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Determining the Effect of the Minimum Wage on Income Inequality

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Abstract

Many recent studies have shown a significant increase to income inequality since the 1980s. One of the proposed methods for fixing this trend is to increase the minimum wage, since this policy would help those at the low end of the income spectrum to see economic growth. To analyze the effectiveness of this policy, we studied data from countries that are part of the Organization for Economic Development and Cooperation. By forming an econometric model to account for many factors that affect income inequality in nations around the world, including the real value of the minimum wage, we can determine the relationship and provide recommendations for future policy. We conclude that increases to the minimum wage can cause a decrease to income inequality until the minimum wage exceeds a maximum effectiveness value, at which point the effect starts to reverse itself. [*excerpt*]

Keywords

Minimum Wage, Income Inequality

Disciplines

Economics | Income Distribution | Inequality and Stratification | International and Area Studies | International Economics | Labor Economics

Comments

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I. Introduction

This paper will focus on the relationship between the minimum wages and income inequality in nations that are members of the Organization for Economic Co-operation and Development (OECD). Throughout these developed nations, the federally mandated minimum wage varies relative to the median hourly earnings, from Hungary, which in 2010 had a minimum wage equal to 21% of the median hourly earnings, to France, which in the same year had a minimum wage equal to 61% of the median hourly earnings.[1] Since minimum wage laws raise the wages for workers at the low end of the income spectrum, this variance would suggest that changes in the minimum wage throughout different nations alters income inequality. We will explain this association more in the next section, but the main theories are the redistribution theory, where the minimum wage takes money from other parts of the economy and gives it to the low-income workers, and the marginal productivity theory of wage inequality, where the minimum wage raises the wages of low-skilled workers, thereby altering the labor markets for low-skilled and lowest-skilled workers.

But why do we care about income inequality? Since 1979, the wealthiest 0.1 percent of Americans have received 20 percent of all increases in incomes.[2] This signals a massive growth in the economy for a small number of people, while the majority of the population is suffering from very little, if any, growth in their incomes. By studying the effect of policies such as the minimum wage on income inequality, we will be able to provide policy analysis on a program designed to help grow the incomes of the low-end of the distribution and possibly provide

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[1] Based on OECD data on the minimum wage and median income, assuming a 40-hour workweek with 50 weeks per year.
[2] Williams, David L. 2014. "Should we care about inequality? Let's ask a philosopher." *The Washington Post*.

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suggestions for improving the policy. This will lead to economic growth for those struggling the most in the current economy, and improve their quality of life.

A main importance of our research is that it will be focusing on countries within the OECD. The reason for this is that all of the countries within this group are considered developed nations and therefore changes to economic policies affect them in similar ways. This will therefore provide significant policy implications, since we will be able to see how changes to labor laws affect the macroeconomy by comparing many countries that have similar economies. This will be able to show us how well certain countries are handling the issue of inequality by adjusting their minimum wages. Overall, the study of OECD nations will help us analyze how developed economies are affected by changes in the minimum wage and allow us to provide policy suggestions pertaining to it.

This paper will empirically address the question of how varying minimum wage across OECD nations affect income inequality. Section II will further develop the theories connecting the minimum wage to income inequality and review previous empirical work testing this relationship. Section III will develop the model being used in this paper, including looking at the theories behind other factors that affect income inequality. Section IV will discuss our data collection. Section V will present our results with empirical analysis. Finally, section VI will discuss conclusions and policy implications.

II. Literature Review

Theory Review

Freeman (1996) presents the redistribution theory, which discusses how the minimum wage shifts the earning distribution towards the lower end through three mechanisms. The first mechanism is the consumers of products made by minimum wage employees. The minimum

