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Effects of the Minimum Wage on U.S. Labor Markets

Dawn M. Otterby
University of Maine, dawnotterby1@gmail.com

EFFECTS OF THE MINIMUM WAGE ON U.S. LABOR MARKETS

By

Dawn Otterby

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Advisory Committee:

Andrew Crawley, Associate Professor of Economics, University of Maine, Advisor

Todd Gabe, Professor of Economics, University of Maine, Advisor

Kathleen Bell, Professor of Economics, University of Maine

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Thesis Advisors: Dr. Andrew Crawley & Dr. Todd Gabe

An Abstract of the Thesis Presented
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The first section of this research investigates the impacts of the minimum wage on regional labor markets in the United States. Using ten years of county-level data, we examine the relationship between the minimum wage and several key components of the labor market. Following past research, employment variables are used to measure labor supply, but—as an extension to the literature—job postings data are included to measure labor demand. Consistent with previous studies, we find a positive relationship between labor force participation and a county's minimum wage. We do not find a statistically significant relationship between job postings and the minimum wage when using our full sample.

Building on the work presented in Chapter 2, the third chapter of this thesis uses a labor market flow framework to explore the effects of minimum wage on job postings and the labor force when controlling for labor market supply and demand. Using an instrumental variable approach to address endogeneity, we do not find a significant relationship between minimum wage levels and the number of job postings. We do, however, observe a significant and positive relationship between the minimum wage level and the size of the labor force.

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CHAPTER 1

INTRODUCTION

1.1 Background

In 1938, President Franklin Delano Roosevelt signed the Fair Labor Standards Act which introduced a federal minimum wage to the United States labor market. Following its introduction, the majority of applied economic studies found an inverse relationship between the minimum wage and employment (Brown et al., 1982). A series of state and federal minimum wage changes in the late 1980s and early 1990s spurred researchers to revisit the minimum wage question using more complete data and improved econometric techniques. Instead of providing clarity, these studies produced conflicting findings and ignited a debate regarding the true relationship between the minimum wage and the labor market. This debate remains unsettled more than 30 years later.

Using case studies, economists continue to explore the effect of raising the minimum wage on labor supply and demand. The seminal work of David Card and Alan Krueger (1994) used survey information collected from fast-food restaurant in New Jersey and Pennsylvania to explore the effects of New Jersey's minimum wage increase. This study, along with several others of the time, failed to find evidence that increasing the minimum wage reduced employment for low-wage workers (Card, 1992b; Card & Krueger, 1995; Katz & Krueger, 1992). More recently, several studies have examined the effects of minimum wage changes in Seattle, WA with varying results (Jardim et al., 2022; Reich et al., 2017; Romich et al., 2020). While these case studies are often able to account for the effects of the minimum wage on labor supply and labor demand, economists often encourage caution when attempting to generalize the results to larger or different markets.

The seminal work of David Neumark and William Wascher (1992) investigated the effects of the minimum wage using national, panel data. At the national level, however Neumark and Wascher were only able to observe changes in labor supply i.e., employment and unemployment levels. Their findings

remain consistent with more recent studies and identify a positive relationship between the minimum wage and unemployment (Thompson, 2009; Partridge & Partridge, 1999; Kandilov & Kandilov, 2020). By not accounting for the actions of the firm, however, panel data studies of this nature fail to provide a complete picture of how the minimum wage effects the labor market as a whole.

1.2 Purpose of Research

To gain a better understanding of how different levels of the minimum wage impact labor supply and labor demand, we explore three research questions:

1. *How does the minimum wage impact labor supply (unemployment and labor force participation) and labor demand (job postings and gross domestic product (GDP)) at a national level?*
2. *How do regional differences influence the relationship between the minimum wage and the labor market?*
3. *What are the effects of minimum wage on job postings and the labor force when we control for labor market supply and demand?*

To answer Question 1, we combine labor supply and demand components and conduct a national analysis. Addressing Question 2, we attempt to explain the often, conflicting findings between case studies and national panel studies by looking at how minimum wage changes affect different types of labor markets e.g., rural vs. urban. After investigating the isolated effects of minimum wage on labor supply and demand components, we examine Question 3 by accounting for total labor market activity.

1.3 Thesis Organization

The remainder of this document consists of two chapters that analyze the relationship between the minimum wage and the labor market. The second chapter explores Questions 1 and 2 by using four equations to estimate the relationship between minimum wage and job postings, unemployment, the labor force, and GDP. To examine regional differences, these equations are then reestimated using three

subsamples of our total data sample. Chapter 3 addresses our third question by employing an instrumental variable approach to control for multiple labor market measures. Chapter 4 summarizes our overall conclusions and highlights our key findings.

CHAPTER 2

REGIONAL CHANGES IN MINIMUM WAGE AND THE U.S. LABOR MARKET

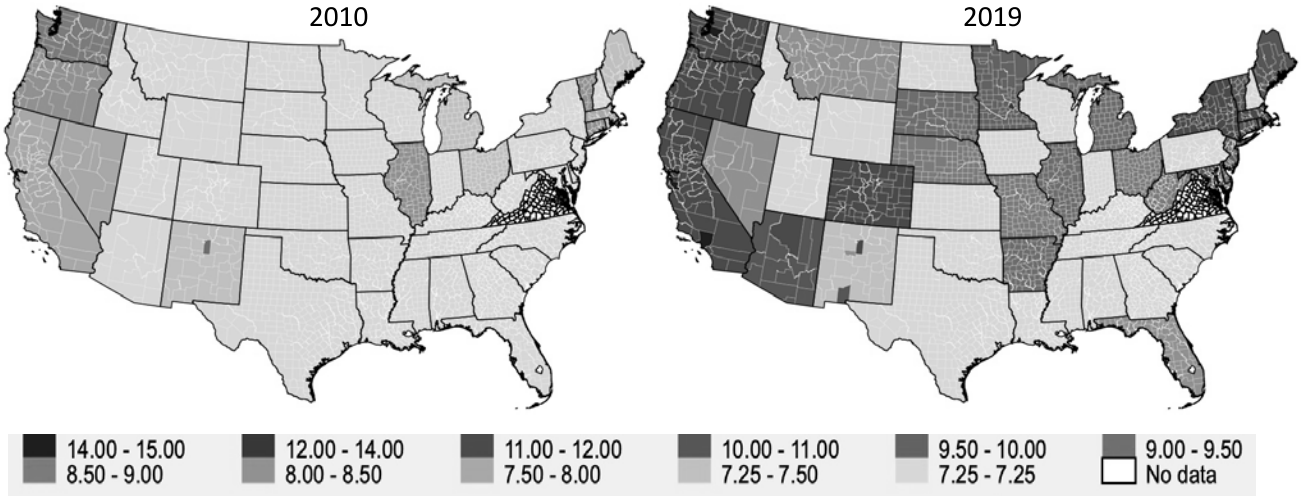
The following chapter is a variation of work with Dr. Andrew Crawley and Dr. Todd Gabe.

2.1 Introduction

In the United States, the relationship between minimum wage and various aspects of regional labor markets has been a topic of discussion since the wage floor was introduced in 1938 (Stigler, 1946). During the last 85 years, advancements in empirical methodologies and data collection have dramatically improved the way researchers estimate the impacts of the minimum wage. Instead of providing clarity, however, researchers continually produce contradictory findings, turning this topic of discussion into one of the most fiercely debated subjects in economics. This debate is also prevalent in the political sphere where policymakers at all levels of government disagree about the impacts of the minimum wage on workers and businesses (Peters, 2009).

The last federal increase took effect in July 2009 and changed the minimum wage from $6.55 to $7.25. At that time, 11 states and the District of Columbia already had wage requirements exceeding the new minimum (Figure 2.1). By the end of 2010, three more states had increased their wage requirements above the federal floor.

Figure 2.1 Minimum wage level by state and county



*Not shown Hawaii's and Alaska's minimum wage increased from $7.25 to $10.10 and $10.19 respectively

In the following years, many state and local governments continued to raise their minimum wages and by 2019, 29 states, five counties and 41 cities had wage requirements above the federal minimum ("Inventory of U.S. City and County Minimum Wage Ordinances," 2022). Even with these wage increases, during 2019 approximately 1.6 million hourly U.S. workers earned wages at or below the federal minimum (Characteristics of Minimum Wage Workers, 2019, 2020).

