

Theoretical Foundations of the Minimum Wage and Post-Secondary Investment*

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Abstract

This paper studies the relationship between state-level minimum wage changes and post-secondary investment decisions. Whereas existing literature presents conflicting evidence on enrollment responses across different types of institutions, I present a unifying framework with which to make sense of these effects. Building on canonical models of human capital investment, this paper explores the potential of the minimum wage to impact college enrollment decisions by shifting both the wage premium and the opportunity cost associated with these investments. Using administrative post-secondary enrollment data from the Integrated Postsecondary Education Data System (IPEDS) and wage data from the Community Population Survey (CPS), I show that the extent to which these parameters are shifted by the changing minimum wage is a function of prevailing wage distributions in the year before a minimum wage change occurs and, specifically, the bite of the new minimum wage. Guided by my theoretical framework, I use the rich variation in state-level minimum wage changes to size the determinants of enrollment responses to individual changes across years and states. I show that states in which higher shares of high school graduates are bound by the minimum wage are those most likely to experience large enrollment declines at community colleges in response to an increasing minimum wage. Finally, I use my framework to consolidate conflicting estimates from the existing literature.

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1 Introduction

Massachusetts passed the first state-wide minimum wage legislation in the United States in 1912, requiring wage boards in the state to set wages sufficient “to supply the necessary cost of living and to maintain the workers in health” (Massachusetts 1912). The success of minimum wage policy in achieving this fundamental goal: improve the lives of those workers at the lowest end of the earnings spectrum (Massachusetts 1912), has been subject to both academic and popular scrutiny in the intervening century.

Economists often cite a central prediction of neoclassical economic theory in their evaluation of the “success” of minimum wage policy: that unemployment will rise as the result of an increasing wage floor. If wage floor legislation causes job loss in equilibrium, is the minimum wage, as a policy lever, working in service of its original goal? Over the last three decades, economists have produced a large body of literature that serves to answer this question empirically, testing the effect of a rising minimum wage on labor demand (see Wolfson and Belman (2019) for an overview). The relationship between the minimum wage and human capital accumulation, however, has inspired only a fraction of the research attention, despite being integral in considering the underlying goal of the minimum wage. Raising the minimum wage may better an individual’s quality of life in the short-run, but the substitution of labor for human capital accumulation in the face of rising wages may act as a countervailing force to the minimum wage mission in the long-run. This paper considers how the minimum wage moves students on the margin of post-secondary schooling and labor force participation, asking the question: how does the minimum wage affect post-secondary investment?

The lack of recent evidence on the relationship between minimum wage and post-secondary education is surprising given that questions of human capital investment and training are significant when considering worker well-being. This gap is also at odds with the growing literature studying the relationship between students’ human capital investment decisions and their local labor market contexts. Atkin (2016), for example, shows that the growth of export manufacturing in Mexico increased the opportunity cost of schooling for students on the margin of attendance, leading to an overall decrease in enrollment. In the domestic context, several recent papers present evidence of increased college enrollment in response to negative labor market shocks (Hubbard 2018; Foote and

Grosz 2020), and results from Charles, Hurst and Notowidigdo (2018) show a corresponding negative enrollment response to a positive shock. Taken together, these studies suggest that students, especially those attending or on the margin of attending college, tend to be sensitive to their local labor market environment. As the minimum wage continues to be an important and highly variable component of local labor market environments around the country, study of the relationship between minimum wages and human capital investment decisions is more important than ever.¹

An early literature brought this question to the fore as it relates to high schools students and young adults. Mattila (1981) and Ehrenberg and Marcus (1982) represent early attempts to understand how minimum wage legislation may affect the educational attainment of teenagers and young adults, showing minimal and mixed effects of the minimum wage on high school enrollment. The 1990s saw this literature move forward thanks to several papers by David Neumark and William Wascher. In conversation with a large body of work on the relationship between minimum wages and teenage *employment*, Neumark and Wascher (1995*a,b*, 2003), along with Chaplin, Turner and Pape (2003) consider employment as an alternative path for teenagers and young adults in their study of enrollment effects of the minimum wage. Evidence from these studies suggests that higher minimum wages are associated with increased high school dropout rates in states without mandatory schooling laws above the age of 16. The complementary nature of these papers with the teenage employment literature (see Card (1992); Katz and Krueger (1992) for examples), however, means that “teenagers” were largely seen as a single entity in a singular “enrollment” state. These papers, in other words, fail to differentiate between high school and college enrollment, instead treating the decision to enroll as a binary antipode to employment. By treating schooling as one decision, and failing to make a distinction between the decision to invest in secondary (high-school) versus post-secondary (college) schooling, these papers obscure the nuance involved in students’ post-secondary investment decision.

The question of minimum wage and *specifically* post-secondary enrollment has gained some traction in the international context over the last decade. A recent study from Alessandrini and Milla (2021) finds that, in Canada, increases in the minimum wage are associated with increases in community college enrollment and decreases in University enrollment. Additionally, several doctoral

¹Today, state-level minimum wage changes are ubiquitous. Thirty states (plus the District of Columbia) have adopted a minimum wage above the U.S. federal level of \$7.25, which has been in place since July 2009.

dissertations explore this relationship in various international contexts such as the United Kingdom and comparatively across OECD countries (Rice 2010; Kurdi 2017). Pacheco and Cruickshank (2007) also find that, in New Zealand, increased minimum wages led to reduced enrollment rates for students aged 16-19 however, similar to earlier studies, the authors don't differentiate between high school and college enrollment in their age group. Only a few recent papers take up the study of minimum wage and college enrollment in U.S. settings. Wescher, Hutchinson and Rannou (2019) use the NLSY97 to track a subset of high school graduates between the ages of 18 and 24. The study highlights a negative relationship between full-time college enrollment and prevailing minimum wages. Another observational study, Lee (2020), uses cross-state-border variation in minimum wages to study the relationship between minimum wage levels and college enrollment patterns, noting results in line with Wescher, Hutchinson and Rannou (2019): lower levels of enrollment in areas with higher minimum wages. Only one recent paper in the U.S. context, however, takes a quasi-experimental approach to estimating the relationship between minimum wages and college enrollment: Li (2022) uses individual-level data on graduating high school seniors in California, leveraging variation in local minimum wage changes to study the impact of a changing minimum wage on students' propensity to enroll in different types of colleges.

Despite recent increased interest in the empirical relationship between minimum wage changes and post-secondary investment, few of the studies that take up this question lay clear theoretical groundwork for thinking about how we would *expect* the minimum wage to interact with post-secondary investment decisions. A common refrain in the existing literature is that the relationship is “theoretically ambiguous.” This ambiguity leaves an important gap in our understanding of how a changing minimum wage interacts with the parameters we believe to affect a student's decision to attend college.²

This paper offers a foundational framework with which to consider this interaction of the min-

²A recent exception to the dearth of work thinking about how the minimum wage interacts with components of the human capital investment model is Jonathan Vogel's work on the relationship between minimum wages and the college wage premium Vogel (2023). Vogel's work focuses largely on how this relationship contributes to wage inequality in a dynamic setting and there are several key differences in how Vogel frames his paper in comparison to this work. First, this paper focuses on the short-run or partial-equilibrium decisions that students make in the wake of an increase in the minimum wage, whereas a key contribution of Vogel's work is the dynamic nature of the effects. Relatedly, Vogel uses the real minimum wage in his models, whereas this model considers the nominal minimum wage under the assumption that students are making decisions based on this value. Finally, this work builds on Vogel's in its consideration of how the impact of the minimum wage on college premiums impacts students post-secondary investment decisions.

imum wage and post-secondary investment. Drawing on canonical models of human capital investment, I first model a potential student’s decision to enroll in post-secondary education as a function of the costs and benefits of that enrollment. I then explore how, in practice, a changing minimum wage interacts with those cost and benefits, shifting the overall return to post-secondary enrollment and thus the individual propensity to enroll. Using national post-secondary enrollment data from the Integrated Postsecondary Education Data System (IPEDS) and wage data from the Community Population Survey (CPS), I show that aggregate enrollment responses to a minimum wage change can be predicted by the extent to which various parameters from the human capital investment model are shifted by an increase in the minimum wage. Drawing on approaches from the employment effects of minimum wage literature, my framework aims to illustrate how the prevailing labor market conditions in a given state set the stage for a minimum wage change to affect post-secondary investment decisions.

The rest of the paper is structured as follows: Section 2 details the familiar human capital investment model and the ways in which an increasing minimum wage interacts with its’ various components. I use three exemplar cases to demonstrate how local labor market conditions matter for the aggregate enrollment response to an increase. Section 4 presents empirical estimates of overall responses to a change in the minimum wage and a meta-analysis of the determinants of individual states’ enrollment responses. Section 6 takes a closer look at the existing empirical literature, using my proposed framework to make sense of conflicting evidence across settings and samples.

2 Conceptual Framework

This paper develops a straightforward conceptual model to help explore the various ways that minimum wage legislation can impact post-secondary investment. Building on existing models of human capital formation, I highlight the effect of increases in the minimum wage specifically on students’ opportunity cost and degree premia. Charles, Hurst and Notowidigdo (2018) lays out a parsimonious model of post-secondary investment in their study of housing demand shocks and college-going that I adapt below. Students in this model are those who have completed a high school degree and can now pursue three immediate paths: enrollment at a four-year university

(with the goal of earning a bachelor’s degree), enrollment at a two-year university (with the goal of earning an associate degree or a certificate of less than two years), or participation in the labor market.

To start, let’s consider a basic model of post-secondary investment in which the potential student i decides to enroll in a year of school at level c if the returns to that enrollment outweigh the costs. In Equation 1, potential students vary by academic inclination θ_i , which is distributed smoothly $[0, 1]$ and encompasses intangible factors in a student’s background that make them more or less likely to attend college including academic preparedness, past experiences in classroom settings, etc. College attendance carries a psychic cost to students $\kappa_c(1 - \theta_i)$ that allows for variation based on college type c as well as student background. This model groups college type c into simple two-year (2yr) and four-year (4yr) types, assuming that the training at four-year college is strictly more challenging than the training in a two-year college such that $\kappa_{4yr} > \kappa_{2yr}$.³ Potential students face a direct cost of F_c in annual tuition, fees, and any other costs that would not have otherwise been incurred for college type c , and can borrow at interest rate b .