wage increases the cost of production of these goods and services, which in turn increases their prices.[3] Therefore the wage of the low-wage workers is increasing while the purchasing power of other people's income decrease, thereby altering equality. The corporations that hire minimum wage workers are the second mechanism used in the redistribution theory, specifically through the stakeholders. By increasing the wages of the workers, profits decrease due to the increased cost of production. Lowered profits thereby decreases the income of the stakeholders, usually at the higher end of the wage distribution, while the increased minimum wage raises the incomes of the low wage workers.[4] The final mechanism for the minimum wage affecting the wage distribution through the redistribution theory is through workers who lose their jobs due to the increased wage. Basic economic theory shows that in a perfectly competitive labor market, the minimum wage acts as a price floor, thereby creating unemployment.[5] Some low-wage workers are paying for the minimum wage increase. Using this mechanism, increases to the minimum wage decrease the wages of low-wage workers due to the unemployment, and income inequality would become larger. An important note about this mechanism is that there are multiple studies that provide evidence that the minimum wage does not decrease employment; with some studies showing employment increases after the minimum wage was raised.[6] These three mechanisms show the relationship between the minimum wage and income inequality through redistribution.

The marginal productivity theory of wage inequality states that wage disparity is caused by disparities in skill level. Higher skilled people have higher wages while lower skilled people

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[3] Freeman, Richard. 1996. "The Minimum Wage as a Redistributive Tool." *The Economic Journal* 106 (May): 640.
[4] Ibid., 641.
[5] Adams, Scott and David Neumark, 2003, "Living Wage Effects: New and Improved Evidence," *NBER Working Papers* no. 9702: 2.
[6] Card, David and Alan B. Krueger, 1995, "How the Minimum Wage Affects the Distribution of Wages, the Distribution of Family Earnings, and Poverty," Chap. 9, In *Myth and Measurement*, Princeton, NJ: Princeton University Press, 276-9.

have lower wages. The connection between the minimum wage and inequality using the marginal productivity theory relies on there being three separate levels of ability, high ability, low ability, and lowest ability. The low ability workers are the ones who earn the minimum wage (including those who would be affected by increases to the minimum wage).[7] High ability workers are those who earn above the minimum wage and lowest ability workers are those in the uncovered sectors that earn below the minimum wage. Most importantly, wage inequality looks at the comparison between the lowest ability workers and the high ability workers. Again, this theory provides three main explanations. The first explanation relates to work in the covered sectors becoming more attractive when the minimum wage is increased. As labor-force participation in the covered sector increases, the labor-force participation rate in the uncovered sector decreases. This drop in labor supply causes the wage in the uncovered sector to increase.[8] With the increase to the wage of the lowest skilled workers without an increase to high-skilled workers, inequality decreases. The increase to the minimum wage could also have negative effects on wage equality. If the minimum wage creates excess labor supply with people trying to move out of the uncovered sector and entering the labor force, disemployment effects in the covered sector cause a flood of labor supply into the uncovered sector, which lowers the wage in the uncovered sector.[9] In this instance, the wage of the lowest-skilled workers decrease relative to the high skilled, thereby increasing inequality. Finally, the minimum wage increase could result in an excess of labor supply in the covered sectors, but the wage in the uncovered sector is below the lowest acceptable wage of the workers who become unemployed.[10] This could lower

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[7] Borjas, 2013, *Labor Economics*, 304.
[8] Rima, Ingrid H., 1981, Labor Markets, Wages, and Employment: An Introduction to Labor Economies, New York, NY: W. W. Norton & Company, Inc.: 321.
[9] Ibid., 321.
[10] Ibid., 321-2.

the labor supply in the uncovered sector, thereby raising the wage of the lowest skilled workers and decrease inequality.

Finally, we will be looking into the idea of the minimum wage having a quadratic relationship with income inequality. The main theory behind including this term is based on the findings of Autor, Manning, and Smith (2014), who used the quadratic term to capture the affects of the minimum wages in areas where it acts as a more binding price floor due to differing labor market conditions. The theory is that the minimum wage is more effective when the price floor is binding, since when the minimum wage is too low, it will not have the same effect on income inequality as it does when the minimum wage is much higher.[11] The quadratic term will allow us to show that small increases to the minimum wage will alter income inequality at a different rate than large changes. The quadratic will possibly be able to provide us with a maximum effectiveness value, since if the previous theories are correct, there will eventually be a disemployment effect caused by increases to the minimum wage. Therefore, we can hypothesize that there is a point at which the minimum wage no longer lowers income inequality, and instead starts to increase it due to the disemployment effects.