This paper contributes to the literature by using panel data of U.S. counties to evaluate the impact of the minimum wage on several key components of the labor market. While the minimum wage literature is substantial, most large-scale studies focus on the impacts of the minimum wage on labor supply indicators (e.g., number of people in the labor force) with little mention of labor demand. One reason for the emphasis on labor supply is the lack of data measuring labor demand. Our study uses job postings data, collected by Lightcast analytics, as a proxy for labor demand.[1] While the number of job postings is not equivalent to actual labor demand, it represents the hiring desires and plans of businesses within U.S. counties. In addition to extending the literature with an analysis of job postings, this paper provides an update to existing studies using data from 2010 to 2019. This period is characterized by relatively stable economic activity, and due to actions taken by state and local legislation, it features large variation in minimum wages across U.S. counties.

2.2 Literature Review

2.2.1 Historical Perspectives on Labor Theory

Neoclassical labor theory argues that because time is finite—i.e., there are only so many hours in a day—all individuals face a tradeoff between hours spent on work and hours spent on leisure (Cahuc & Zylberberg, 2004). Theory further argues that wage dictates how workers navigate this tradeoff. A low

[1] Lightcast was formerly Emsi and Burning Glass Technologies. Information about Lightcast and how it collects job postings data can be found here: https://kb.emsidata.com/glossary/total-job-postings/

wage is thought to decrease the amount of time an individual spends working while a high wage should result in the individual working more hours. If wages fall too low, an individual may choose to spend zero hours on work (Greenlaw & Shapiro, 2017). This tipping-point wage, or the lowest wage an individual is willing to accept, is referred to as the reservation wage (Falk et al., 2006). In general, an individual's reservation wage is determined by their search costs, the rate of job offers they receive, and the distribution of their wage offers (Addison et al., 2013).

As suggested by neoclassical labor theory, the employed population is comprised of individuals who have a reservation wage below the market wage. Conversely, the unemployed population is made-up of individuals who have a reservation wage above the market wage. Together, the employed and unemployed populations make up the total labor supply (Vachris & Bohanon, 2012). Under this theory, an individual's characteristics and preferences determine if they choose employment or unemployment. Likewise, neoclassical labor demand theory is conceptually straightforward. As long as the expected profits from a vacant job are positive, existing firms will continue to hire workers and new firms will enter the market creating additional vacancies. This pattern will continue until the cost of the vacancy is equal to the expected profit from the job being filled. Once a firm reaches this equilibrium, it will not hire additional workers unless its output profits increase or its wage requirements decrease (Cahuc et al., 2014).

Neoclassical labor theory, however, is heavily debated. In a 1936 publication, John Maynard Keynes introduced the idea of involuntary unemployment. Under Keynes' theory, individuals may be denied employment even if their reservation wage is below the market wage. In this situation, labor demand falls below labor supply, and the mismatch adds to the unemployed population (Keynes, 1936; Spencer, 2006). The Keynesian labor hypothesis suggests that the demand for a firm's products determines the number of people that the business employs. If a firm experiences a decrease in product

demand, it will respond by laying off workers rather than lowering output prices (Keynes, 1936; Bils et al., 2013).

Neoclassical and Keynesian theories provide a logical base for explaining specific labor market dynamics. Neither theory, however, fully explains observable events in modern markets. By assuming labor markets are perfectly competitive, theory does not account for the effects of resource allocation, imperfect information, mobility costs, job search costs, recruitment costs and more (Cahuc et al., 2014). Utilizing a theoretical base while acknowledging these limitations is essential when examining the relationship between wages and employment at regional and macro levels.

2.2.2 Evolution of Modern Minimum Wage Theory

Prior to 1990, most applied economic studies found an inverse relationship between the minimum wage and employment (Brown et al., 1982). In the early 1990s, however, a series of studies by David Card, Alan Krueger and Lawrence Katz reignited the debate regarding the minimum wage's effect on employment. Focusing on the 1991 federal minimum wage increase, Katz and Krueger were unable to identify a negative effect on employment in Texas' fast-food industry (Katz & Krueger, 1992). Likewise, Card and Krueger failed to find a negative impact on employment when looking at New Jersey's fast-food industry before and after a state-mandated wage increase (Card & Krueger, 1994).

The findings of Card (1992b), Katz and Krueger (1992), and Card and Krueger (1994) generated renewed interest in the impacts of the minimum wage. For example, David Neumark and William Wascher produced results from a national analysis which concluded a "10% increase in the minimum wage causes a decline of 1-2% in employment among teenagers and a decline of 1.5-2% in employment for young adults" (Neumark & Wascher, 1992, p. 55). Card, Krueger, and Katz revisited the 1992 study by Neumark and Wascher and, after altering the methodology, produced results consistent with their finding (from the Texas and New Jersey studies) of no negative impact on employment (Card et al., 1994). Likewise, Neumark and Wascher reevaluated the Card and Krueger 1994 study and, after

changing the data from survey data (used by Card and Krueger) to payroll data, identified results consistent with their 1992 research (Neumark & Wascher, 1995). By the second half of the 1990s, contradictory findings related to the impacts of the minimum wage appeared in other industrialized countries including the United Kingdom, Netherlands, New Zealand, and Portugal (Neumark & Wascher, 2004).[2]

The debate over the effect of the minimum wage on employment persists in the United States and abroad. A 2014 analysis reviewed 74 minimum wage studies published after 2000 and found the results of these studies varied widely in magnitude, sign, and significance (Belman & Wolfson, 2014). More recent work by Alan Manning (2021) acknowledges the inconsistent relationship between wages and employment. With that in mind, Manning suggests that labor economists should focus on identifying the level at which the minimum wage produces negative employment effects. A study of Greece's labor market attempts to determine this level. Using data collected between 2004 and 2019, Eirini Andriopoulou and Alexandros Karakitsios (2021) failed to find evidence of a causal relationship between raises in the minimum wage and transitions into unemployment. Their analysis suggests Greece's minimum wage may still be below the "adequate" level.

Variation in wage rates between countries is often dramatic but can be explained in part by institutional and regulatory differences. Wage variation within a country, however, is harder to explain because labor and capital are unconstrained and differences in institutions and regulations are relatively small. To understand regional wage disparities within a country, researchers need to examine local labor markets (Enrico, 2011).

[2] United Kingdom (Minford and Ashton [1996] vs. Machin and Manning [1994, 1997])
Netherlands (Van Soest [1994] vs. Dolado et al. [1996])
New Zealand (Maloney [1995] vs.Chapple [1997])
Portugal (Pereira [2003] vs. Portugal and Cardoso [2002])

2.2.3 Regional Approaches to the Minimum Wage and Employment

In his seminal 1992 publication, Card exploited regional differences in employment and wages to examine how the 1990 federal minimum wage increase impacted teen employment. This research, along with several other studies conducted in the early 1990s, laid the foundation for modern minimum wage analysis (Neumark & Wascher, 1992; Katz & Krueger, 1992; Williams, 1993). Recent contributions to the literature continue to expand the scope of the 1990s studies. A 2019 U.S., county-level analysis of the agricultural industry looked at long-run elasticity and found evidence that a "10% increase in the minimum wage is associated with a 4% decline in aggregate farm employment after 10-20 years" (Kandilov & Kandilov, 2020, p. 626). Results from an economic study in Poland indicate that national wage increases between 2006 and 2012 did not impact overall employment. As the mandatory increases continued, however, the estimated impact on employment became (and remained) negative from 2013 to 2018. Likewise, research shows that regions with higher average wages are less likely to experience negative employment effects after a mandatory wage increase compared to regions with lower average wages (Majchrowska & Strawiński, 2021).