Labor market participants earn Y based on their level of education and the period t . For my purposes, labor market participants who hold a high school degree will represent the “baseline” income level Y_t^0 , or the income that could be earned by anyone in our model if they decide to forgo post-secondary education. In any period t , then, labor market participants earn Y_t^0 or Y_t^c . I allow income Y to vary from one period to the next based on the state of the labor market and various shocks. The “premium” associated with each type of college is thus $\prod_t^c = Y_t^c - Y_t^0$. Equation 1 combines these terms to define the lifetime payoff that person i receives as the result of enrollment in college type c in period t .

$$R_{it}^c(\theta_i) = \sum_{k=1}^{L-t} E_t \left[\prod_{t+k}^c \right] - bF_c - \kappa_c(1 - \theta_i) - Y_t^0 \quad (1)$$

Equation 1 shows that the lifetime return to college c is the college premium ($\sum_{k=1}^{L-t} E_t [\prod_{t+k}^c]$) less the direct (bF_c), psychic ($\kappa_c(1 - \theta_i)$) and opportunity (Y_t^0) costs associated with enrollment at college c . A potential student decides to enroll in a two-year college if $R_{it}^{2yr}(\theta_i) > 0$ and decides

³Future work should question this assumption and extend college type c to encompass student supports at various college types that encourage continued student enrollment and persistence.

to enroll in a four-year college if $R_{it}^{4yr}(\theta_i) > R_{it}^{2yr}(\theta_i) > 0$.⁴

The effect of a minimum wage change on students' post-secondary investment decisions depends on how the change shifts the return function in Equation 1. The direction and magnitude of this shift is composed of three separate effects:

$$\frac{dR_{it}^c(\theta_i)}{dMW} = \frac{d \sum_{k=1}^{L-t} E_t [\Pi_{t+k}^c]}{dMW} - b \frac{F_c}{dMW} - \frac{dY_t^0}{dMW} \quad (2)$$

First, note that the psychic cost and borrowing cost terms drop out from the original human capital investment model once we shift to thinking about the minimum wage. There is little reason to believe that a change in the minimum wage should change the psychic cost of college for students. The minimum wage has no affect on student academic preparedness and thus should not interact with the psychic cost of enrollment. One caveat to this assumption is the ability of an increase in the minimum wage to lessen the mental and emotional financial burden of college. It's possible that, for example, a student who works part time while in school experiences a minimum wage increase as a relief to financial constraints not in the ability to pay for college (as this would impact our direct cost term), but in the mental and emotional toll that being financially constrained in spending or pocket money takes on a young adult. Minimal literature exists on the psychic toll of minor financial constraints (i.e. pocket or spending money rather than costs that prohibit enrollment in college) and, to my knowledge, none exists on the impact of positive financial shocks on the psychic well-being of college students in the U.S.⁵ I assume null effects of the minimum wage on psychic costs for the purpose of this model, but this provides a rich area for future study. Similarly, I assume a null effect of the minimum wage on the interest rate b at which students are able to borrow for college. Once again, a lack of empirical evidence exists exploring this question. One way

⁴Importantly, this model can be estimated for an individual in any period t in which they are a specific age. Age matters in this model as any of the terms in Equation 1 can vary with age and, as discussed, students enroll in college—especially two-year college—at all ages, not simply at age 18 upon graduation from high school. The first term in Equation 1 illustrates that the premium gained through post-secondary investment is declining with age, or as t increases. Similarly, Mincerian models tell us that wages increase with experience. Thus, equating age and experience, we expect Y_t^0 to increase with age as well. To the extent that individuals accumulate savings and/or skills as they age, b and θ_i can also vary with age.

⁵A few exceptions include: a randomized control trial in Malawi, which studies positive income shocks on measures of psychological distress among adolescent girls (Baird, de Hoop and Özler 2013); a qualitative study of the ways in which students experience financial stress Moore et al. (2021); and an analysis of survey responses from Ohio that shows that the vast majority of students surveyed report feeling some sort of personal financial stress in college (Heckman, Lim and Montalto 2014).

in which the minimum wage could impact borrowing cost b is the extent to which students *need* to borrow for college. If we believe a minimum wage change has the potential to significantly increase overall wealth, then we can imagine a situation in which the change reduces borrowing costs. It is unlikely, however, that an increase in the minimum wage has an immediate effect large enough to significantly impact students' need to borrow for college.

Next, the second term in Equation 2, although included in the initial model, will prove to be less relevant in subsequent sections. There are several plausible mechanisms through which one could imagine the direct cost of college (F_c) is impacted by a change in the minimum wage. First, to the extent that these institutions utilize low-wage workers, an increase in the minimum wage has the potential to result in an increase in the cost of labor. Often, increased cost of operation is cited as the reason colleges raise the costs of tuition and fees.⁶ If institutions pass this increased cost of labor through to students, we may expect to see an increase in tuition. In contrast, if institutions are sensitive to enrollment and have relative freedom in their ability to price-adjust, we may expect to see the cost of college responding to the enrollment changes resultant of a minimum wage change. This general equilibrium effect, however, would likely manifest in the longer-run and may not be picked up in a simple event study. Additionally, the ability of institutions to price-adjust flexibly varies across states. Fewer than half of states allow tuition adjustment made by single campus boards at four-year universities or local community college boards at two-year institutions. The majority of states require coordination across either multi-campus boards (four-year institutions) or state systems of higher education (both four- and two-year institutions) to set tuition.⁷ These coordination processes mean that tuition is less likely to make an immediate adjustment to enrollment responses resulting from a minimum wage increase.

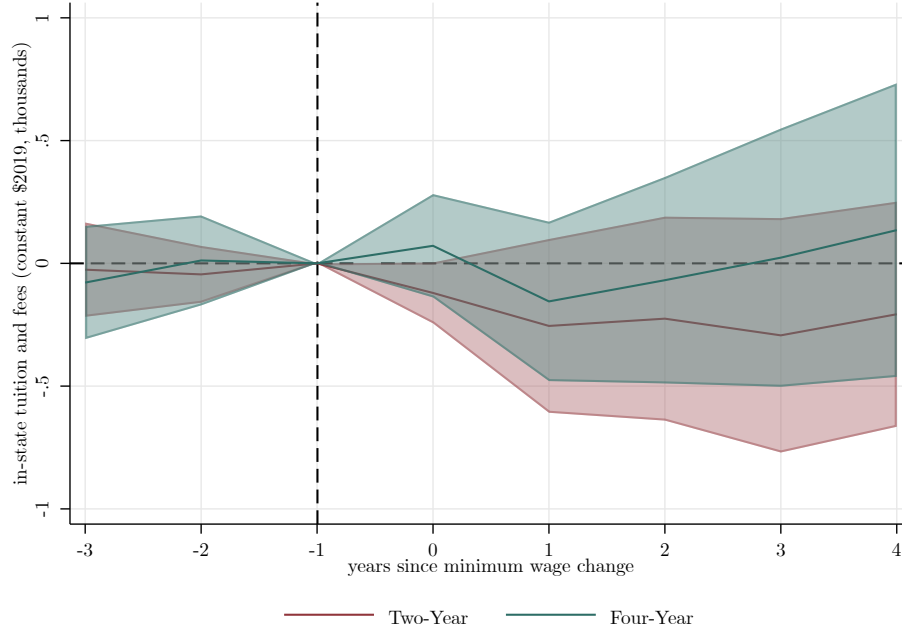
To illustrate the stability of direct costs in the wake of a minimum wage change, Figure 1 gives estimates from a simple event study (methodology detailed in Section 4) that uses minimum wage changes of 5% or larger to estimate the effect of a minimum wage change on tuition and fees (in 2019 dollars) at two- and four-year institutions.⁸

⁶See an anecdotal example of an administration citing increased costs in their decision to raise tuition at the University of Virginia [here](#).

⁷See the Education Commission of the States' resource on [tuition setting](#) for more information on policy variation in tuition setting across states.

⁸Larger minimum wage changes are used in order to capture larger potential cost increases passed through by colleges.

Figure 1
Impact of minimum wage change on tuition and fees at non-profit institutions



Notes: This figure plots the results of a stacked event study measuring the impact of a state-level minimum wage increase on tuition and fees at two- and four-year colleges. Data on tuition and fees come from IPEDS. In-state tuition and fee totals are used. The shaded region identifies 95% confidence intervals. Minimum wage changes of all sizes are used. Controls are included for federal minimum wage changes that occur in the years around the change. Standard errors are clustered at the state level. Red identifies changes in two-year college enrollment. Green identifies changes in four-year college enrollment. The black dashed line identifies the year before the change took place. Year 0 identifies the first academic year with an increased minimum wage.

Figure 1 shows a negligible tuition response to an increase in the minimum wage at both two- and four-year colleges. If anything, we see a decrease in tuition at two-year institutions in response to a minimum wage change, but the effect is not statistically significantly different from zero. The framework that follows will not take into account the effect of a minimum wage change on the direct price of college.

The first and last terms in Equation 2 will be the focus of the remainder of the paper. I refer to the first term as the “premium effect” or the way in which a change in the minimum wage impacts the expected future payoff of having earned degree type c . The premium effect, as I show in Section 2.3 depends largely on a) the initial distribution of wages for various degree holders in a given state, and b) where the new minimum wage hits those distributions. I refer to the fourth term in Equation 2 as the “opportunity cost effect.” Opportunity cost has been the focus of many existing papers studying the relationship between minimum wage and human capital investment

at various levels, but this paper formalizes our understanding of how the opportunity cost effect operates when the minimum wage increases, and how it interacts with the rest of the human capital investment model to shift students' post-secondary investment decisions.

2.1 Theoretical relationship between enrollment and the minimum wage

Much of the existing literature on minimum wages and human capital investment claims that the effect of a minimum wage increase on school enrollment at various levels is theoretically ambiguous. I argue below that, under a few straightforward assumptions, I can model how a minimum wage change will effect the opportunity cost and premium associated with college enrollment, which in turn are predictive of the effect of the minimum wage on the aggregate post-secondary investment response. The labor market context in which the minimum wage change occurs matters for the direction and magnitude of these opportunity cost and premium responses. Below I outline “types” of settings in which minimum wage changes may occur and how the features of each setting can help us predict the nature of an aggregate enrollment response. These cases model aggregate changes in enrollment at the state-level in contrast to the individual decisions modelled above in Equations 1 and 2. These state-level enrollment changes can be conceptualized as the aggregate effect of individual decisions made by students in the given state. After my discussion of the three cases I give an overview of the assumptions implicit in this framework.

Case 1. *Only HS degree holders are bound by the minimum wage.*

In this case, the new minimum wage binds people with a high school degree or less, but does not tend to bind those with any type of post-secondary education. A minimum wage change under these conditions has the effect of shifting only the distribution of wages for high school degree holders while the distributions for c degree holders stay constant. This in turn decreases the premium effect and increases the opportunity cost effect for a very large overall decrease in $\frac{dR_{it}^c(\theta_i)}{dMW}$, the return to degree c . In this case we would expect a large decrease in enrollment.

Case 2. *Both HS and c degree holders are bound by the minimum wage.*

In this case, the minimum wage binds people across the education distribution. As an example, take the case where high levels of both high school degree holders and associate degree holders are bound by the new minimum wage. In this example, an increase in the minimum wage has the effect of increasing the wages of both high school graduates *and* associate degree holders who are

currently making less than the new minimum wage. This has an ambiguous effect on the associate degree wage premium. If wages of both groups are shifting, then we can expect a smaller—if any—decrease in the premium effect than observed in Case 1. As in Case 1, however, the opportunity cost of a year of college increases, resulting in an overall decrease in $\frac{dR_{it}^c(\theta_i)}{dMW}$, although, importantly, smaller than that observed in Case 1. In this case we would expect a slight decrease in enrollment, smaller than observed in Case 1.

Case 3. *Nobody is bound by the minimum wage.*

In the final case, very few—if any—degree holders (HS, AA, or BA) are bound by the new minimum wage. A minimum wage change under these conditions has little effect on wage distributions for HS, AA, or BA holders and thus has little to no effect on the premium or opportunity cost terms in the model. In this case we would expect little to no change in enrollment.

2.2 Assumptions

The parsimonious nature of these cases and the underlying framework rely on several assumptions. Below, I detail these assumptions and provide suggestive evidence from existing literature and theory in support of each:

No disemployment effects. First, I assume that an increase in the minimum wage has little to no effect on an individual’s probability of being employed. There is reasonable evidence to support this assumption given recent literature studying employment effects on a national level from Allegretto et al. (2017); Cengiz et al. (2019); Wolfson and Belman (2019). On the other hand, there has been significant study of the effects of a minimum wage change on specifically teenage and young adult employment that shows that low-skill and younger workers bear the brunt of the disemployment burden (Neumark and Wascher 2007). Cengiz et al. (2019), however, show no effects of heterogeneity in employment effects across age or demographics.