Empirical Review

The connection between the minimum wage and income inequality is a topic that has been looked at from multiple angles over the last two decades. DiNardo, Fortin, and Lemieux (1996) looked at the decline in the real value of the minimum wage from 1979-1988 and saw how this affected wage differentials between multiple pairings of different percentile wages. This study started by analyzing kernel density functions of hourly wages in order to observe the wage distribution. An important discovery noted is that for many years, the observed

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[11] Autor, David, Alan Manning, and Christopher L. Smith, 2014, "The Contribution of the Minimum Wage to U.S. Wage Inequality Over Three Decades: A Reassessment," *NBER Working Papers* (16533): 7-8.

distribution has large amount of clustered data points around the value of the minimum wage.[12] DiNardo et al. then continued to analyze these distributions in order to explain the effects of declining real minimum wages on different wage differentials through this time period. The differentials that were the most affected by the falling value of the real minimum wage were the ones between the 10th and 90th percentiles and the 10th and 50th percentiles. They found that just for the wage differentials in men, the 27 percent decline in the real value of the minimum wage "explains 25 percent of the change in the 10-90 differential [and] 66 percent of the change in the 10-50 differential."[13] These values are even greater when looking at the results presented about women. DiNardo et al. show how changes to the real value of the minimum wage can affect wage differentials between high-income and low-income workers.

Card and Krueger (1995) also present another important study finding the relationship between the minimum wage and inequality in their book, *Myth and Measurement*. After briefly mentioning that recent labor market data gives no support to the standard economic theory that discusses the disemployment effects of the minimum wage, Card and Krueger show how increases in the federal minimum wage halt and temporarily reverse the trend of growing income inequality in the United Sates over the last 30 years.[14] The effects are only temporary, since in years after the minimum wage increases, inequality continues to rise again. Card and Krueger also warn that these changes to the level of inequality are small since these increases tend to only increase the incomes of the lowest-paid workers by a fairly small amount, usually around 10-15 percent.[15] Therefore the effects tend to seem small, although they are statistically significant.

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[12] DiNardo, John, Nicole M. Fortin, and Thomas Lemieux, 1996, "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach," *Econometrica* 64 (5): 1002.
[13] Ibid., 1014 and 1030
[14] Card and Krueger, 1995, "How the Minimum Wage Affects the Distribution of Wages," 276-9.
[15] Ibid., 277

Wu, Perloff, and Golan (2006) did another study looking at the effects of a wide range of government policies on income inequality, primarily looking at the different effects of the policies on urban versus rural populations. Instead of only looking at wage differentials, Wu et al. used four measures of inequality, including the Atkinson index, the Gini index, coefficient of variation of income, and the relative mean deviation of income.[16] Other than the minimum wage, this study looks at different tax policies and welfare systems in the United States and builds a model using panel data for the 50 states between 1981-1997.[17] Important variables included in Wu et al.'s model are the GDP and Unemployment rate for each state to account for macroeconomic conditions.[18] The results shown by this study pertaining to the minimum wage contradict the study done by Card and Krueger (1995), since in urban areas, increases in the minimum wage create disemployment effects, mostly for workers from low-income families. The hypothesis presented for this is that the minimum wage is not means tested, so a large portion of minimum wage workers are teenagers from well-off families. Wu et al. find that the teenagers disproportionately are able to keep their jobs while workers who rely on the minimum wage job suffer from the disemployment.[19] The results are very different in urban areas, since the minimum wage is shown to have no statistically significant effect on income inequality.[20] Therefore, we will include data in our analysis to control for how much of the population lives in urban areas.

Again looking at multiple labor market institutions simultaneously, Koeniger, Leonardi, and Nuniata (2007) analyze data from eleven OECD countries to see how different laws and

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[16] Wu, Ximing, Jeffrey M. Perloff, and Amos Golan, 2006, "Effects of Government Policies on Urban and Rural Income Inequality," *Review of Income and Wealth* 52 (2): 213.
[17] Ibid., 214-6.
[18] Ibid., 217.
[19] Ibid., 226.
[20] Ibid., 231.