2.2.4 Job Vacancies and the Labor Market

Within the literature, there are a limited but growing number of studies utilizing the number of job postings as a measure of labor demand. In a 2007 publication, researchers manually collected "help-wanted ads" from Sunday editions of the *Portland Oregonian* and the *Seattle Times*.[3] Using this data, the study produced evidence suggesting that raises in the minimum wage "reduced the amount of job vacancies (and related hiring efforts), particularly for those jobs for which the minimum wage is relatively binding" (Singell & Terborg, 2007, p. 41). Since the 2007 study, web scraping tools, online databases, and other technological advances have vastly improved the accuracy and availability of job postings data. When studying the pandemic, Shuai and colleagues collected weekly job postings data

[3] Help wanted ads were collected for specific eating/drinking and hotel/lodging jobs between 1994 and 2001.

and found “COVID-19 caused a significant decline in labor demand, by as much as 30%, measured by the number of job advertisements” (Shuai et al., 2021, p. 29). This research also determined that the correlation coefficient between their job postings data and the official U.S. non-agricultural employment data was 0.75 (significant at a 99% confidence level). Other pandemic-related studies use job vacancy data as an indicator of future employment and argue that it is a main determinant of how many unemployed people will be able to find work (Fukui et al., 2020). Our study builds on these contributions by using ten years of job postings data as a measure of labor demand in U.S. counties.

2.3 Data

To estimate the effects of changes in the minimum wage on aspects of regional labor markets, we use panel data collected annually from 2010 to 2019. This timeframe, characterized by relatively stable economic conditions, minimizes the influence of 2007’s recession and 2020’s COVID-19 pandemic. Concerning the level of analysis, we assess labor markets at the county level. By analyzing these smaller regions, we follow the examples of Thompson (2009) and Kandilov and Kandilov (2020), who argue that counties are a more accurate representation of labor markets than larger, more heterogeneous states.

Minimum wage data are from the U.S. Department of Labor and the University of California, Berkeley’s Labor Center. Using this data, we determined that, in 2010, 14 states and the District of Columbia had a minimum wage higher than the federal requirement of $7.25 per hour (Changes in Basic Minimum Wages, 2022). These 14 states contain 542 counties, which account for approximately 17% of the total number of U.S. counties. By 2019, however, 29 states, five counties and 41 cities had increased their wage requirements above the federal minimum (“Inventory of U.S. City and County Minimum Wage Ordinances,” 2022). Collectively, these 29 states have 1,343 counties, or approximately 43% of all U.S. counties. While it was relatively straightforward to assign state and county-level minimum wage

changes to the appropriate counties and years, addressing wage increases at the city level was more challenging.[4] As a result, we determined that if a wage ordinance was enacted in a city that contained more than 30% of its county's population, the higher wage would be used for the entire county. For example, the city of Flagstaff, Arizona, increased its minimum wage in 2017. At that time, 51% of Coconino County's population resided in Flagstaff; therefore, the higher wage was applied to the entire county. If multiple cities within a county raised their wages, we used the wage from the most populous city. It is important to note that during the sample period, multiple city wage ordinances were exceeded by state-mandated increases. Finally, because our data are measured annually, all wage changes were applied to the entire year, regardless of what month they took effect.

Information regarding local job vacancies (also referred to as "job postings"), used as a measure of labor demand, was collected via Lightcast, previously EMSI and Burning Glass Technologies. Lightcast's job vacancy data are compiled from more than 45,000 websites and it is cleaned to remove duplicate postings. This labor market database has been used in several academic studies including research by Azar et al. (2019), Hershbein and Kahn (2018) and Deming and Kahn (2018).[5] After extracting vacancy data for our sample period, we discovered that 13 counties returned zero job postings for one or more years. These counties were eliminated from the sample in order to maintain a balanced panel.[6] Population estimates are from the U.S. Census Bureau.[7] Employment, unemployment and labor force numbers came from the Bureau of Labor Statistics. Finally, we used information collected by the Bureau of Economic Analysis for GDP and average wage estimates. Table 2.1 shows a complete list of variables and descriptive statistics.

[4] Minneapolis and multiple cities in California imposed wage rates based on the size of the firm. In these situations, we used the wage for firms who employed between 25 and 500 employees.
[5]See Azar et al. (2019) for a more complete overview of Lightcast (EMSI & Burning Glass) and its use in academic research.
[6] Eliminated counties include Blaine County, Nebraska; Echols County, Georgia; Kent County, Texas; Keya Paha County, Nebraska; Loup County, Nebraska; Loving County, Texas; McPherson County, Nebraska; San Juan County, Colorado; Slope County, North Dakota; Terry County, Texas; Throckmorton County, Texas; Webster County, Georgia; King County, Texas.
[7]A U.S. census was collected in 2010.

Table 2.1 Descriptive statistics of variables used in Equations 1-4

Variable		Mean	Std. dev.	Min	Max
Minimum Wage *(dollars)*	Overall	7.70	0.85	7.25	15.00
	Between		0.63	7.25	11.38
	Within		0.57	4.87	12.65
Labor Force *(persons)*	Overall	51,661.39	167,823.50	217.00	5,153,091.00
	Between		167,758.00	225.90	5,010,230.00
	Within		5,524.96	-83,632.61	257,713.30
Unemployment *(persons)*	Overall	3,216.61	12,233.76	8.00	621,950.00
	Between		11,510.95	11.00	396,917.50
	Within		4,147.67	-166,665.90	228,249.10
Job Postings	Overall	8,434.87	37,913.09	1.00	1,392,074.00
	Between		35,119.20	9.20	764,357.70
	Within		14,298.19	-410,585.80	636,151.20
Gross Domestic Product *(thousands of chained 2012 dollars)*	Overall	5,588,256.00	23,900,000.00	6,311.00	704,000,000.00
	Between		23,800,000.00	18,201.50	622,000,000.00
	Within		2,179,634.00	-63,900,000.00	90,600,000.00
Average Wage *(dollars)*	Overall	39,945.95	11,534.13	14,929.00	225,987.00
	Between		10,701.65	17,472.60	194,093.90
	Within		4,306.47	-9,870.95	89,246.65
Population Change (*percent*)	Overall	0.08	1.29	-34.61	23.65
	Between		0.90	-3.89	10.23
	Within		0.93	-30.92	19.40

Note: Excluding population change, the total number of observations is 29,630, or ten observations of 2,963 counties. The number of observations for population change is 26,667, or nine observations of 2,963 counties. Overall values are calculated using all of the observations. The between values show the variation between the counties for the sample period (2,963 observations) and the within values show the variation in a specific county given that county and year (29,630 or 26,667 observations) (StataCorp, 2023).

Additional data cleaning was required to ensure consistent, county-level data collection across the various agencies. We began by addressing the United States' 41 independent cities. While these cities are treated as county equivalents by the Census Bureau, other government and private agencies combine a variety of independent cities with nearby counties when reporting data.[8] These differences led us to exclude the state of Virginia, which removed 95 counties and 38 independent cities. We then merged the three remaining independent cities with their surrounding counties and adjusted the data accordingly.[9] Alaska was also excluded from the analysis due to inconsistencies pertaining to its boroughs and census areas. After data cleaning, our final sample contained 10 annual observations of 2,963 counties.

2.4 Empirical Strategy and Methods

The empirical analysis examines the effects of a county's minimum wage on the number of job postings (*Posts*), the number of people in the labor market (*Labor*), the number of people who are unemployed (*Unemp*) and a county's level of output (*GDP*). As noted above, the number of people in the labor market is a measure of labor supply, whereas the number of job postings by businesses is used to represent labor demand in a county. The number of people who are unemployed is an outcome of a binding wage floor and the forces of labor demand and supply in a region, and county-level GDP is a measure of the amount of economic activity in the region. Equations 1 to 4 summarize the models used in our analysis, which are estimated using ordinary least squares:

(1) $\ln(Posts_{c,t}) = \beta_1 \ln\left(Min\_Wage_{c,t}\right) + \beta_2\left(X_{c,t}\right) + \sigma_c + \tau_t + \varepsilon_{c,t}$

(2) $\ln(Labor_{c,t}) = \beta_1 \ln\left(Min\_Wage_{c,t}\right) + \beta_2\left(X_{c,t}\right) + \sigma_c + \tau_t + \varepsilon_{c,t}$

(3) $\ln(Unemp_{c,t}) = \beta_1 \ln\left(Min\_Wage_{c,t}\right) + \beta_2\left(X_{c,t}\right) + \sigma_c + \tau_t + \varepsilon_{c,t}$

[8] Louisiana's parishes were treated as counties.
[9] St. Louis City joined St. Louis County, Baltimore City joined Baltimore County, Carson City joined Douglas County.