No up-skilling effects. Relatedly, I assume no up-skilling effects of a minimum wage change. In other words, my model holds under the condition of no change in an employer’s propensity to hire more highly credentialed labor in response to a change in the minimum wage. There is relatively less work studying this question in comparison to the question of disemployment effects. Clemens, Kahn and Meer (2021) find increases in the share of jobs listing a high school diploma requirement as the result of minimum wage changes. This could suggest some up-skilling effects of the minimum

wage, but largely on the high school graduate - high school dropout margin, which is less relevant for my study of post-secondary investments but will play a role in Section 6 when I discuss the literature on high school enrollment effects of the minimum wage.

Correlated wage distribution placements. Finally, I assume a relative correlation in individual i 's place in counterfactual wage distributions across education levels. For example, if Person A earns at approximately the 5th percentile in the high school wage distribution, my model assumes that their counterfactual place in the associate and bachelor's degree distributions would be less than or equal to the 5th percentile. This assumption comes into play when considering shifting behavior of the premium in response to a minimum wage change. Take a Case 2 example in which the bottom 6%, say, of both the high school graduate wage distribution *and* the associate degree distribution are bound by the new minimum wage. In order for Person A to expect no significant change in their degree premium, they must anticipate earning in approximately the same position in the associate degree wage distribution as they are in the high school distribution (i.e. in both cases they expect to be shifted *up* by the minimum wage.)

2.3 Exemplar states

Figure 2 showcases “real-world” examples of each of the cases discussed in Section 2.1. Moving forward, this paper will focus on the two-year enrollment margin, rather than referring broadly to colleges of type c . Given that the return to enrollment at a two-year institution ($\sum_{k=1}^{L-t} E_t [\Pi_{t+k}^c]$ as defined in Equation 1) is in most cases lower than the return to four-year enrollment, investment in two-year post-secondary education is more responsive to shifting opportunity costs and premia as they respond to a change in the minimum wage. I demonstrate this empirically in Section 4.1: there is little to no aggregate enrollment change at four-year institutions in response to minimum wage increases. Thus, in the work that follows, I present exemplar cases and further results for enrollment responses at two-year colleges only.

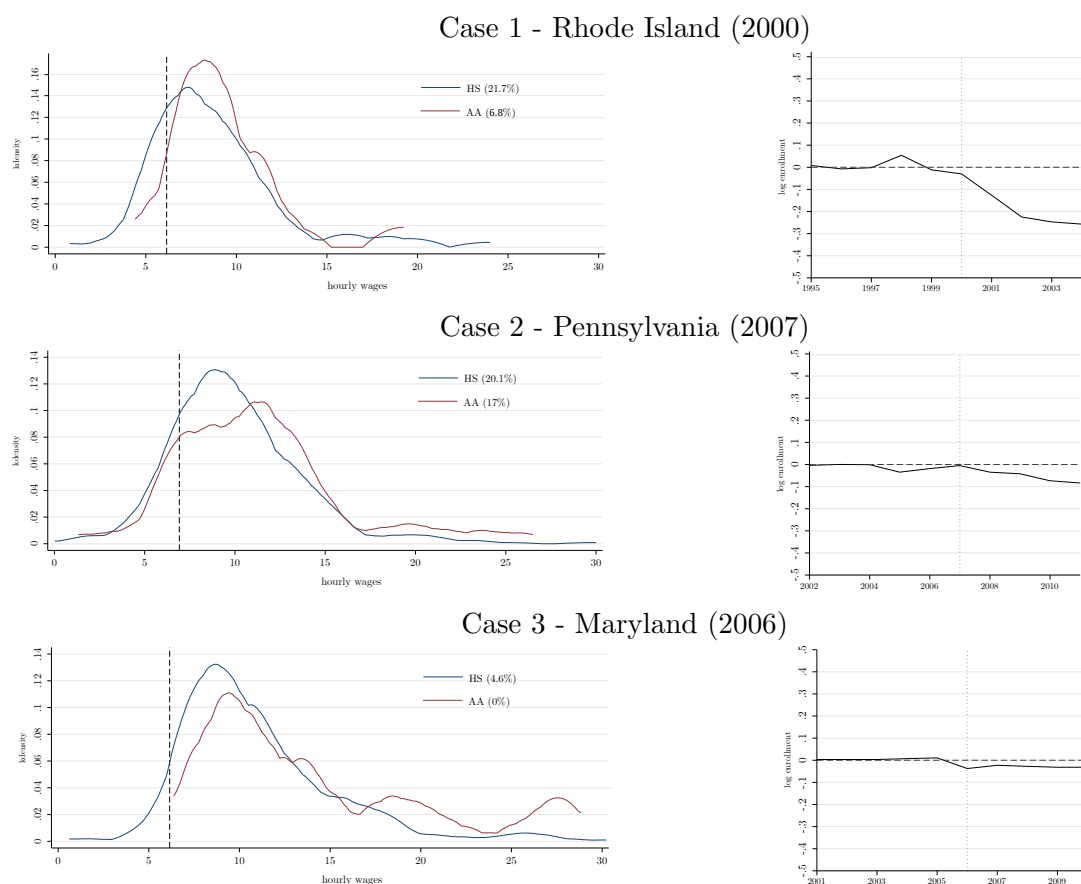
Figure 2 plots kernel density estimates of wages for two types of degree holders—high school and associate degrees—in the year before a minimum wage change.⁹ The dashed line marks the new minimum wage to go into effect in the next year. As discussed above, the impact of the new minimum wage on the premium and opportunity cost terms in Equation 2 depends on who we

⁹Hourly wages are truncated at \$30 per hour for the sake of these visual examples.

expect to be bound by the new minimum wage and to what extent. Enrollment changes are plotted next to the wage distributions and are computed using a basic synthetic controls approach detailed in Appendix A.1.

In the illustration of Case 1 (Rhode Island, 2000), high school degree holders are highly bound by the minimum wage. In fact nearly a quarter of high school degree holders make below the proposed minimum wage in the year leading up to the change. In contrast, only 10% of associate degree holders make below the new minimum wage. As predicted, we see a correspondingly large drop in enrollment.

Figure 2
Exemplar States: wage distributions and enrollment changes



Notes: This figure shows the distribution of wages and the change in enrollment in each of the exemplar states around the time of a minimum wage change. The exemplar states each represent a minimum wage change chosen to illustrate one of the three cases detailed in Section 2.1. On the left, kernel density estimates of hourly wages are plotted for high school and associate degree holders in the given state in the two years preceding the minimum wage change. The previously binding minimum wage is given by the solid line and the new minimum wage is given by the dashed line. On the right, synthetic control estimates are plotted to show the change in enrollment as the result of the given minimum wage in the state of interest. Details of the synthetic control plots can be found in Appendix A.1.

In Case 2, illustrated by Pennsylvania in 2007, the distribution of wages for high school and associate degree holders making below the new minimum wage are nearly identical. This indicates that we can expect both groups to experience an increase in wages as the result of the new minimum wage, minimizing any change to the premium term in Equation 2. As expected, we observe a smaller decrease in enrollment as the result of this minimum wage change than that in exemplar Case 1. Finally, the 2006 minimum wage change in Maryland gives us a clear example of Case 3 in which next to nobody in the state is bound by the minimum wage. In this case, under 5% of combined high school degree and associate degree holders make less than the new minimum wage and thus, not only is our premium term unaffected, the opportunity cost remains largely unchanged as well. Correspondingly, we see little to no change in enrollment in response to the changing minimum wage.

What can we learn from these exemplar cases? Much of the existing literature claims that the relationship between minimum wages and human capital investment is theoretically ambiguous. These authors are correct to the extent that we can expect the relationship to vary based on prevailing labor market conditions in the state experiencing a change. The model and exemplar cases laid out above, however, suggest that understanding the characteristics of labor markets in the given state, including who is bound by the new minimum wage and to what extent, can provide a framework to predict state-level enrollment responses to a changing minimum wage.

Research on the employment effects of the minimum wage discuss the “bite” of the new minimum wage. “Bite” is generally defined in this work as the extent to which the new minimum wage will raise wages for workers in a given setting, and is generally a function of how many workers are earning below the new minimum wage. This parameter, however, has yet to be explored as it relates to how the minimum wage interacts with post-secondary investment.¹⁰ As shown above, the bite of a given minimum wage change as it relates to the wage distributions across education levels in a given state can help us understand how the opportunity cost and wage premia are shifting. The remainder of this paper focuses on the extent to which enrollment responses to state-level minimum wage changes can be explained by the relationship between the bite of a given change and these shifting parameters.

¹⁰An exception is a recent working paper from Jonathan Vogel, which explores the impact of the minimum wage on college wage premia (Vogel 2023).

3 Data

I use several data sources to study the relationship between post-secondary investment and the minimum wage: data on post-secondary enrollment and institutional characteristics from the Integrated Post-secondary Education Data System (IPEDS); monthly and annual minimum wage series from Vaghul and Zipperer (2022); and annual Merged Outgoing Rotation Groups data from the Community Population Survey (CPS) on income and education levels from 1992 to 2019.

IPEDS

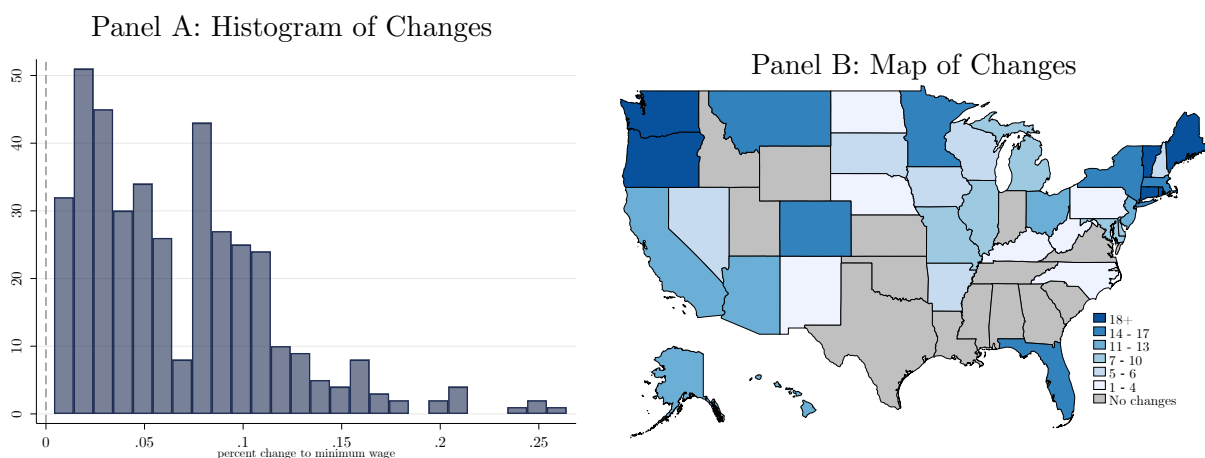
Enrollment in two- and four-year colleges is my primary outcome of interest. These enrollment data come from IPEDS, an administrative data set provided by the National Center for Education Statistics (NCES). The enrollment data span 1986-2019 and cover the universe of Title IV-eligible U.S. post-secondary institutions. I restrict the data to non-profit, degree-granting institutions and classify schools as “two-year” or “four-year.” Schools are classified as two-year if the highest or predominant degree offered is an associate degree, and four-year if the predominant degree offered is a bachelor’s degree or above, given they are not graduate-degree only institutions. Enrollment at these institutions is measured in the Fall. The intensity of enrollment—how many students are enrolled part-time versus full-time in classes—is indicated in the data, but for the majority of my analyses I use a combined enrollment count. Analyses separated by part- and full-time enrollment are included in Appendix [A.2](#). I also use data on institutional characteristics. These data include information on control of the school (for-profit versus non-profit and public versus private), tuition and fees, and geographic location.