regulations, such as the minimum wage, affect inequality. This paper provides a model for comparing multiple countries within the developed world. An important note made by the authors is that developed economies are fairly well connected in many aspects; therefore changes in inequality are likely to be caused by changes in country-specific institutions, such as the minimum wage.[21] Koeniger et al. use a feasible fixed-effects GLS estimator to determine the effects of these institutions on the wage differential of the 90th and 10th percentiles.[22] Their estimation results show that the minimum wage has a highly statistically significant negative relationship with income inequality.[23] By also looking at the 90-50 and 50-10 wage differentials, Koeniger et al. are able to see if there are altering effects of these institutions on the upper part and lower part of the wage distribution. For many of the institutions however, including the minimum wage, both halves of the distribution are affected similarly.[24] Therefore we can see that labor market institutions that seemingly only affect those at the lower end of the income distribution actually affect the entire economy.

Our research will provide new information to the literature since there has not been a lot of research done on a transnational level, and what has been done looks mostly at the effect of microeconomic factors on income inequality. Koeniger et al. (2007) approached their analysis from the assumption that many of the macroeconomic forces between OECD countries were fairly standard (and fairly well connected to one another) so their analysis only focused on the institutions that varied between countries. By developing a model that looks at transnational affects of minimum wages on income inequality, taking into account the different macroeconomic theories, we are better able to analyze this one specific institution.

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[21] Koeniger, Winfried, Marco Leonardi, and Luca Nunziata, 2007, "Labor Market Institutions and Wage Inequality," *Industrial and Labor Relations Review* 60 (3): 340.
[22] Ibid., 342.
[23] Ibid., 344.
[24] Ibid., 347.

III. Modeling

In order to test the relationship between the minimum wage and the inequality, we will be using the following model.

$$Gini_{it} = \beta_0 + \beta_1 MW_{it} + \beta_2 MW_{it}^2 + \beta_3 Coll_{it} + \beta_4 Manu_{it} + \beta_5 Union_{it} + \beta_6 Trade_{it}$$
$$+ \beta_7 Growth_{it} + \beta_8 Urban_{it} + u_{it}$$

The dependent variable *Gini* is the Gini coefficient and the main independent variables are *MW* and MW^2, which are the minimum wage and the squared minimum wage respectively. The control variables being used are the percent of the population with a college degree, *Coll*, will be used as a proxy for the human capital theory, the percent of the population working in manufacturing sector, *Manu*, to measure the size of the manufacturing sector, the percent of the population in unions, *Union*, is to measure the affect of unions on income inequality, merchandise trade as a percentage of GDP, *Trade*, is being used to measure the amount of international trade, the economic growth rate, *Growth*, to account for macroeconomic trends in each country, and finally, the percentage of people who live in urban areas, *Urban*, to account for the findings of Wu et al. (2006), which showed that the minimum wage had different effects on urban versus rural populations. Also u is the error term, and *i* as a subscript represents the different countries of the observations while *t* as a subscript represents the different years of the observations.

In developing this model to test the relationship between the minimum wage and income inequality, we look at the different theories of what causes income inequality, all of which focus on the relationship between the labor market for skilled and unskilled labor. The first theory relates to the amount of people receiving college degrees. The human capital theory states that people increase their future earnings by forgoing current earnings and spending money on their

education.[25] The market for college-educated workers represents the market for skilled workers, since receiving a college education signals a higher skill level to employers.[26] Therefore, increases to the supply for college-educated workers decreases the price of skilled workers, thereby decreasing income inequality.[27] We thereby hypothesize a negative relationship between the amount of the population with college degrees and income inequality. Related to the human capital theory is the idea that immigration is related to income inequality. Immigration tends to be less educated, and therefore look for jobs in the unskilled labor market.[28] Countries with higher levels of immigration would see an increase in supply of unskilled workers, which would cause unskilled wages to decrease. Therefore we hypothesize that increases in immigrant populations within a country would lead to an increase in inequality through the increase of workers with lower levels of education. The final aspect of human capital theory that affects income inequality is technological growth. Bound and Johnson (1992) empirically looked at the effect of technological changes on inequality along with other factors. Their conclusion was that the many factors have caused increased inequality, but the "computer revolution" and rapid growth in technology has had the most prominent effect.[29] Increased technological growth requires higher levels of education, which would create higher demand for skilled workers, causing inequality to rise. From all of these factors, we can hypothesize that changes in human capital have a strong affect on income inequality.