(4) $\ln(GDP_{c,t}) = \beta_1 \ln(Min\_Wage_{c,t}) + \beta_2(X_{c,t}) + \sigma_c + \tau_t + \varepsilon_{c,t}$

where, ln(*Posts*) is the natural logarithm of the number of job postings, ln(*Labor*) is the natural logarithm of the number of people who are employed or actively seeking employment, ln(*Unemp*) is the natural logarithm of the number of people looking for work, ln(GDP) is the natural logarithm of the value of goods and services produced in the county, and ln(*Min_Wage*) is the natural logarithm of the minimum wage. The error term is denoted by $\varepsilon_{c,t}$.

Equations 1 to 4 include fixed effects for the year (τ_t) and county (σ_c). This specification differences away county-specific, time-invariant factors that influence the dependent variables. Following common practice in the literature, we include a matrix of demographic control variables ($X_{c,t}$), to account for population growth and average wages in the county. Population growth is included in the regressions given its close connection to the supply of (and demand for) labor in a county. We include average wages in a county as a proxy for worker productivity. In Equations 1 to 3, we also include county-level GDP, lagged by one year, as an explanatory variable to control for the size of a county's economy. All variables included in the model are logged, therefore the coefficient estimates can be directly interpreted as elasticities. Using these specifications, we can benchmark our results within the literature and create a baseline for reference when conducting additional analysis.

Previous studies suggest that changes in the minimum wage do not have a uniform effect across labor markets. To explore the heterogeneity in the effects of the minimum wage, we analyze subgroups of U.S. counties. Following the work of Enrico (2011) and Gilbert et al. (2001), we compare urban and metropolitan counties to rural and non-metropolitan counties.[10] We also examine the effects of the

[10] Urban and rural counties were determined using the U.S. Census Bureau's *List of Population, Land Area, and Percent Urban and Rural in 2010*. Metro and non-metro areas were classified using the USDA's 2013 Urban-Rural Continuum Codes where metropolitan counties are assigned a number between 1-3 and non-metropolitan counties have a number between 4 and 9.

minimum wage in counties with the lowest average wages. In theory, these low wage counties should be more impacted by minimum wage changes than higher-wage counties.

2.5 Empirical Results

2. 5.1 Main Findings

Table 2.2 presents regression results on the effects of the minimum wage on job postings, the number of people in the labor market, the number of people who are unemployed, and county-level GDP. The second specification uses the variables shown in Equations 1 to 4, while Specifications 1 and 3 display results for alternative models.

In Specification 2, the effects of raising the minimum wage on the numbers of people in the labor force and those who are unemployed are positive and statistically significant. Using the parameter estimates, a 100% increase (i.e., doubling) in the minimum wage is associated with a 4.5% increase in the labor force and a 17.4% increase in unemployment. The result pertaining to the labor force variable suggests that a higher minimum wage brings more people into the labor force and the effect related to unemployment suggests that a higher minimum wage increases the gap between the number of people in the labor force and the number of jobs provided by businesses in the region. These findings are consistent with the results of Biçerli and Merve, (2019), Brunt and Barilla (2018), and Partridge and Partridge (1999). Estimates for the effects of the minimum wage on job postings and GDP are negative, but not statistically significant.

These regression results are highly robust to the inclusion and exclusion of several explanatory variables in the model. For example, the minimum wage has a positive and statistically significant effect on the labor force and unemployment variables in a regression that—along with the dummy variables indicating the year and county—has a single explanatory variable representing the minimum wage (Specification 1). Likewise, the results are similar when we control for a county's (lagged) GDP, which represents the size of regions. Although the models' goodness-of-fit increase substantially with the

inclusion of county GDP (e.g., from less than 0.1 to about 0.5 or higher), the estimated coefficients corresponding to the minimum wage variable are practically identical between Specifications 2 and 3.

Along with the analysis of the full sample of 2,963 U.S. counties, we examine the effects of the minimum wage on the labor markets of several different types of regions. For these regressions, we use model Specification 1 that includes the minimum wage variable along with dummy variables for the county and year. In the tables (2.3 to2. 5) that present these results, we highlight the estimated coefficients that measure the effect of the minimum wage on the four different dependent variables (i.e., job postings, labor market, unemployment, GDP).

Table 2.2 Regression results from primary models

	Specification 1				Specification 2				Specification 3		
Variable	ln(Posts)	ln(Labor)	ln(Unemp)	ln(GDP)	ln(Posts)	ln(Labor)	ln(Unemp)	ln(GDP)	ln(Posts)	ln(Labor)	ln(Unemp)
ln(Min_Wage)	-0.060 (0.062)	0.057*** (0.011)	0.119*** (0.031)	0.015 (0.025)	-0.077 (0.059)	0.045*** (0.010)	0.174*** (0.027)	-0.030 (0.025)	-0.072 (0.058)	0.047*** (0.009)	0.177*** (0.027)
ln(Ave_Wage)	-	-	-	-	0.057 (0.074)	0.200*** (0.012)	-0.630*** (0.029)	0.943*** (0.036)	-0.059 (0.071)	0.153*** (0.011)	-0.706*** (0.029)
Population Change	-	-	-	-	0.024*** (0.003)	0.005*** (0.000)	-0.019*** (0.002)	-0.001 (0.001)	0.025*** (0.003)	0.005*** (0.000)	-0.019*** (0.002)
l.ln(GDP)	-	-	-	-	-	-	-	-	0.244*** (0.047)	0.098*** (0.008)	0.158*** (0.013)
Time/County Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Obs	29,630	29,630	29,630	29,630	26,667	26,667	26,667	26,667	26,667	26,667	26,667
R^2 Overall	0.062	0.009	0.037	0.001	0.061	0.080	0.007	0.139	0.605	0.824	0.470
Note: Robust standard errors are reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01											

2.5.2 Urban and Rural Analysis

Our first subsample analysis examines the effects of the minimum wage in urban and rural counties (Table 2.3). A county is considered urban if more than one-half of its population resides in an urban area, as defined by the U.S. Census Bureau (see footnote 10). All other counties were classified as rural. Using the 11,930 observations for urban counties, we once again find a positive and statistically significant effect of the minimum wage on the number of people in the labor force (0.048), but a negative and statistically significant effect on unemployment (-0.139). The decrease in unemployment associated with the minimum wage is in accord with the results of Card and Krueger (1994), who suggest that a reasonable increase in the minimum wage will have a small, if any, negative consequence on the labor market.

Focusing on the 17,700 observations in rural counties, the regressions show positive and statistically significant parameter estimates for the impacts of the minimum wage on the number of people in the labor force and unemployment. Applying these estimates, which are similar to those found in our analysis of all U.S. counties, we find that doubling the minimum wage is associated with a 3% increase in the rural labor force and an 34.3% increase in rural unemployment. The magnitude of the minimum wage's impact on rural unemployment aligns with the work of Thompson (2009), who found that smaller counties (i.e., those employing less than 10,000 people) experienced relatively larger employment effects after a wage increase. Likewise, a study of Great Britain's labor market found the effects of a minimum wage increase to be "the greatest in remote rural areas where labor markets are less integrated with urban ones" (Gilbert et al., 2001, p. 769).