Minimum Wage

Data on minimum wage levels and changes come from the state-level monthly minimum wage series described in Vaghul and Zipperer (2022). As my outcome of interest is the decision to enroll in college in the Fall of a given school year, relevant minimum wage changes for student decision-making occur in the *academic* year preceding the Fall of enrollment measurement. For example, regardless of whether a minimum wage change happened in December 2013 or January 2014, Fall 2014 enrollment is the outcome of interest that corresponds to the change. Thus, I align

minimum wage changes with the academic year that they occur in rather than the calendar year. Figure 3 shows the frequency and location of these minimum wage changes across my time period (1986-2019).

Figure 3
Minimum Wage Change Descriptive Figures



Notes: This figure shows the size and location of all minimum wage changes from 1986 to 2019. Panel A shows a histogram of total changes over the time period. Panel B shows a map of total changes; the shade of blue indicates how many minimum wage changes above the threshold occur in a given state.

Panel A shows the frequency and size of minimum wage changes across my time period. Minimum wage changes are sized as the percent increase in the prevailing minimum wage, and between the academic years of 1986 and 2019, over 300 minimum wage changes occur at the state level. Panel B shows that state-level minimum wage changes above the federal level are prevalent but not universal: 14 states in the U.S. face no state-level minimum wage changes from 1986 to 2019. These states are largely concentrated in the South and Rocky Mountain regions of the U.S., and tend to lean Republican in both state and national-level politics.

4 Empirical Evidence

In this section, I present two main sets of results. First, Section 4.1 gives event study estimates of the average enrollment effects of state-level minimum wage changes. I show what these enrollment effects look like at the aggregate level, using a stacked event-study approach to provide evidence for enrollment declines at two- and four-year colleges in response to minimum wage changes across

cases. Next, Section 5 highlights the determinants of event-level enrollment effects guided by the framework discussed in Section 2. Using a meta-regression approach, I estimate a separate treatment effect for each minimum wage change and regress these treatment effects on various measures of the predicted determinants of post-secondary investment responses Section 2.

4.1 Overall enrollment response

Empirical implementation

The key empirical challenge in measuring the response of enrollment to a state-level minimum wage increase is to estimate the counterfactual enrollment patterns in the absence of the change. As changes in the minimum wage are staggered across years and states, I take a stacked event-study approach (as in Schwab, Autor and Donohue III (2006); Cengiz et al. (2019)) to address estimation concerns with the traditional staggered difference-in-differences approach.¹¹ The stacked approach treats each minimum wage change as its own event (e), creating “clean” datasets for each event and estimating enrollment effects in the eight-year window around that event. I specify clean control states as those that do not have a minimum wage change in the eight year panel around event e . States that do see a minimum wage increase in the given window are dropped from the event-specific data set.¹²

The regression equation is then:

$$Y_{st} = \sum_{\tau=-3}^4 \alpha_{\tau} I_{st}^{\tau} + \mu_s + \delta_t + \omega_{st} + \varepsilon_{st} \quad (3)$$

where Y_{st} is the log enrollment in two- or four-year schools in state s time t . The treatment indicator I_{st}^{τ} equals one if state s saw a minimum wage increase τ years from year t . This specification controls for state-by-event effects as well as time-by-event effects. ω_{st} is an indicator that controls for any federal minimum wage changes that take place within the eight-years around the given event.

Standard errors are clustered at the level of treatment.

¹¹See Baker, Larcker and Wang (2022); Roth et al. (2022) for recent reviews of the literature concerning new approaches to difference-in-differences and event study approaches.

¹²All states experience federal minimum wage changes over this period. I control for federal minimum wage changes to assure they do not confound my main effects. Specifically, I construct dummy variables equal to one if a control state experiences a federal change in the minimum wage during the pre ($-3 \leq \tau < 0$) or post ($0 \leq \tau \leq 4$) period of the eight year treatment window. These dummies are then included in the regression specification as ω_{ste} in Equation 3.

This design identifies the causal effect of a minimum wage change on post-secondary enrollment under the assumption that, in the absence of the change, enrollment in treated and untreated states would move in parallel. As in the standard event study case, this assumption cannot be directly tested but pre-trends can be observed in the years leading up to the change. The results presented in Section 4.1 assess the visual existence of pre-trends.

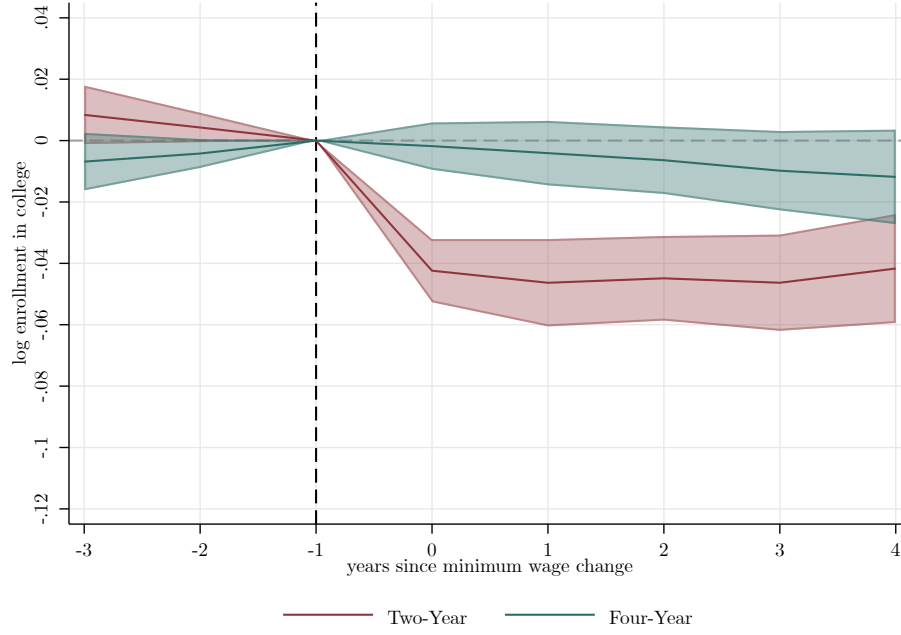
Results

Figure 4 shows the impact of an increase in the minimum wage on log post-secondary enrollment in four-year and two-year schools. Recall from Figure 3 that there are 327 unique increases in the minimum wage over our time period (1986 - 2019), and that the stacked event-study approach treats each as a separate event. The average change in enrollment in response to these events is estimated in years 0-3 after the minimum wage change. Figure 4 shows a 4 log point decrease in enrollment *at two-year schools* in the year after a minimum wage change in the treated state compared to the control states. A fairly precise null effect can be seen when considering enrollment at four-year colleges. Neither two-year or four-year enrollments exhibit a statistically significant trend in the years leading up to a minimum wage change. Main effects as well as heterogeneity by gender and part vs. full-time enrollment can be found in Table A.1.

Keeping in mind that the data I use are cross-sectional, these results can be interpreted as the average state-level aggregate change in enrollment in each subsequent year after a minimum wage increase. Figure A.1 shows my stacked regression estimates alongside a classic two-way fixed effects (TWFE) estimator. Although the TWFE estimate lacks power, the pattern across the two estimators is consistent. This is as expected, as the stacked regression approach uses a relatively large sample of never and not-yet treated control states whereas the TWFE estimator is limited to using the more narrow group of never-treated states.

To address concerns that the size of the minimum wage change may be influencing enrollment responses, or that the frequency of small minimum wage changes may be capturing unwanted or unrelated variation in enrollment, Figure 5 shows enrollment responses to minimum wage changes of various sizes. The red line indicates the average *two-year* enrollment response to minimum wage changes of 6% or larger, green represents 8% or larger, and pink shows 10% or larger. As seen,

Figure 4
Impact of minimum wage change on post-secondary enrollment

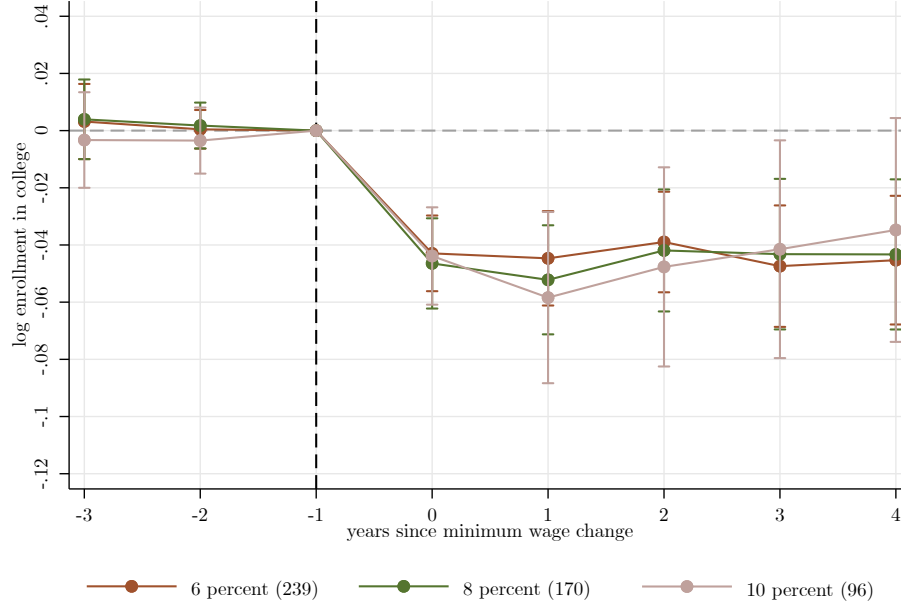


Notes: This figure plots the results of a stacked event study measuring the impact of a state-level minimum wage increase on enrollment in two- and four-year colleges. Part- and full-time enrollment at non-profit colleges is used. The shaded region identifies 95% confidence intervals. Minimum wage changes of all sizes are used. Controls are included for federal minimum wage changes that occur in the years around the change. Standard errors are clustered at the state level. Red identifies changes in two-year college enrollment. Green identifies changes in four-year college enrollment. The black dashed line identifies the year before the change took place. Year 0 identifies the first academic year with an increased minimum wage.

enrollment responses are largely constant across minimum wage change size. The effect sizes are not statistically significantly different from one another, and they are similar to those seen in Figure 4.

The consistency of enrollment response across minimum wage changes of varying sizes also indicates that the simple percent increase in minimum wage is not enough to determine or predict how the change will impact students' post-secondary enrollment decisions. This is intuitive based on the examples shown in Section 2.3. Take a Case 3 state, for example: regardless of the size of the change, if the new minimum wage doesn't bind either high school graduates or associate degree graduates, we wouldn't expect either the premium or the opportunity cost of college enrollment to shift and thus, the overall returns to college for students on average stay the same. What matters is not the size of the change, but where and how it hits the existing wage distributions.