Another main theory behind the increased income inequality is the shift away from manufacturing jobs, which has led to a decrease in unionization. Since industrial manufacturing

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[25] Murphy, Kevin M. and Finis Welch, 1989, "Wage Premiums for College Graduates: Recent Growth and Possibly Explanations," *American Education Research Association* 18 (4): 17.
[26] Juhn, Chinhui, Kevin M. Murphy, and Brooks Pierce, 1993, "Wage Inequality and the Rise in Returns to Skill," *Journal of Political Economy* 101 (3): 411-2.
[27] Mincer, Jacob, 1991, "Human Capital, Technology, and the Wage Structure: What do Time Series show," *NBER Working Papers* (3581): 1.
[28] Borjas, George J, 2013, *Labor Economics*, Sixth ed. New York, NY: McGraw-Hill Irwin: 300
[29] Bound and Johnson, 1992, "Changes in the Structure of Wages," 371.

jobs were higher paying jobs for unskilled workers, a decrease in the manufacturing sector jobs would lead to unskilled workers looking for jobs in service industries, which are usually do not pay as much. [30] Increased demand for unskilled service jobs combined lowers wages for unskilled workers, thereby increasing inequality. [31] The decrease in manufacturing jobs has also caused unionization rates to fall. Since unions are one of the main tools used to raise the earnings of unskilled workers, decreases in unionization should increase inequality. [32] Freeman (1993) found that decreased unionization has increased inequality, although the effects have been fairly minimal. Overall, we hypothesize that lower supplies of manufacturing jobs will increase income inequality though increased demand for unskilled service jobs and lower unionization rates.

Increases to international trade are related to the sectorial shifts away from manufacturing jobs in many developed countries. [33] Since wages for manufacturing jobs are cheaper in developing countries, increases in international trade has caused many of these jobs to move overseas, thereby causing part of the shift away from manufacturing sectors in developed countries. Murphy and Welch (1991) found that trade actually has two effects on the labor market. The first one is the composition effect, where the increased imports reduce demand in the industry. The second effect is the scale effect, where "increases in import deficits increase

[30] Blackburn, McKinley L., David E. Bloom, and Richard B. Freeman, 1990, "The Declining Economic Position of Less Skilled American Men," Chap. 2, In *A Future of Lousy Jobs?*, edited by Gary Burtless, 31-76, Washington, D.C.: The Brookings Institution, 42.

[31] Katz, Lawrence F. and Kevin M. Murphy, 1992, "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," *The Quarterly Journal of Economics* 107 (1): 54.

[32] Freeman, Richard B, 1993, "How Much has De-Unionization Contributed to the Rise in Male Earnings Inequality," Chap. 4, In *Uneven Tides: Rising Inequality in America*, edited by Sheldon Danzinger and Peter Gottschalk, 133-163. New York, NY: Russell Sage Foundation, 133.

[33] Bound, John and George Johnson, 1992, "Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations," *The American Economic Review* 82 (3): 371; and Katz and Murphy, 1992, "Changes in Relative Wages," 36.

demand due to the effect of the increasing aggregate spending."[34] From these previous findings, we hypothesize that trade does not directly affect income inequality, but instead affects the size of the manufacturing sector, which then affects inequality.

The theories presented have led to many testable hypotheses that help us develop our model to discover how the minimum wage affects income inequality, using college education, manufacturing sector size, unionization rates, technology, international trade, and immigration as control variables. We then must determine how the minimum wage affects income inequality, which relies on multiple factors. The first factor is the coverage rate of the minimum wage. Marginal productivity theory relies on there being a large uncovered sector, or at least large enough to have a measurable effect on the economy. Since many OECD countries have minimum wages that cover almost all of the population, the minimum wage increases should not lead to a change in the wages for uncovered workers at a significant enough level to affect income inequality. This leads to the redistribution theory being prevalent. Within the three mechanisms discussed earlier, we tend to see an order to how they take affect. The simplest way to pay for an increase to the minimum wage is through decreases in profits and salaries of higher-level employees and executives. Notably, the salaries of employees will most likely not actually decrease, but will simply not grow as quickly as the minimum wage increase. Through this mechanism, the wages of workers at the lower end of the income spectrum would increase relative to those at the higher end, thereby decreasing inequality. The second step in the redistribution theory would be to increase prices to pay for the minimum wage, thereby affecting consumers' purchasing power. This would also be seen more in smaller companies that have a harder time decreasing profits and salaries. Again, by increasing the income of low-wage