Table 2.3 Regression results for urban and rural subsamples

Panel A. Counties where more than 50% of the population is considered urban (URBAN)					
Dependent Variables	Explanatory Variable	Model Fit			
	ln(Min_Wage)	R^2 Within	R^2 Between	R^2 Overall	rho
ln(Posts)	-0.087 (0.069)	0.712	0.055	0.056	0.973
ln(Labor)	0.048*** (0.015)	0.033	0.053	0.012	0.999
ln(Unemp)	-0.139*** (0.042)	0.857	0.070	0.034	0.993
ln(GDP)	0.021 (0.033)	0.150	0.049	0.002	0.994
No. Obs.	11,930				
Panel B. Counties where less than 50% of the population is considered urban (RURAL)					
Dependent Variables	Explanatory Variable	Model Fit			
	ln(Min_Wage)	R^2 Within	R^2 Between	R^2 Overall	rho
ln(Posts)	0.099 (0.096)	0.670	0.010	0.156	0.900
ln(Labor)	0.030** (0.015)	0.126	0.000	0.000	0.998
ln(Unemp)	0.343*** (0.044)	0.855	0.000	0.064	0.987
ln(GDP)	-0.027 (0.037)	0.040	0.001	0.001	0.983
No. Obs.	17,700				
Note: Robust standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01					

2.5.3 Metropolitan and Non-metropolitan Analysis

A second analysis of subsamples of the dataset of all U.S. counties investigates the impacts of the minimum wage on metropolitan and non-metropolitan regions (Table 2.4). The metropolitan versus non-metropolitan area classification is based on the USDA Rural-Urban Continuum Codes (see footnote 10). The regression results focusing on metropolitan counties show a negative and statistically significant effect of the minimum wage on the number of job postings by businesses in a county. Specifically, we find that a 100% increase in the minimum wage is associated with a 33.3% decrease in the number of job postings. This negative impact of the minimum wage on job postings aligns with the recent empirical study by Romich et al. (2020), which found that approximately one in four employers of

low-wage workers reported reducing their workforces in response to Seattle's minimum wage increase.[11]

Results from the analysis of non-metropolitan counties mirrored those found in the regressions focusing on the rural subsample of counties. In response to an increase in the minimum wage, non-metropolitan counties experience a positive and statistically significant increase in the labor force (0.067) but a larger change—in terms of elasticity—in the number of people who are unemployed (0.213). Overall, the results pertaining to the impacts of the minimum wage on unemployment in metropolitan and non-metropolitan counties provide additional support for the argument that minimum wage increases have more adverse employment effects in less dense labor markets.

Table 2.4 Regression results for metro and non-metro subsamples

Panel A. Metro Counties					
Dependent Variables	Explanatory Variable	Model Fit			
	ln(Min_Wage)	R^2 Within	R^2 Between	R^2 Overall	rho
ln(Posts)	-0.333*** (0.081)	0.696	0.098	0.041	0.975
ln(Labor)	0.006 (0.014)	0.132	0.097	0.000	0.999
ln(Unemp)	0.007 (0.041)	0.889	0.114	0.042	0.994
ln(GDP)	0.016 (0.030)	0.206	0.099	0.001	0.997
No. Obs.	10,790				
Panel B. Non-Metro Counties					
Dependent Variables	Explanatory Variable	Model Fit			
	ln(Min_Wage)	R^2 Within	R^2 Between	R^2 Overall	rho
ln(Posts)	0.139 (0.089)	0.669	0.020	0.131	0.919
ln(Labor)	0.067*** (0.014)	0.133	0.005	0.001	0.998
ln(Unemp)	0.213*** (0.044)	0.835	0.007	0.061	0.986
ln(GDP)	-0.008 (0.036)	0.041	0.005	0.001	0.983
No. Obs.	18,840				
Note: Robust standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01					

[11] Workforce reductions include reductions in hours and/or employees.

2.5.4 Average Wage Analysis

Our final analysis of subsamples of U.S. counties separates regions by the average wages of workers in the county (Table 2.5). We are particularly interested in the effects of the minimum wage on the labor markets of low-wage counties, given that the minimum wage is likely to be "more binding" in these areas (Ford et al., 2012). Specifically, we identified and grouped the 296 counties with the lowest average wages in 2015, which accounts for roughly ten percent of all counties in our main sample.[12] The rest of the counties, with higher wages as of 2015, were used as a comparison group.

Table 2.5 Regression results for average wage subsamples

Panel A. 90% of Counties with the Highest Average Wage in 2015					
Dependent Variables	Explanatory Variable	Model Fit			
	ln(Min_Wage)	R^2 Within	R^2 Between	R^2 Overall	rho
ln(Posts)	-0.016 (0.063)	0.667	0.050	0.061	0.964
ln(Labor)	0.046*** (0.011)	0.026	0.038	0.009	0.999
ln(Unemp)	0.080** (0.032)	0.852	0.045	0.034	0.994
ln(GDP)	-0.005 (0.025)	0.087	0.038	0.000	0.994
No. Obs.	26,670				
Panel B. 10% of Counties with the Lowest Average Wage in 2015					
Dependent Variables	Explanatory Variable	Model Fit			
	ln(Min_Wage)	R^2 Within	R^2 Between	R^2 Overall	rho
ln(Posts)	-0.513* (0.309)	0.669	0.009	0.174	0.884
ln(Labor)	0.038 (0.056)	0.310	0.001	0.001	0.997
ln(Unemp)	0.482*** (0.117)	0.885	0.009	0.106	0.982
ln(GDP)	0.067 (0.150)	0.004	0.000	0.000	0.983
No. Obs.	18,840				
Note: Robust standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01					

[12] To maintain a balanced panel, we determined our groups based on 2015's values and then include the ten observations of those counties.

Regression results from an analysis of the low-wage counties show that the minimum wage has a negative effect on job postings and a positive effect on the number of people who are unemployed. When looking at the higher-wage counties, the results show a positive and statistically significant impact of the minimum wage on the number of people in the labor force and those who are unemployed. While the analysis of both subsamples of counties indicates a positive relationship between unemployment and the minimum wage, results from the low-wage subsample suggest that a doubling of the minimum wage is associated with a 48% increase in unemployment. Doubling the minimum wage in higher-wage counties, however, is associated with only an 8% increase in unemployment. These findings align with the research of Clemens and Wither (2019), Singell and Terborg (2007), and Majchrowska and Strawiński (2021), who argue that mandatory wage increases have larger employment effects in markets where the wage is binding.

2.6 Conclusions

This study examines the effects of the minimum wage on several indicators of U.S. regional labor markets. We use the number of people in the labor market as an indicator of labor supply and, as an extension to the minimum wage literature, the job postings of businesses to represent labor demand. Regression results from an analysis of (almost) all U.S. counties suggest that a higher minimum wage brings more people into the labor market and, subsequently, is associated with a larger number of people who are unemployed. The analysis of all U.S. counties, however, does not reveal a statistically significant relationship between the number of job postings in a county and the minimum wage.

Extensions to the main analysis investigate the effects of the minimum wage on different subsamples of counties. Here, we find that—generally speaking—an increase in the minimum wage has more pronounced impacts on unemployment in rural and non-metropolitan areas, and in counties with lower average wages. Although the analysis of 2,963 U.S. counties does not uncover a negative effect of the minimum wage on the job postings of businesses, our analysis of subsamples of U.S. counties shows

a negative relationship between the number of postings and the minimum wage in metropolitan counties and low-wage areas.

Our findings suggest that the effects of the minimum wage on regional labor markets differ depending on the type of county (e.g., rural versus urban, low wage versus higher wage) and the labor market indicator considered. Although these differences limit our ability to come up with a definitive conclusion for how the minimum wage impacts businesses and workers, our findings shed light on recent minimum wage studies that show very different and, often, contradictory results. In the literature review summarized at the beginning of this paper, we noted the wide differences in results regarding the minimum wage in studies that used different methodologies and data and focused on different areas. In this study, we find substantial heterogeneity in our results across different types of regions despite using the same empirical methods and data.

Future research can use our insights into the effects of the minimum wage on different types of U.S. counties to show the uneven impacts of potential increases in the U.S. minimum wage across regions. Because our equations are likely correlated, another promising avenue for research could look to address endogeneity concerns in Equations 1-4.

Overall, these results suggest to state and local policymakers that there's no one-size-fits-all answer to the question of how the minimum wage affects workers, businesses, and regions. Whereas an increase in the minimum wage might disrupt the labor market of a low-wage, rural area, a minimum wage hike might go largely unnoticed—in terms of the impact on unemployment—in a high-wage, urban county. Our findings also provide a challenge to federal policymakers when considering the impacts of an increase to the U.S. minimum wage. That is, the overall impacts of an increased U.S. minimum wage on total U.S. employment will likely conceal large impacts in some regions that are balanced by smaller (or offsetting) impacts elsewhere.