Figure 5
Impact of different sized minimum wage changes on two-year enrollment



Notes: This figure plots the results of a stacked event study measuring the impact of state-level minimum wage increases of various sizes on enrollment in two- colleges. Part- and full-time enrollment at non-profit colleges is used. Whiskers identify 95% confidence intervals. Controls are included for federal and minor (smaller than the level indicated) minimum wage changes that occur in the years around the change of interest. Standard errors are clustered at the state level. The black dashed line identifies the year before the change took place. Year 0 identifies the first academic year with an increased minimum wage.

5 Determinants of enrollment response

The aggregate enrollment results presented above provide foundational evidence to show that, on average, individuals respond to an increasing minimum wage by decreasing post-secondary investment. The nature of the stacked event-study, however, is such that potential variation in enrollment response is obscured. Variation in aggregate response, as discussed in Section 2, can forward our understanding of the conditions under which we may expect to see large (or any) enrollment declines in response to a minimum wage change. In what follows I discuss the measurement of the various determinants of state-level enrollment responses, I walk through my empirical approach, and I show results that aim to quantify the importance of each of these determinants.

5.1 Empirical implementation: measurement

In order to understand the determinants of the enrollment responses to minimum wage increases, I first estimate a separate enrollment response for each minimum wage change in my sample. I estimate these effects using individual, event-by-event estimates of Equation 3. Recall that the stacked event study specification takes the following form:

$$Y_{st} = \sum_{\tau=-3}^4 \alpha_{\tau} I_{st}^{\tau} + \mu_s + \rho_t + \omega_{st} + \varepsilon_{st}$$

In the results that follow, this specification is estimated separately for each event (e), producing a treatment effect that represents the enrollment response associated with each minimum wage change. Although estimated separately for each post-change year in my original results, the meta-analysis will use effect sizes in year $t + 1$.

To capture the determinants of the size of these changes, I use data from the CPS Merged Outgoing Rotation Groups (MORG) to capture hourly wage distributions at the state and education levels. In the analyses that follow, I shorten my panel from 1986-2019 to 1992-2019, as detailed education classifications are only available in the MORG data after 1992.¹³ I restrict the MORG sample to labor market participants of ages 18-30 not currently enrolled in school. I use two metrics to capture the determinants of enrollment response size:

Opportunity Cost

First, to capture the opportunity cost effect, or the extent to which we may expect a change in the minimum wage to affect the opportunity cost of college enrollment, I estimate the percent of individuals with a high school degree who are bound by the new minimum wage. Simply put, this is the share of high school graduates who—in the year before the minimum wage increases—earn below the new minimum wage. These are individuals whose wage we would expect to increase in response to the minimum wage and thus this metric captures the extent to which the opportunity cost of enrollment is increasing in a given state. A negative relationship, therefore, is expected between the share of high school graduates bound by the new minimum wage and enrollment effect

¹³MORG data is preferred to ACS or CPS data because individual hourly wages can be measured with less error. See Lemieux (2006) for more detail.

(a larger share results in a more negative enrollment effect.)

Premium

Next, to capture the premium effect, or the extent to which we may expect a change in the minimum wage to affect the expected returns to a degree, I use the density of expected wage increases for wage earners below the new minimum wage—i.e. the expected wage increase for those who would expect to be shifted “up” by the minimum wage—in the high school graduate population and the associate degree holder population. Formally, I measure:

$$\int_{omw-nmw}^0 (f(w, hs) dw - f(w, aa) dw) \quad (4)$$

where $f(w)$ is a density function with respect to the difference between current wages and the new minimum wage (the expected wage increase) over the interval from the difference between the original minimum wage (omw) and the new minimum wage (nmw) to zero. $f(w, hs)$ represents the density function for high school graduates and $f(w, aa)$ represents the density function for associate degree holders. In other words, the area under the curve captured by each term represents the total increase in expected wages for each group. Taking the difference of these two areas then allows me to capture the degree of overlap between the two distributions and thus parsimoniously demonstrate the gap in expected wage changes between groups. This gap represents the extent to which we expect the returns to an associate degree above and beyond a high school degree to change as the result of a minimum wage increase. As a large gap represents a larger expected wage increase for high school graduates in relation to associate-degree holders, I expect a growing gap to be associated with decreasing enrollment (i.e. I expect a negative relationship between the premium effect and enrollment.)

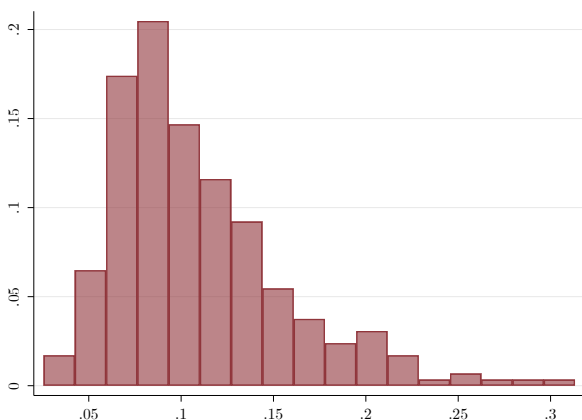
For example, thinking back to the exemplar cases presented in Section 2.3: in the Case 1 example, nearly 22 percent of high school degree holders are bound by the new minimum wage. Approaching this conservatively, anyone who was making greater than or equal to the old minimum wage would expect to be shifted “up” to the new minimum wage in the face of an increase.¹⁴ In

¹⁴There are many reasons that individuals could be earning below the minimum wage. These include sub-minimum wage and tipped positions, measurement error, and unregulated work. For the sake of example, I assume that nobody currently making sub-minimum wage will be shifted up by the increase. This, if anything, is expected to understate the effect of a minimum wage increase.

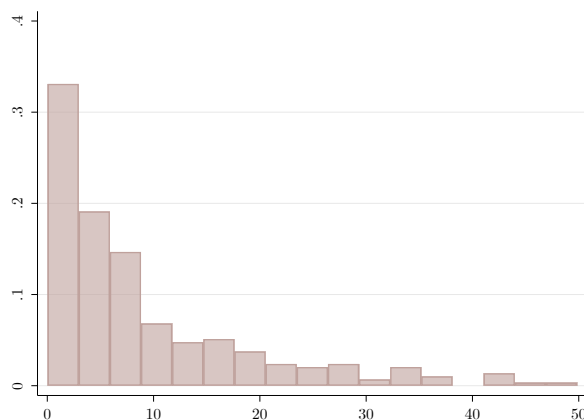
this case, I expect the high school distribution to exhibit a much larger shift in response to the change in comparison to the associate degree distribution. Put another way, high school graduates have a much larger expected increase in total wages than their associate degree holding peers. The premium to earning an associate degree, in this case, is expected to shrink dramatically as a large portion of high school graduates experience a wage increase compared to very few associate degree holders. In Case 2, however, there is just a three percentage point difference between the share of high school graduates and the share of associate degree holders who are bound by the new minimum wage. Once again excluding the sub-minimum wage earners, in this case we expect wages in both groups to shift up in response to the new minimum wage, resulting in a largely unchanged premium. In the comparison of these two cases, a decreasing premium is likely to *decrease* overall returns to college (especially when paired with an increasing opportunity cost) and thus *decrease* overall enrollment.

Figure 6
Distributions of Determinants of Enrollment Effects

Panel A: Histogram of Opportunity Cost Effects



Panel B: Histogram of Premium Effects



Notes: This figure shows the distributions of each determinant of the enrollment effect of a minimum wage change. Panel A shows the distribution of percent of high school graduates in a given state in the year before that state experiences a minimum wage change who are bound by the new minimum wage. Similarly, Panel B plots the distribution of the difference in the total expected wage gain between high school graduates and associate degree holders..

I refer to these two metrics (the opportunity cost effect and the premium effect) as the determinants of the enrollment response to a minimum wage change. Figure 6 shows the distribution of these determinants across the entire sample of minimum wage changes. Table 1 shows these determinants at the state level. As seen in Table 1 there is significant variation in these determi-

nants both within and across states. All but one state (New Mexico) changes its minimum wage more than once over my time period, providing important within-state variation in the determinants of the enrollment response to a minimum wage change. The results presented in Section 5.2 leverage both within and between-state variation to understand the importance of each of these determinants.

5.2 Empirical implementation: meta-analysis

I use a random effects meta-regression approach to understand the relative importance of the opportunity cost and premium effects in determining the size of an enrollment response to a minimum wage change. Specifically, I hypothesize that the enrollment response to a given minimum wage change takes the following form:

$$\alpha_{\tau ye} = \theta + \beta_1 OppCost_{s,\tau=-1} + \beta_2 Premium_{s,\tau=-1} + u_e + \epsilon_e \quad (5)$$

where θ is the pooled average enrollment effect across all events. The opportunity cost and premium effects cause the enrollment effect from an individual event to deviate from the pooled average. The choice of a random effects model assumes no common effect across changes, instead allowing the individual effect α to vary based on the given determinants. In Equation 5, u_e represents within-event error or sampling variability, and ϵ_e represents treatment effect heterogeneity or between-event error. In practice, I account for both sources of variability by using inverse-variance weighting across all events, E . In what follows, I present estimates of β_1 and β_2 .

Results

Figure 7 shows an unweighted, binned scatter plot of the estimated enrollment effects against the determinants of the size of the effect as discussed above. These plots use 314 eligible minimum wage changes occurring between 1992 and 2019. The plots illustrate the basic negative relationship between the parameters and treatment effect size, as hypothesized above. The relationship is stronger in Panel A, which shows the opportunity cost effect, or the effect size plotted against the share of high school graduates bound by each new minimum wage. These scatter plots serve as a visual representation of the raw relationship between my hypothesized determinants and the size of

Table 1 : State-by-state averages of determinants of enrollment response to the minimum wage

	% HS grads bound (1)	AA-HS wage increase gap (2)		% HS grads bound (3)	AA-HS wage increase gap (4)
Alaska	0.098 [0.04]	0.069 [0.09]	Montana	0.094 [0.03]	0.034 [0.04]
Arizona	0.142 [0.10]	0.084 [0.14]	Nebraska	0.129 [0.01]	0.207 [0.20]
Arkansas	0.127 [0.03]	0.159 [0.09]	Nevada	0.064 [0.02]	0.082 [0.07]
California	0.208 [0.08]	0.244 [0.02]	New Hampshire	0.045 [0.00]	0.073 [0.07]
Colorado	0.116 [0.06]	0.078 [0.08]	New Jersey	0.100 [0.04]	0.080 [0.11]
Connecticut	0.099 [0.04]	0.046 [0.04]	New Mexico	0.132 [0.03]	0.220 [0.19]
Delaware	0.083 [0.02]	0.043 [0.02]	New York	0.157 [0.08]	0.247 [0.18]
Florida	0.088 [0.01]	0.050 [0.05]	North Carolina	0.069 [0.02]	0.065 [0.01]
Hawaii	0.132 [0.05]	0.117 [0.09]	Ohio	0.092 [0.01]	0.048 [0.03]
Illinois	0.109 [0.03]	0.193 [0.09]	Oregon	0.159 [0.03]	0.081 [0.07]
Iowa	0.094 [0.01]	0.106 [0.09]	Pennsylvania	0.078 [0.01]	0.102 [0.09]
Kentucky	0.073 [0.03]	0.086 [0.08]	Rhode Island	0.120 [0.05]	0.096 [0.12]
Maine	0.100 [0.07]	0.131 [0.17]	South Dakota	0.086 [0.01]	0.039 [0.06]
Maryland	0.118 [0.07]	0.139 [0.09]	Vermont	0.114 [0.04]	0.058 [0.05]
Massachusetts	0.136 [0.08]	0.196 [0.10]	Washington	0.152 [0.05]	0.059 [0.06]
Michigan	0.114 [0.03]	0.123 [0.12]	West Virginia	0.137 [0.03]	0.212 [0.12]
Minnesota	0.090 [0.04]	0.090 [0.11]	Wisconsin	0.058 [0.01]	0.067 [0.04]
Missouri	0.085 [0.02]	0.068 [0.07]			