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[34] Murphy, Kevin M. and Finis Welch, 1991, "Role of International Trade in Wage Differentials," Chap. 2, In *Workers and their Wages: Changing Patterns in the United States*, edited by Marvin H. Kosters, 39-76, Washington, D.C.: The AEI Press,, 62.

workers, we expect to find decreases in inequality. Finally, we hypothesize that the last step in the process would be to lay off workers earning the minimum wage. This hypothesis is based on the previous research presented by Card and Krueger (1995), which showed that increases to the minimum wage do not decrease employment. We do believe that there could be a level of the minimum wage where disemployment effects are observed, even though this was not the case in the Card and Krueger's research. If this is true, then we expect to see a nonlinear relationship between the minimum wage and income inequality.

The small caveat to the theory presented here, is that it relies on the research of Card and Krueger (1995), which found the labor market for unskilled workers in the United States to not be competitive enough for there to be disemployment effects of raising the minimum wage. Neumark and Wascher (2004) however show this relationship to be dependent on the structure of the labor market, specifically related to labor standards and employment protections.[35] Higher standards and protections lead to structural changes in the labor markets between countries that cause more competitive labor markets for unskilled workers. With higher levels of competition, the minimum wage will start to act as a price floor, leading to increased disemployment. Neumark and Wascher (2004) do state that the United States is on the lower end of the spectrum (within OECD nations) as far as labor standards and employment protections are concerned, and therefore, the findings by Card and Krueger (1995) fit their results.

IV. Data

The data for this research will be collected from the World Bank and OECD database for 17 of the 34 OECD nations over the time period of 1980-2010. We are only using half of the countries in the OECD since the data sets being used do not offer enough full data points for the

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[35] Neumark, David and William Wascher, 2004, "Minimum Wages, Labor Market Institutions, and Youth Employment: A Cross-National Analysis," *Industrial & Labor Relations Review* 57 (2): 241.

other half of the countries, including missing data values for the Gini coefficient and the minimum wage. An important note is that countries are being excluded based on the fact that neither of these databases have full information for every country in every year being studied and that this exclusion has no relationship to how the minimum wage and the other control factors affect income inequality. This time period was chosen since many previous studies have seen the growth of income inequality since 1980.[36] The World Bank database was used for the data on the variables *Coll*, *Manu*, *Trade,* and *Urban*. The OECD database was used for the variables *Gini*, *MW*, *Union,* and *Growth*. The reason for the use of different databases is simply that the organizations gather data for different variables, so we used the database that had the information we needed. Summary statistics of the data are shown in table 1.

Table 1: Summary Statistics

Variable Name	Mean	Standard Deviation	Min	Max
Gini	0.31	0.0357	0.25	0.38
Minimum Wage	6.57	3.52	0.99	14.82
College Degree	61.09	16.78	10.22	97.09
Manufacturing Sector	26.63	6.07	12.6	41.5
Merchandise Trade	67.05	43.22	13.07	180.38
Union Population	22. 32	11.48	7.05	54.91
Growth	4.95	3.58	-10.11	15.60
Urban Population	74.39	9.59	54.685	97.64

N=162

The main hypothesis for this model is that the minimum wage will help reduce wage inequality. Although the marginal productivity theory of inequality is ambiguous about the relationship present, the redistribution theory strongly supports this hypothesis. Two of the three mechanisms predict the minimum wage to reduce inequality. The third mechanism, the minimum wage being paid for by other low-wage workers losing their jobs, would increase inequality, but there is significant previous research that contradicts this mechanism. Our other

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[36] Bound and Johnson, 1992, "Changes in the Structure of Wages in the 1980s," 371.

hypotheses, which were mentioned in the modeling section, pertain to our a priori expectation for the control variables.