CHAPTER 3

THE EFFECT OF THE MINIMUM WAGE ON JOB POSTINGS AND THE LABOR FORCE: AN INSTRUMENTAL VARIABLE APPROACH

3.1 Introduction

Throughout the last decade, the labor economics literature has played host to a vibrant debate surrounding the effects of the minimum wage on employment (Chletsos & Giotis, 2015). These studies however have often fallen short when identifying how wage changes influence labor market flows (Boffy-Ramirez, 2022). By simply identifying changes in the employment level after an increase in the minimum wage, researchers fail to provide insight into the shifting dynamics behind the new level. Estimating the impact of raises in the minimum wage on specific labor market components without considering overall labor market connectivity may lead researchers to inaccurately capture the total effect of the wage change (Blanchard & Diamond, 1992).

In Chapter 2 of this thesis, we explored separately the effect of the minimum wage on job postings, unemployment, the labor force and GDP. This chapter expands on the previous findings by considering the possible presence of endogeneity when modeling these components separately. Using labor flow and wage price inflation theories, we provide a framework to explain the relationship between wages, job vacancies, the labor force and unemployment. Applying the theoretical framework, we reexamine both labor demand (proxied by *job postings)* and labor supply (proxied by *labor force)* and include additional controls to account for total labor market activity. We then use an instrumental variable approach to address endogeneity concerns. Our empirical analysis identifies a positive and significant relationship between the minimum wage and the labor force but an inverse and insignificant relationship between wage levels and the number of job postings.

The next section of this paper covers our literature review and highlights labor flow and wage inflation theories. The third section discusses our data collection and cleaning process, specifically it

outlines our use of Lightcast[13] to gather our instrumental variable data. Section 4 reveals the empirical strategy and the design of our two-stage-least-squares estimators. Section 5 presents the results from Equations 7 and 8. The final section contains our conclusion and potential applications for our findings.

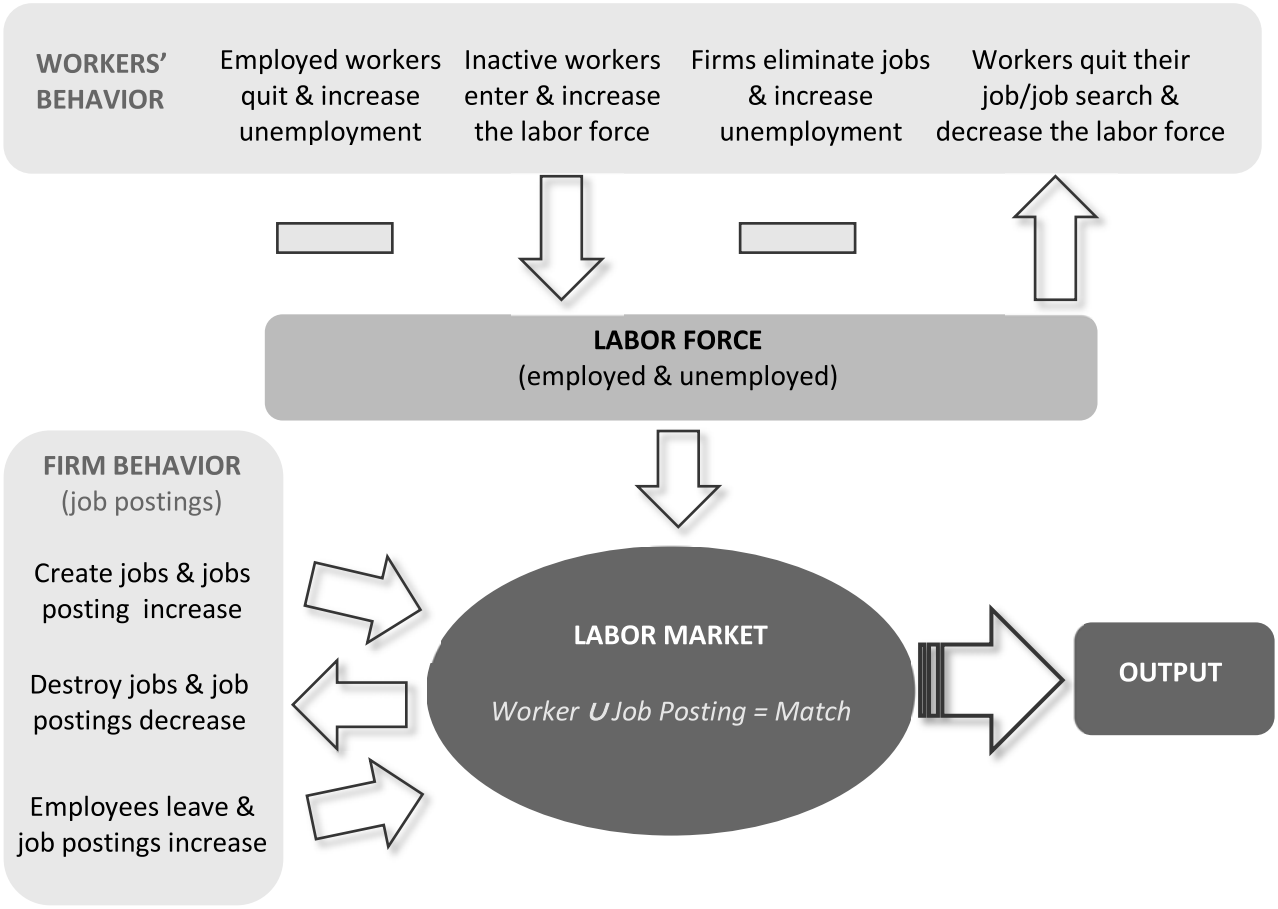
3.2 Literature Review

3.2.1 Labor Flows

In the labor market there is continual churn with movement between labor supply (workers) and labor demand (firms). Dependent on a variety of economic and personal factors, an individual worker may choose to continue with their current job, or they may opt to leave. Referring to Figure 3.1, an individual's decision to leave may result in them immediately gaining employment with a different firm (employed to employed). It may also result in that worker searching for a job (employed to unemployed) or leaving the labor market altogether (employed to inactive) (*Labor Force Status Flows*, 2015). The movement between employment and unemployment does not change the level of the labor force. The labor force is only influenced by individuals moving into and out of the inactive population of workers. From a demand perspective, firms may choose to retain workers, holding the employment level constant, or terminate workers leading to an increase in unemployment. Unlike individual workers, however, firms have a third option, they may select to hire additional workers, increasing employment. These firm level choices move individuals into employment or unemployment and may influence a worker's choice to exit the labor force (Burgess et al., 2000).

[13] Lightcast was formerly Emsi and Burning Glass Technologies. Information about Lightcast and its data collection practices can be found here: https://emsiburningglass.co.uk/

Figure 3.1 Labor market flow



Traditional theory argues that a firm will terminate an individual's employment if an adverse shock results in a working relationship that is no longer profitable for the firm. Under this theory, wages adjust slowly to changing market conditions and as a result, these 'sticky' wages are responsible for increasing unemployment (Dube et al., 2016). Another theoretical perspective argues that adverse shocks do not contribute to unemployment through firm layoffs but instead the shocks make hiring new workers less profitable. This theory further states that increases in unemployment arise when workers, who were previously outside of the labor force, begin searching for a job and experience unusual difficulty finding employment (Hall, 2005). While adverse shocks increase unemployment and lead to job destruction, positive shocks lead firms to create new jobs. In other words, a positive shock will encourage firms to hire more workers (Carlsson et al., 2021).

From a labor supply perspective, a worker will only leave a firm if the worker gains more from leaving than their employer loses (Hall, 2005). Factors including stagnate wages, declines in working conditions or increased opportunity costs may motivate a worker to leave a firm (Campbell et al., 2012). Conversely, workers will seek new employment if the benefits from making a change are greater than the benefits from maintaining their status quo. The decision of one individual has almost no impact on the overall labor flow. The aggregate of these individual choices, however, is equal to the market's total labor supply (Burda & Wyplosz, 1994).