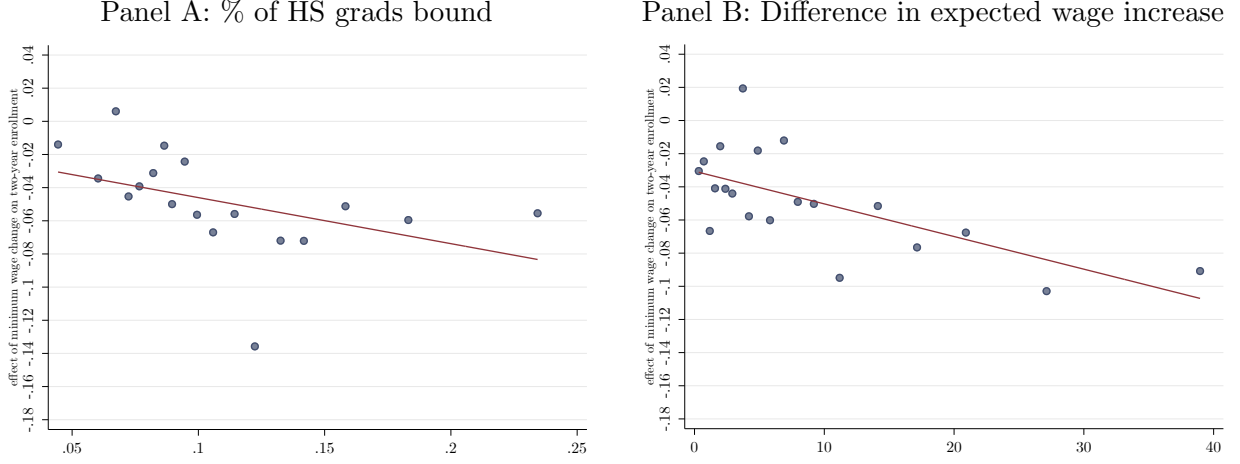
Notes: This table gives the averages and standard deviations of the determinants of enrollment effects of a minimum wage change in each state. The determinants in question are percent of high school graduates bound by the new minimum wage and the difference in associate degree and high school degree holders bound by the new minimum wage. Standard deviations are given in brackets.

enrollment responses to a minimum wage change. Effect sizes in year $t + 1$ are used, but analogous scatter plots for years $t + 0$ and $t + 2$ can be found in Appendix A.2.¹⁵

¹⁵A scatter plot of the full event data set (not binned) can also be found in Appendix A.2.

Figure 7

Determinants of the effect of minimum wage changes on two-year enrollment (year $t + 1$)



Notes: This figure shows a binned scatter plot of the determinants of the effects of minimum wage changes on two-year enrollment against the treatment effect size from a given minimum wage change. The determinants are the percent of high school graduates bound by the new minimum wage in the year before the change happens (Panel A) and the difference in the total expected wage increase between associate degree holders and high school graduates (Panel B). The treatment effect is measured for every state that experienced a state-level minimum wage change in the years 1992-2019.

Estimates from a meta-regression are presented in Table 2. The meta-analysis approach regresses treatment effects on the corresponding determinants (share high school graduates bound and difference in share bound by the new minimum wage) using a random effects specification as detailed in Equation 5. Percent bound measures are calculated using MORG data from the year before the minimum wage change in question, and treatment effects are estimated for the year after the change occurs ($t + 1$).¹⁶ Column one presents the overall two-year enrollment response to a change in the minimum wage. This estimate—an enrollment reduction of 4.7%—is analogous to the estimate shown in Figure 4 except for the years of data used in its estimation: Table 2 uses 1992-2019 data, whereas the estimate presented in Figure 4 uses 1986-2019.

Columns two and three give the relationship between our two parameters of interest (opportunity cost and returns to credential) and the enrollment effect of a minimum wage change. Coefficients can be interpreted such that the following changes result in the given percentage point change in the enrollment effect: a 10 percentage point change in the opportunity cost and a \$100 increase in the overall gap in expected hourly wages between high school and associate degree

¹⁶Notice that this analysis uses only 293 of the total 327 minimum wage changes. These estimates are limited to post-1992 and also to states with sufficient MORG data in each education category (HS, AA, BA holders).

Table 2 : Meta-analysis estimates of determinants of enrollment effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Opportunity cost		-0.028 (0.011)		-0.026 (0.014)	-0.041 (0.016)	-0.026 (0.015)	-0.042 (0.018)
Premium			-0.016 (0.005)	-0.003 (0.008)	-0.022 (0.013)	-0.004 (0.008)	-0.018 (0.013)
Interaction					0.239 (0.131)		0.202 (0.133)
Size of change				-0.029 (0.015)	-0.026 (0.015)	-0.016 (0.014)	-0.015 (0.014)
Intercept	-0.047 (0.005)	-0.017 (0.013)	-0.033 (0.007)	0.001 (0.017)	0.017 (0.019)	-0.146 (0.030)	-0.128 (0.032)
State FE						X	X
N	293	293	293	293	293	293	293

Notes: This table gives estimates from a meta regression of treatment effect sizes on determinants as detailed in 5. Column 1 shows a constant-only regression that gives the average effect of a minimum wage change on two-year enrollment. Column 5 controls for state fixed effects. Data from 1992-2019 are used.

holders. As predicted, large opportunity cost shifts and premia shifts are associated with a more negative enrollment effects (columns 2 and 3). Column 4 controls for the size of the minimum wage change: a 10 percentage point increase in the size of the minimum wage increase. Columns 5 and 7 include an interaction term that uses the premium effect measure interacted with the percent of associate degree holders bound by the new minimum wage. The interaction term better captures not just the extent to which the premium is affected by the minimum wage change, but also how many individuals are affected by the premium change.

Finally, columns 6 and 7 control for state fixed effects. The inclusion of state-level fixed effects allows me to leverage the within-state variation in my determinants of enrollment effects, holding state-specific factors such as industry and demographic composition of the state constant. Using state fixed effects, we see that a 10 percentage point increase in the share of high school graduates bound by the new minimum wage—an increase in the opportunity cost—increases the magnitude of the negative enrollment effect by between 2.5 and 4.2 percentage points. Across the board, the premium effect (the difference in share bound by credential) appears to have a minor and insignificant effect on the size of the enrollment effect.

These meta-analysis results point to the out-sized role of the opportunity cost effect in determining the magnitude of an enrollment response to the minimum wage. In some ways, this is mechanical. If high school graduates are unlikely to be bound by the minimum wage, then associate degree holders are also unlikely to be bound and thus there exists little room for the premium effect to play a role. This situation can be visualized in the “Case Three” example given in Section 2.1. Within a given state context, if more high school graduates are bound by the new minimum wage, we would predict a larger two-year enrollment decline in response to the change.

6 Literature Harmonization

One adverse effect of the current literature’s tendency to ascribe theoretical ambiguity to the relationship between minimum wages and post-secondary investment is the lack of a unifying framework with which to make sense of conflicting empirical findings. Lee (2020), for example, documents a significant, negative relationship between the minimum wage and community college enrollment using a cross-border design in the U.S., whereas Alessandrini and Milla (2021) show evidence of a significant *increase* in community college enrollment in response to rising minimum wages in the Canadian context. It would be easy to attribute these differences to vague contextual or analytical variation, but a theoretical framework like the one I’ve presented above allows me to consolidate this type of conflicting evidence based on a flexible set of parameters.

Table 3 gives an overview of the existing empirical evidence on the relationship between the minimum wage and enrollment across levels of education. Studies were chosen based on their framing of a research question—only studies focused on enrollment were included—and their research design. Many early studies use multinomial probit models to measure how students make trade-offs between enrollment and employment. Only studies that specifically quantified the relationship between the minimum wage and enrollment were included, which means that descriptive studies of national or international trends in minimum wage and enrollment patterns were excluded (Kurdi (2017); Rice (2006), for example.) A basic review of estimates in coarse terms (positive, negative, or mixed/null) can be found in the far right columns.

Below, I broadly apply the proposed framework to different types of estimates in the existing literature:

Table 3 : Estimates from exiting literature

Year	Author	Title	Publication	Sample and data	Summary of results	Results	
						HS	2yr 4yr
1982	Ehrenberg, Ronald G.; Marcus, Alan J.	Minimum Wages and Teenagers' Enrollment-Employment Outcomes	The Journal of Human Resources	Men and women aged 14-19 in the NLS	No significant enrollment response to the minimum wage		↔
1995	Neumark, David; Wascher, William	Minimum-Wage Effects on School and Work Transitions of Teenagers	The American Economic Review	May CPS 1979-1992; 16-19 year olds	A 10% increase associated with 8% decrease in enrollment		↓
1997	Landon, Stuart	High School Enrollment, Minimum Wages and Education Spending	Canadian Public Policy	16 and 17 year-olds enrolled in high school; 1975-1989; six Canadian provinces (Nova Scotia, New Brunswick, Ontario, Manitoba, Saskatchewan, and Alberta)	10% increase associated with 0.8 - 1.7 pp decrease in high school enrollment	↓	N/A N/A
2003	Chaplin, Duane D.; Turner, Mark D.; Pape, Andreas	Minimum wages and school enrollment of teenagers: a look at the 1990's	Economics of Education Review	Common Core grade-state-level data 1989-1996	\$1 increase associated with 2.5 pp decrease in "continuation ratio" (in states with dropout ages of 16-17)	↓	N/A N/A
2005	Campolieti, Michele; Fang, Tony; Gunderson, Morley	Minimum wage impacts on youth employment transitions, 1993-1999	Canadian Journal of Economics	Survey of Labor and Income Dynamics, Canada, 1993-1999; ages 16-24	No significant enrollment response to the minimum wage		↔
2005	Baker, Michael	Minimum wages and human capital investments of young workers	Government of Canada Working Paper Series	Labor force survey 1983-2000; ages 15-24	No significant enrollment response to the minimum wage		↔
2007	Pacheco, Gall A.; Cruickshank, Amy A.	Minimum wage effects on educational enrollments in New Zealand	Economics of Education Review	New Zealand national data (similar to CPS); 1986-2004; ages 16-24 in each year	10% increase associated with 0.9 pp decrease in enrollment		↓
2009	Crofton, Stephanie.; Anderson, William.; Rawe, Emily	Do Higher Real Minimum Wages Lead to More High School Dropouts? Evidence from Maryland	The American Journal of Economics and Sociology	High school dropout rates among student populations by race across counties in Maryland 1993-2004	\$1 increase (2004 dollars) associated with 2.2 pp increase in high school dropout rates among Hispanic students	↓	N/A N/A
2010	Warren, John Robert; Hamrock, Caitlin	The Effect of Minimum Wage Rates on High School Completion	Social Forces	State-year level high school completion rates 1982-2005	No significant enrollment response to the minimum wage		↔
2019	Wascher, Lance; Hutchinson, Travis; Ramnou, Anna	Minimum Wages, Employment, and College Enrollment	The American Economist	NLSY97 HS grads aged 18-24 (college grads excluded)	10% increase associated with 4-5% decrease in CC enrollment	N/A	↓
2020	Lee, Chang Hyung	Minimum Wage Policy and Community College Enrollment Patterns	ILR Review	IPEDS 1990-2010, institution level enrollment paired across borders	10% increase associated with 5.2% decrease in 4yr enrollment, 6% increase in CC enrollment	N/A	↓
2021	Alessandrini, Diana; Milla, Joniada	Minimum Wage Effects on Human Capital Accumulation: Evidence from Canadian Data	IZA Working Paper Series	Survey of Labor and Income Dynamics, Canada, 1993-2011; ages 18-45 with at least a high school diploma	No community college enrollment effect; \$1 increase results in .57 pp increase in four-year enrollment	N/A	↑
2022	Li, Alice Qin	Essays on the Economics of Higher Education	Dissertation	High school seniors, CA; 2010-2019		N/A	↔