V. Empirical Analysis

We start our analysis by looking at our data for any specification errors. Since we are only able to use data values where we have data for every variable, the data set is a fairly unbalanced panel. Over the 30-year timespan, none of these countries are able to provide full data points for every year. Therefore we run into the issue of one country only having 4 usable data points, while another country has 29 usable data points. The average number of usable values is 10. In addition to looking at the balance of the data set, we tested for first-order autocorrelation and heteroskedasticity. We used the Wooldridge test for autocorrelation in panel data and the likelihood-ratio test. Finally, after running our panel regression for both fixed effects and random effects we performed the Hausman specification test. Results for all of these tests can be found in table 2.

Table 2: Test Results

Test Type	Null Hypothesis	Test Statistic	P-value
Wooldridge test	No first-order autocorrelation	$F = 13.994$	Prob>F= 0.0022
Likelihood-ratio test	GLS model is nested in uncorrelated heteroskedastic error structure model	$Chi^2 = 128.52$	Prob>Chi^2= 0.972
Hausman test	Difference in coefficients is not symmetric	$Chi^2 = 26.68$	Prob>Chi^2= 0.0008

From these statistics, we see very strong results that suggest there is not heteroskedasticity, but unfortunately we also see strong results that suggest there is first-order autocorrelation. To correct for this error we will be including a feasible generalized least squares model in our regression results in table 3. Finally, from the Hausman test, we see that the fixed effects panel regression model will give us a better representation of our data.

Our regression using the model presented provides results shown in table 3. The four types of models shown are a pooled-data ordinary least squares regression, a fixed effects panel regression, a random effects panel regression, and a feasible generalized least squares regression that controls for first-order autocorrelation.

Table 3: Regression Results

Gini Coefficient	OLS	FE	RE	FGLS
Minimum Wage	-0.00812**	-0.0169**	-0.0118**	-0.0158****
	(0.00338)	(0.00596)	(0.00495)	(0.00351)
Minimum Wage^2	0.000296	0.000709**	0.000444*	0.000671****
	(0.000213)	(0.000309)	(0.000265)	(0.000185)
College Degree	0.000372**	-0.000385***	-0.000361**	-0.000376***
	(0.000164)	(0.000129)	(0.000162)	(0.000125)
Manufacturing Sector	-0.00279****	-0.00402****	-0.00398****	-0.00340****
	(0.000488)	(0.00104)	(0.000902)	(0.000670)
Merchandise Trade	-0.000465****	0.000044	-0.000155*	-0.00000621
	(0.0000521)	(0.000145)	(0.0000904)	(0.000108)
Union Population	0.0000661	-0.000524*	-0.000633***	-0.000539*
	(0.000238)	(0.000260)	(0.000219)	(0.000282)
Growth	0.000834*	0.000417	0.000618	0.000245
	(0.000491)	(0.000401)	(0.000386)	(0.000262)
Urban Population	-0.000331	-0.00105	-0.000517	-0.000674
	(0.000255)	(0.000714)	(0.000546)	(0.000636)
Constant	0.452****	0.60****	0.550****	0.602****
	(0.0301)	(0.0809)	(0.0610)	(0.0632)

*$p<0.1$ **$p<0.05$ ***$p<0.01$ ****$p<0.001$*

Since we stated earlier that there area errors related to auto-correlation, our discussion will be related to the results found in that model. Starting by looking at our control variables, we see that the human capital theory, represented by the percentage of the population with a college degree has a significant negative relationship with the minimum wage, which meets our a priori expectations. Our expectations about the size of the manufacturing sector were also correct, since the decrease in manufacturing sector jobs has led to an increase in income inequality. Although the size of the union population is not as significant as other factors, we can explain this by looking at our original hypothesized theory, which stated unionization rates affecting

income inequality through the manufacturing sector. This also explains the insignificance of the trade coefficient, since we hypothesized that trade's effect on income inequality is mostly seen through the changes in the manufacturing sector. Finally, growth and urban population were only to control for factors that were discussed in previous empirical literature, so it is not surprising that those results are less significant since there are not theories to truly support their connection.