In contrast to traditional Neoclassical Theory, labor market studies in the second half of the 20th century determined that the employment level is not solely reliant on firm level decisions, but it is instead influenced by vacancies and unemployment (Blanchard & Diamond, 1989; Stiglbauer et al., 2003). Put simply, workers respond to labor demand choices made by the firm, but firms also respond to the labor supply behavior of individual workers. The well documented relationship between vacancies, employment, unemployment, and the labor force presents endogeneity challenges for economists when estimating labor market behavior (Partridge & Partridge, 1999; Neumark & Wascher, 1992; van Soest, 1994). If researchers choose to isolate individual market elements, they may fail to truly capture total labor market effects, however if researchers choose to include all labor market components, their models may produce inaccurate estimates due to simultaneity bias (Fang & Ha, 2022).

3.2.2 Wage Inflation

Much like employment, wages also depend on vacancies and unemployment (Blanchard & Diamond, 1992). In a 1958 publication, William Phillips identified a negative, nonlinear relationship between unemployment and inflation. This relationship was consistent and observable for the period between 1861 and 1957. Phillips explained the relationship by arguing that an increase in labor demand or excess labor demand shrinks the pool of unemployed workers. In response to the decrease in

available workers, employers increase wages to attract remaining talent from the smaller pool. To offset their higher labor costs, firms then charge more for their goods (Phelps, 1968).

Building on the work of Phillips, Richard Lipsey derived a way to determine excess demand using the number of unemployed workers and job vacancies (Wulwick, 2011). This theoretical approach states that any change in the wage rate will be proportional to the excess demand for labor (Lipsey, 1960).

The work of Phillips and Lipsey aligns with the theory of wage price inflation. Under this theory, an increase in aggregate demand, "would increase output and employment, leading firms to desire higher prices and workers higher wages; this would start a wage price spiral, which would end only if and when this 'demand pull' inflation decreased real money balances sufficiently to return the economy to a steady state" (Blanchard, 1986, p.543).

3.2.3 The Role of Minimum Wage

From a labor flow perspective, a policy mandated increase in the minimum wage could be categorized as an adverse exogenous shock. If the higher wage is binding for a firm, classical flow theory predicts the firm will respond by reducing the size of its workforce and/or by eliminating vacant job positions (Biddle, 2014; Fehr, 1991). These actions taken by the firm may potentially be observed as an increase in unemployment or a decrease in labor demand.

When accounting for inflation, theorists argue that absent all other changes, raising the minimum wage may increase inflation, output, and employment. Increases in wage requirements, may lead to a rise in consumer demand (Kenton, 2022). These higher demand levels could be the result of workers earning more money and/or higher wages motivating members of the inactive population to gain employment (Biçerli & Merve, 2019). An increase in consumer demand allows firms to hire more workers and raise output levels but it also allows firms to charge more for that output (Glover & Mustre-del-Rio, 2021). If raises in the minimum wage however are matched by increases in productivity, then the higher wage will not have an inflationary effect (Samuelson & Solow, 1960).

Building on the empirical analysis in Chapter 2, this chapter attempts to connect changes in the minimum wage with the labor force and job postings in the United States.

3.3 Data

We use annual, county-level data collected between 2010 and 2019 to examine the impact of minimum wage on job postings and the labor force. The Bureau of Labor Statistics provided estimates for the labor force. A complete list of variables with descriptive statistics can be found in Table 3.1.

Table 3.1 Descriptive statistics of variables used in Equations 7 & 8

Variable	Mean (Std. dev.)
Minimum Wage *(dollars)*	7.70 (0.85)
Labor Force *(persons)*	51,661.39 (167,823.50)
Job Postings	8,434.87 (37,913.09)
Industry Mix *(Expected change in the number of jobs)*	-0.67 (325.96)
Age Share 19-25 *(Population between 19 & 25 / County Population)*	6.27 (2.36)
Age Share 55-64 *(Population between 55 & 64 / County Population)*	13.92 (2.10)
Age Share 65+ *(Population over 65/ County Population)*	17.81 (4.54)
Note: The total number of observations is 29,630, or ten observations of 2,963 counties.	

Minimum wage numbers were collected from the U.S. Department of Labor and the University of California, Berkley's Labor Center. Starting in 2010, 14 states and the District of Columbia had minimum wages higher than the federal requirement of $7.25 per hour (*Changes in Basic Minimum Wages*, 2022). By 2019, 29 states, five counties and 41 cities required a minimum wage level above the federal floor ("Inventory of U.S. City and County Minimum Wage Ordinances," 2022). While state and

county wage changes were easily applied to the appropriate counties and years, city wage increases presented more of a challenge.[14] To address city-specific wages, we determined that if a wage ordinance took effect in a city that contained more than 30% of its county's population, the higher wage would be used for the entire county. For example, in 2015 the city of Chicago, IL increased its minimum wage. At that time, approximately 52% of Cook County's population resided in Chicago, therefore the higher wage was used for the entire county. If multiple cities within a county raised their wages, we applied the wage from the most populous city. It is important to note that during the sample period, several city wage ordinances were exceeded by state mandated increases. Finally, because our data is annual, wage changes were applied to the entire year, regardless of what month they took effect.

Information regarding local job postings, used as a proxy for labor demand, was collected from Lightcast, previously EMSI and Burning Glass Technologies. This proprietary database has been used in several academic studies including Azar et al. (2019), Hershbein and Kahn (2018) and Deming and Kahn (2018).[15] Lightcast's job vacancy data is collected from more than 45,000 websites and it is cleaned to remove duplicate postings. After extracting the vacancy data, we discovered that 13 counties returned zero job postings for one or more years during our sample period. To maintain a balanced panel, these counties were eliminated from the sample.[16] Lighcast also provided county level estimates for the share of the population that was between 19 and 25, 55 and 64, or was over 65 years old. Finally, using Lightcast we determined the 2-diget industrial mix effect for each county. This metric indicates if regional changes can be explained by national trends or if they are unique to the specific area.

Additional data cleaning addressed the U.S.'s 41 independent cities. While some agencies treat these cities as county equivalents, it is not a standard practice across all government and private

[14] Minneapolis and multiple cities in California imposed wage rates based on the size of the firm. In these situations, we used the wage for firms who employed between 25 and 500 employees.
[15] See Azar et al. (2019) for a more complete overview of Lightcast (EMSI & Burning Glass) and its use in academic research.
[16] Eliminated counties include Blaine County, Nebraska; Echols County, Georgia; Kent County, Texas; Keya Paha County, Nebraska; Loup County, Nebraska; Loving County, Texas; McPherson County, Nebraska; San Juan County, Colorado; Slope County, North Dakota; Terry County, Texas; Throckmorton County, Texas; Webster County, Georgia; King County, Texas.

entities. Dependent upon the data source, independent cities are combined with nearby counties in a variety of ways when reporting data.[17] Due to these inconsistencies, we excluded the state of Virginia which consists of 95 counties and 38 independent cities. We then merged the three remaining independent cities with their surrounding counties and adjusted the data accordingly.[18] Alaska was also excluded due to inconsistencies related to its boroughs and census areas. After data cleaning, our final sample contained 10 observations of 2,963 counties.

3.4 Methods

As shown in the literature review section of this chapter, labor supply and labor demand do not function independently of one another. Therefore, when we examine how wages effect labor supply (labor force), we must also account for the effects of labor demand (job postings) and vice versa (Blanchard & Diamond, 1992). Using the labor market elements identified in the literature review, we designed Equations 5 and 6.

(5) Labor Force = f(minimum wages, job postings, population age, county trends, time trends)

(6) Job Postings = f(minimum wages, labor force, population age, county trends, time trends)

By including multiple, labor market measures however, we risk introducing endogeneity into the models. For example, if raises in the minimum wage are implemented as a policy response to increases in low-wage employment, then OLS estimates will be influenced by simultaneity bias and therefore inaccurate. To address endogeneity concerns, we again follow the literature and utilize a two-stage-least -squares approach.

