	24098.13	24528.28	24165.04	24906.39

Values in parenthesis are t-statistics.
* Indicated significance at the .10 level
** Indicates significance at the .05 level
*** Indicates significance at the .01 level
Source: ipums.org