These results show that the minimum wage does significantly reduce income inequality, although there are diminishing effects as the minimum wage increases. This provides evidence for the nonlinear relationship between the real value of the minimum wage and income inequality, as hypothesized using the redistribution theory. When interpreting the effect of the minimum wage in income inequality however, it is important to note the multicolinearity between the minimum wage and squared minimum wage, since we cannot alter one variable without seeing a change in the other. By looking at the quadratic presented from these coefficients, we are able to calculate the point at which the minimum wage would change from having a negative relationship with income inequality to a positive relationship. This value would also be considered the maximum effectiveness value, since it is the value of the minimum wage that would cause income inequality to be at its lowest point. We are able to determine this value by using basic calculus, where we take the derivative of Gini with respect to the minimum wage and then solve for the minimum value by setting the derivative to zero.

$$Gini = -0.0158MW + 0.000671MW^2$$

$$\frac{d(Gini)}{d(MW)} = -0.0158 + 0.001342MW = 0$$

$$MW = 11.77$$

These findings mean that the minimum wage would need to be above $11.77 for income inequality to increase due to the minimum wage. Since the highest value of the minimum wage seen in this data set is $14.82, we can state that there are some countries that would see their income inequality decrease by lowering their minimum wage. That being said, the mean minimum wage was $6.57, most countries could lower their inequality by increase the minimum wage. We can therefore state that our results provide evidence to support our hypothesis since the minimum wage has a negative relationship with income inequality until the maximum effectiveness value, at which point the relationship becomes positive.

The results found are similar to those discussed in the previous empirical research. Since no country's minimum wage is close to approaching the tipping point, the evidence found in the previous literature tends to find negative relationships between the minimum wage and income inequality. DiNardo et al. (1996) saw falling real values of the minimum wage explained the expanding wage differentials between the 90th and 10th percentiles. Card and Krueger (1995) provide evidence for increases to the federal minimum wage reversing the growth of income inequality with no disemployment effects. Finally, Koeniger et al. (2007) show how the minimum wage has a highly statistically significant negative relationship with income inequality when looking at 11 OECD countries. Overall, our findings are fairly consistent with many recent findings.

VI. Conclusion

Our results provide evidence that increases to the real value of the minimum wage can lower income inequality. Although there is a diminishing effect as the minimum wage increases, we still see statistically significant results that confirm our hypothesis. In these countries, increases to the real value of the minimum wage redistribute wealth from the higher end of the

income spectrum to the lower end of the spectrum, thereby decreasing inequality. Most importantly, since we did see a non-linear relationship between the minimum wage and income inequality, we can conclude that the three types of redistribution do present themselves in order, where prices increase, before corporations start cutting executive salaries, and then finally if companies need to, disemployment effects are observed. That being said, the macroeconomy will not see disemployment effects cause a problem until the real value of the minimum wage is $11.77. As long as the value of the minimum wage is below this, any increases will result in a decrease in income inequality.

This evidence also provides us with many policy implications that help us determine best practices for shaping fiscal policy in developed countries. First of all, according to the evidence seen here, setting a minimum wage to $11.77 would provide the lowest level of income inequality. This shows that for many of the OECD nations, they would be able to help decrease inequality within their country by raising the minimum wage even by a small amount, although there are some countries that have overshot the maximum effectiveness value. The second policy implication from this research is found in the fact that we used the real values of the minimum wage. By seeing that higher real values of the minimum wages decrease inequality, we can state that lower real values of the minimum wage increase inequality. Therefore creating policy to keep a constant real value of the minimum wage will stop inequality from increasing, thereby leading to a more prosperous economy. Looking at this research shows how developed economies can benefit from not only increasing their minimum wages, but also stopping their real value from decreasing. This implies a policy of having the minimum wage increase with inflation would help to keep income inequality from rising further.

Overall, we can conclude that increases to the real value of the minimum wage affect income inequality by redistributing wealth, primarily from the people who buy goods made by minimum wage workers and the stakeholders of companies that higher minimum wage workers. Although we do notice the potential for some disemployment effects when the minimum wage becomes too high, caused by a redistribution of wealth from some low-wage workers losing their jobs to other low-wage workers who continue to work after the minimum wage increase, this effect is not being seen by any OECD country currently due to the need for the minimum wage to be set extremely high for this to occur. Changing policy to reflect these findings would help improve the economy by creating a more equal society and thereby improving the general quality of life.

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