Equation 5 requires an instrument to predict the number of *job postings* in a county. While we use job postings as a proxy for labor demand, it also represents potential local employment growth. Therefore, following the work of Li et al., (2016), Bartik, (1993); and Malecki, (1993) we use the industry

[17] Louisiana's parishes were treated as counties.
[18] St. Louis City joined St. Louis County, Baltimore City joined Baltimore County, Carson City joined Douglas County.

mix effect as an instrument for job postings. The industry mix reflects the hypothetical employment change that would occur if all the industries in a county followed the national trends. Changes in national industry trends are exogenous, which is why the industry mix variable is commonly used as an instrument for local employment change (Li et al., 2016).

Age shares were identified as an instrument for the labor force in Equation 6. While the size of a counties labor force is likely to be endogenous with its number of job postings and its minimum wage, the age of a county is not (Cook, 2002). Using the share of each county's population between the ages of 19 and 25, 55 and 64, and over 65, we can account for the size of the labor force without introducing endogeneity into the model.

Equations 7 and 8 summarize the empirical models estimated in the analysis:

(7) $\ln(Labor_{c,t}) = \beta_1 \ln(Min\_Wage_{c,t}) + \beta_2(Posts = Ind\_Mix_{c,t}) + \beta_3(Age\_Shares_{c,t}) + \sigma_c + \tau_t + \varepsilon_{c,t}$

(8) $\ln(Posts_{c,t}) = \beta_1 \ln(Min\_Wage_{c,t}) + \beta_2(Labor = Age\_Shares_{c,t}) + \beta_3(Ind\_Mix_{c,t}) + \sigma_c + \tau_t + \varepsilon_{c,t}$

where, ln(*Labor*) is the natural logarithm of the number of employed and unemployed individuals, ln(*Posts*) is the natural logarithm of the number of job postings, ln(*Min_Wage*) is the natural logarithm of the minimum wage, (*Ind_Mix*) is the industry mix effect, and (*Age_Shares*) is the share of workers between ages 19 and 25, 55 and 65 and over 65. These equations also include fixed effects for the year (τ_t) and county (σ_c). Our error term is denoted by $\varepsilon_{c,t}$.

3.5 Results

We examined the strength and validity of our instruments using the first-stage regression results (Table 3.2). Results from the first-stage regressions do not show a statistically significant relationship between the share of the population ages 19-25 and the size of the labor force (Panel B). For this reason, we chose to exclude this age share from the second stage. With the exception of the 19-25 age

share, the first-stage regressions support the use of our proposed instrumental variables in the second stage.

Table 3.2 First-Stage Regression Results for Equations 7 & 8

Panel A. First Stage Results for the Job Postings Instrument		
Variable	Coefficient	Model Info
ln(Min_Wage)	-0.075 (0.059)	F(14, 2962): 1121.72
Ind_Mix	0.000*** (7.19e-06)	Observations: 29,630
Age_Share19	0.129*** (0.012)	Rho: 0.960
Age_Share55	0.032*** (0.010)	Time/County Effects: Yes
Age_Share65	-0.004 (0.006)	
Panel B. First Stage Results for the Labor Force Instrument		
Variable	Coefficient	Model Info
ln(Min_Wage)	0.063*** (.011)	F(14, 2962): 50.79
Industry Mix	5.07e-06** (2.29e-06)	Observations: 29,630
Age_Share19	0.001 (0.002)	Rho: 0.999
Age_Share55	-0.008*** (0.002)	Time/County Effects: Yes
Age_Share65	-0.007*** (0.003)	
Note: Robust standard errors in parentheses *p<0.1, ** p<0.05, *** p<0.01		

When controlling for total labor market activity, the effects of raising the minimum wage on the number of people in the labor force is positive and statistically significant (Table 3.2). Using the parameter estimates from Panel A, a 100% increase (i.e., doubling) in the minimum wage is associated with an 8.3% increase in the labor force. This result aligns with our findings in Chapter 2 and suggests that a higher minimum wage brings more people into the labor force.

Table 3.3 Regression results from Equations 7 & 8

Panel A. Estimates for Effect of Minimum Wage on the Labor Force		
Variable	Coefficient	Model Info
ln($\widehat{Posts}$)	0.272* (0.140)	Wald chi2(14): 1.96e+13
ln(Min_Wage)	0.083*** (0.022)	Observations: 29,630
Age_Share19	-0.034* (0.018)	Rho: 0.988
Age_Share55	-0.017*** (0.005)	
Age_Share65	-0.006*** (0.002)	
i.Year	All values were (-) & significant at p<0.10	
Panel B. Estimates for Effect of Minimum Wage on Job Postings		
Variable	Coefficient	Model Info
ln($\widehat{Labor}$)	0.122 (0.686)	Wald chi2(12): 14530.56
ln(Min_Wage)	-0.067 (0.074)	Observations: 29,630
Industry Mix	0.000* (0.000)	Rho: 0.866
i.Year	All values were (+) & significant at p<0.01	
Note: Robust standard errors in parentheses *p<0.1, ** p<0.05, *** p<0.01		

The results from Equation 8 are also consistent with our findings in Chapter 2. When controlling for the size of the labor force, we identify an inverse relationship between the minimum wage and the number of job postings. Additionally, we observe a positive relationship between the number of job postings and the size of the labor force. Neither relationship, however, is statistically significant. Equation 8 produced a small but positive relationship and statistically significant relationship between the number of job postings and the industry mix in a given county. This result follows logic and indicates that the industrial make up of a county may influence the number of job postings in that county.

3.6 Conclusions

This study examines the effects of the minimum wage on labor supply and demand. We use the number of people in the labor force as an indicator of labor supply and the number of job postings by businesses as a proxy for labor demand. We also add controls for labor market activity and use an instrumental variable approach to address endogeneity. Results from our two-stage-least-squares analysis suggest that a higher minimum wage brings more people into the labor force. Additionally, the analysis reveals a statistically significant relationship between increases in the minimum wage and decreases in the number of job postings.

Overall, the results of this paper provide additional support for our findings in Chapter 2. Furthermore, while we observed a small changes in the size of the minimum wage coefficients, the overall results from Equations 7 and 8 do not provide evidence indicating that Equations 1 and 2 are heavily influenced by omitted variable or simultaneity bias.

CHAPTER 4

CONCLUSIONS

In this thesis we sought to answer three questions: (1) How does the minimum wage impact labor supply (unemployment and labor force participation) and labor demand (job postings and GDP)? (2) How do regional differences influence the relationship between the minimum wage and the labor market components identified in Question 1? (3) What are the effects of minimum wage on job postings and the labor force when we control for total labor market activity.

Our analysis in Chapter 2 concludes that a higher minimum wage brings more people into the labor market and, subsequently, is associated with a larger number of people who are unemployed. When looking at (almost) all U.S. counties, however, we could not identify a statistically significant relationship between the number of job postings in a county and the minimum wage. Findings from this paper also suggest that the effects of the minimum wage on regional labor markets differ depending on the type of county (e.g., rural versus urban, low wage versus higher wage). While these differences limit our ability to produce a definitive conclusion for how the minimum wage impacts businesses and workers, our findings do provide an explanation for the varied and often contradictory results of modern minimum wage studies.

Overall, our Chapter 3 analysis provides evidence to support the claim that an increase in the minimum wage leads to an increase in the size of the labor force but does not reveal a significant relationship between the minimum wage and the number of job postings.

Ultimately, this thesis shows that there's no one-size-fits-all answer to the question of how the minimum wage affects workers, businesses, and regions. An increase in the minimum wage might disrupt the labor market of a low-wage, rural area, while a minimum wage hike may be of little consequence in a high-wage, urban county. When considering the entire United States, the combined results from Chapter 2 and Chapter 3 provide evidence that aligns with classic labor theory. These

results indicate an association between higher levels of the minimum wage and increases in unemployment and the labor force.

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BIOGRAPHY OF THE AUTHOR

Dawn Otterby was born in Logan, Utah on October 11, 1992. She was raised in Paradise, Utah and graduated from Mountain Crest High School in 2011. She attended Utah State University and graduated in 2015 with bachelor's degrees in Economics, Agricultural Communication and Communications and Journalism. Following graduation, Dawn spent six years working in the outdoor recreation industry in the western United States. In 2021, Dawn enrolled in The University of Maine's School of Economics' graduate program. Dawn is a candidate for the Master of Science degree in Resource Economics and Policy from the University of Maine in May 2023.