High school enrollment findings

Across the board, the existing literature tends to find null to negative effects of a minimum wage change on high school enrollment (also framed as a positive effect on high school dropout rates). These findings are largely concentrated in states that, at the time of study, had a low or no minimum schooling age in place, meaning that students were legally able to drop out of school at any age. As mentioned in Section 1, some of these studies are flawed in their measurement of enrollment as cumulative across high school and post-secondary settings. In general, however, we may be more likely to see a decrease in high school enrollment in response to the minimum wage because those with less than a high school education are those who are most likely to be bound by the minimum wage. If this group is the most likely to be bound, a change in the minimum wage is highly likely to increase the opportunity cost of an extra year of high school. Note, however, that the decision to remain in high school is markedly different than that to enroll in post-secondary education. Returning to our original model:

$$\frac{dR_{it}^c(\theta_i)}{dMW} = \frac{d \sum_{k=1}^{L-t} E_t [\Pi_{t+k}^c]}{dMW} - b \frac{F_c}{dMW} - \frac{dY_t^0}{dMW}$$

In the case of high school enrollment, the direct cost term drops out completely (assuming public high school is available, as it should be for every student in the U.S.). Once our second term drops out, Equation 2 leaves us with the simple shifting of the premium versus the shifting of the opportunity cost. As covered, we may expect the opportunity cost effect to be large, given that the share of sub-high school graduates bound by the minimum wage is likely to be the highest of any education group. Considering the results presented in Section 5.2, which underscored the role of a shifting opportunity cost in enrollment responses to minimum wage changes, this framework would predict significant high school enrollment declines in states where dropping out is legal. Beyond basic enrollment declines, any variation in enrollment effects across contexts is going to depend on how the premium shifts in response to the minimum wage change. This variation will be driven by the position of high school graduate wage distributions in a state relative to sub-high school wage distributions.

Conflicting community college enrollment effects

Another notable conflict in evidence is between the three most recent studies on the relationship between the minimum wage and community college enrollment. Lee (2020) finds a significant decrease in community college enrollment associated with higher minimum wages in the U.S., Alessandrini and Milla (2021) finds a significant increase in community college enrollment associated with higher minimum wages in Canada, and Li (2022) finds a null effect on community college enrollment in response to local changes to the minimum wage in California. The Canadian context is unique, as Alessandrini and Milla point out, because the two-year degree in Canada is largely “apprenticeship” based, unlike the focus on academic two-year programs in the U.S. People holding an apprenticeship certificate in Canada, especially men, have significantly higher median incomes, even relative to bachelor’s degree holders. Additionally, even those who opt for a two-year academic degree in Canada make relatively more than they do in the U.S. For example, a two-year degree holder in Canada made 82% of what a bachelor’s degree holder made, whereas in this U.S. an associate degree holder made just under 70% of bachelor’s degree holders. If we restrict that to apprenticeship certificate holders, that figure is nearly 90% across Canada. Given these dynamics, it is possible that both two-year academic degree holders and apprenticeship certificate holders are less likely to be bound by the minimum wage in Canada than they are in the U.S., which would account for a non-negative enrollment response to a minimum wage change.

Not dissimilar to the effect documented by Alessandrini and Milla (2021), the setting studied in Li (2022) is another in which we may be unlikely to see negative enrollment responses to an increasing minimum wage. Li uses minimum wage changes at the local level, which are commonly legislated in particularly high-income areas in order to account for differential costs of living across a state. Some of the localities that saw minimum wage changes during Li’s period of study (2010-2019) and setting included San Francisco, San Jose, and San Diego: three cities with notoriously high costs of living and high wages to match. These are cities, as is the case in many politically progressive localities, in which we may expect fewer people to be bound by the new minimum wage, especially if they have above a high school credential.

7 Discussion

This paper aims to address a foundational gap in the literature by outlining a framework with which to consider post-secondary investment responses to state-level minimum wage changes. I begin by reviewing the canonical human capital investment model and highlighting the effect of a minimum wage change on the different parameters that affect a student’s propensity to invest. I then propose several simple metrics to conceptualize the effect of a minimum wage change on the extent to which both the opportunity cost and college premium shift in response to this change. By leveraging available information about the prevailing local labor market conditions in which the minimum wage change is occurring, I show that we can roughly predict the relative size of enrollment responses to minimum wage legislation. Additionally, I use a meta-analysis approach to show that the opportunity cost effect dominates relative to the premium effect in forecasting the size of an enrollment response to a minimum wage change. Ultimately, I demonstrate that, within a given state context, larger shares of high school graduates bound by the new minimum wage are associated with larger two-year enrollment declines in response to the change. This result is useful in considering the conditions under which enrollment will be effected by minimum wage legislation. Finally, I use the proposed framework to broadly consolidate conflicting findings in the existing literature.

Beyond addressing a gap in the literature, this work aims to challenge prevailing wisdom about the minimum wage and human capital investment. A simple take on the minimum wage and post-secondary investment, one that takes a broad-brush approach to identifying a negative enrollment effect of minimum wage changes, obscures the ways in which minimum wage legislation has the potential to interact with specific state- and local-level contexts. Moreover, an understanding of the conditions under which a minimum wage increase is predicted to affect post-secondary investment is important in the conceptualization of the general equilibrium and long-run welfare effects of minimum wage legislation. If the goal of the minimum wage is to raise standards of living for the most vulnerable populations, consideration of how this legislation impacts human capital investment decision-making should accompany the existing consideration of its effect on labor demand.

Importantly, modelling who may be influenced by a change in the minimum wage can allow policies to talk to one another. For example, raising minimum compulsory schooling ages can

and has combated dropout rates among high school students in response to minimum wages. If a policy goal is to raise the minimum wage while minimizing negative enrollment effects at two-year institutions, a state or locality might consider proportional wage increases based on level of education, so to maintain a significant premium associated with an associate degree.

Finally, future work is necessary to consider the nuanced facets of this relationship between human capital investments and the minimum wage. Broad exploration of subgroups or industries more likely to be bound by the minimum wage, as well as the heterogeneity of responsiveness to various determinants across states represent two priority areas for study.

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A Appendix

A.1 Synthetic Controls Analysis

Synthetic control methods have seen significant growth in popularity and use over the last several decades. These approaches are particularly useful in the estimation of effects in cases where an intervention is implemented at an aggregate level, affecting a small number of large units (Abadie 2021). They are useful, therefore, in my exemplar estimation of the enrollment effects of a single minimum wage change. In my estimation of enrollment effect plots in Figure 2, I construct a synthetic control state against which to compare the “treated” state in each case that has been subject to a minimum wage increase.

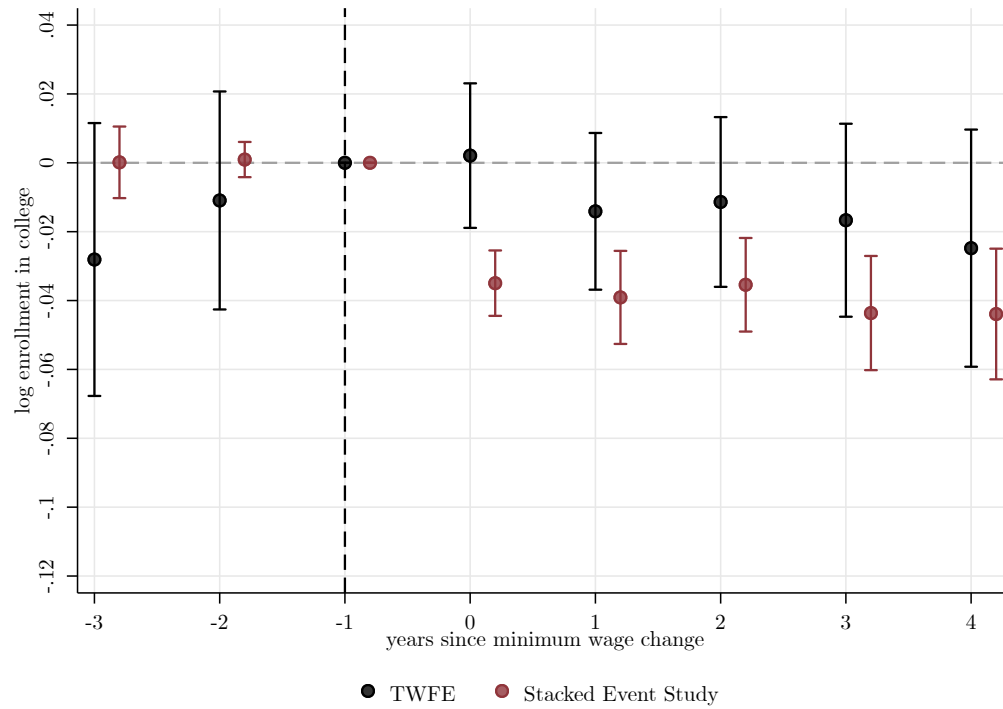
Take Case 1 as an example: a minimum wage change occurs in Rhode Island in 2000. The synthetic controls plot uses a pool of untreated donor states to generate a synthetic Rhode Island to use as a “control” state. Ideally, a well-matched synthetic control in my case will estimate the evolution of two-year college enrollment in Rhode Island in the absence of a minimum wage change. This facilitates estimation of the dynamic effect of the minimum wage increase across years after the change as the difference in each year between Rhode Island’s actual path and the path of the synthetic control.

I construct my donor pool in the creation of the synthetic control using all states that do not experience a minimum wage change in the window around the minimum wage change in question. For example, the Rhode Island change happens in 2000. My window is defined from 1995 to 2004. Donor pool states do not experience a state-level minimum wage increase in these years. Additionally, it is standard in some synthetic control specifications to match the entire pre-period on pre-treatment outcomes. I allow for initial matching on pre-treatment outcomes in the first two years of my pre-period, but then allow the treatment and synthetic control states to vary. This allows me to assess a robustness check on my synthetic control comparison. If, for example, the synthetic control and treatment states appeared to be comparable in the pre-treatment years when they were being matched on pre-treatment outcomes ($t = [-4, -2)$), but trends diverged in the pre-period when pre-treatment outcomes were not being used ($t = [-2, 0]$), then we may be worried that the effect observed in the post-period is purely mechanical. As seen in Figure 2, my synthetic

control states in all three Cases appear to be strong counterfactuals for the treated states.

A.2 Tables and Figures

Figure A.1
TWFE and stacked regression results



Notes: This figure plots the results of a stacked event study measuring the impact of a state-level minimum wage increase on enrollment in two-year colleges from a standard TWFE model and my preferred stacked regression estimator. Whiskers represent 95% confidence intervals. Minimum wage changes of all sizes are used. Controls are included for federal minimum wage changes that occur in the years around the change. Standard errors are clustered at the state level. The black dashed line identifies the year before the change took place. Year 0 identifies the first academic year with an increased minimum wage.

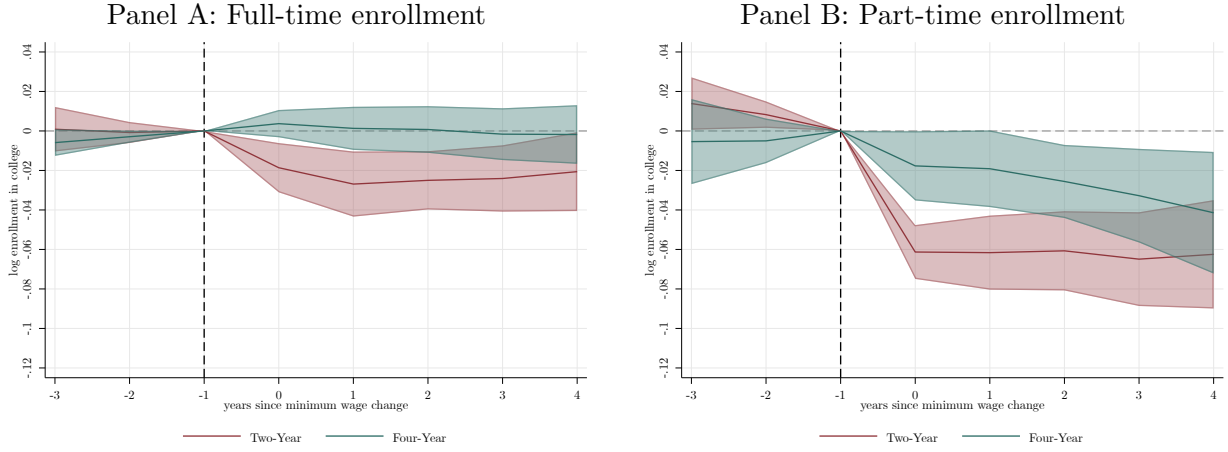
Table A.1 : Enrollment responses to a change in the minimum wage

	Two-year enrollment			Four-year enrollment		
	Total (1)	Men (2)	Women (3)	Total (4)	Men (5)	Women (6)
<i>Panel A: All Schools</i>						
Total enrollment	-0.047 (0.009)	-0.049 (0.012)	-0.048 (0.008)	0.004 (0.008)	0.009 (0.008)	0.000 (0.008)
Full-time enrollment	-0.032 (0.011)	-0.027 (0.010)	-0.036 (0.011)	0.004 (0.006)	0.007 (0.006)	0.002 (0.006)
Part-time enrollment	-0.045 (0.013)	-0.055 (0.019)	-0.042 (0.010)	0.003 (0.021)	0.012 (0.021)	-0.005 (0.021)
<i>Panel B: Non-Profit Schools</i>						
Total enrollment	-0.052 (0.009)	-0.056 (0.013)	-0.051 (0.007)	0.000 (0.006)	0.005 (0.006)	-0.005 (0.006)
Full-time enrollment	-0.036 (0.009)	-0.034 (0.010)	-0.040 (0.009)	0.003 (0.005)	0.006 (0.005)	0.000 (0.005)
Part-time enrollment	-0.064 (0.012)	-0.077 (0.019)	-0.059 (0.009)	-0.004 (0.015)	0.002 (0.014)	-0.010 (0.015)
<i>Panel C: For-Profit Schools</i>						
Total enrollment	-0.067 (0.069)	-0.092 (0.069)	-0.070 (0.072)	0.007 (0.132)	0.126 (0.133)	-0.035 (0.141)
Full-time enrollment	-0.048 (0.055)	-0.059 (0.056)	-0.054 (0.059)	0.076 (0.135)	0.144 (0.138)	0.064 (0.143)
Part-time enrollment	-0.177 (0.135)	-0.158 (0.124)	-0.234 (0.139)	-0.061 (0.102)	-0.038 (0.107)	-0.061 (0.105)

Notes: This table gives the results of a stacked event study measuring the impact of a state-level minimum wage increase on enrollment in two- and four-year colleges. Minimum wage changes of eight percent or more are used. Controls are included for federal minimum wage changes that occur in the years around the change. Standard errors are clustered at the state level.

Figure A.2

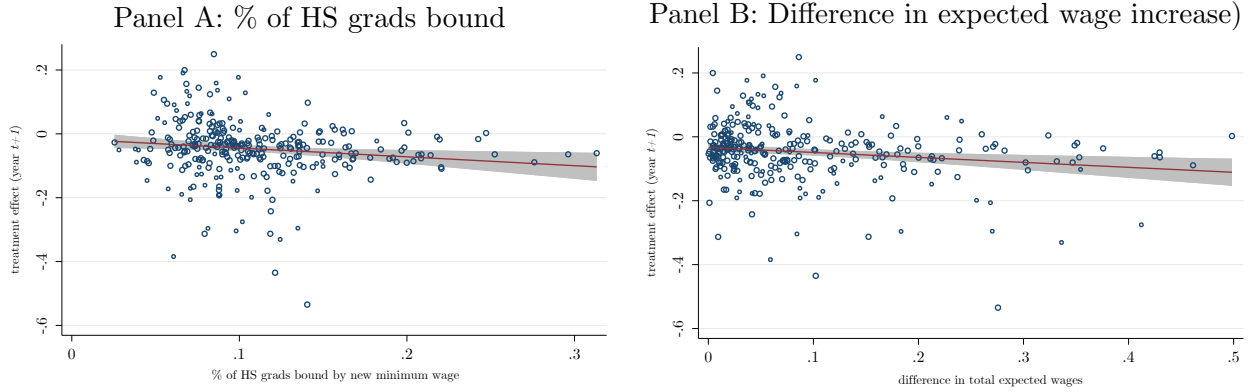
Full-time and part-time enrollment responses to a change in the minimum wage



Notes: This figure plots the results of a stacked event study measuring the impact of a state-level minimum wage increase on part- and full-time enrollment in two- and four-year colleges. The shaded region identifies 95% confidence intervals. Minimum wage changes of all sizes are used. Controls are included for federal minimum wage changes that occur in the years around the change. Standard errors are clustered at the state level. Red identifies changes in two-year college enrollment. Green identifies changes in four-year college enrollment. The black dashed line identifies the year before the change took place. Year 0 identifies the first academic year with an increased minimum wage.

Figure A.3

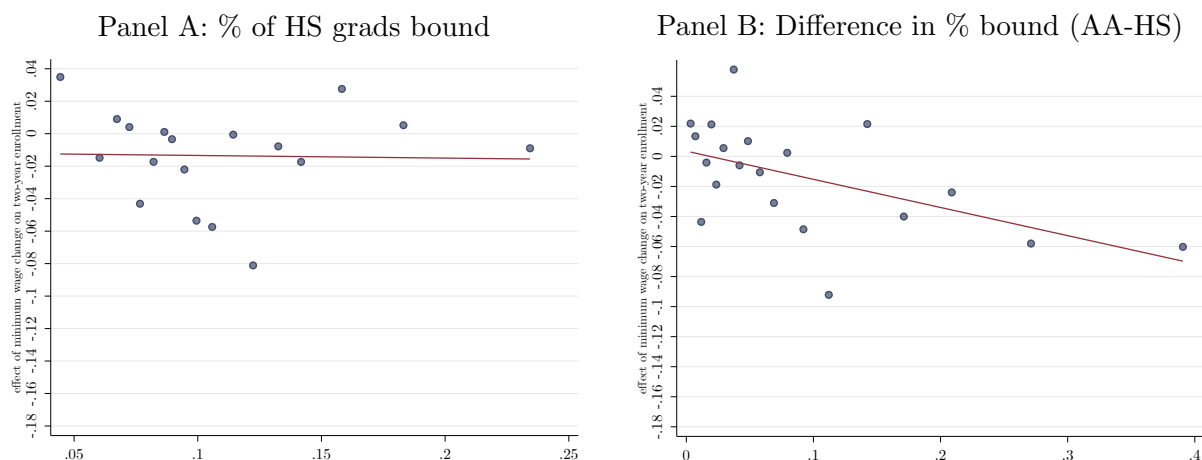
Determinants of the effect of minimum wage changes on two-year enrollment (year $t + 1$)



Notes: This figure shows a weighted scatter plot of the determinants of the effects of minimum wage changes on two-year enrollment against the treatment effect size from a given minimum wage change. The determinants are the percent of high school graduates bound by the new minimum wage in the year before the change happens (Panel A) and the difference in the total expected wage increase between associate degree holders and high school graduates (Panel B). The treatment effect is measured for every state that experienced a state-level minimum wage change in the years 1992-2019. Each point represents one of these changes and the points are weighted (indicated by size) using inverse-variance weights.

Figure A.4

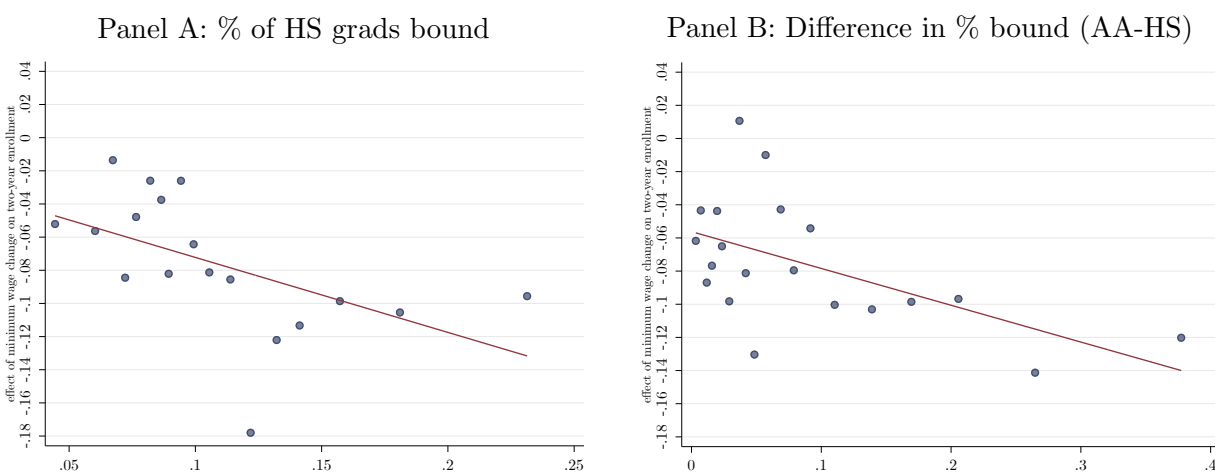
Determinants of the effect of minimum wage changes on full-time enrollment (year $t + 1$)



Notes: This figure shows a binned scatter plot of the determinants of the effects of minimum wage changes on full-time two-year enrollment against the treatment effect size from a given minimum wage change. The determinants are the percent of high school graduates bound by the new minimum wage in the year before the change happens (Panel A) and the difference in the total expected wage increase between associate degree holders and high school graduates (Panel B). The treatment effect is measured for every state that experienced a state-level minimum wage change in the years 1992-2019.

Figure A.5

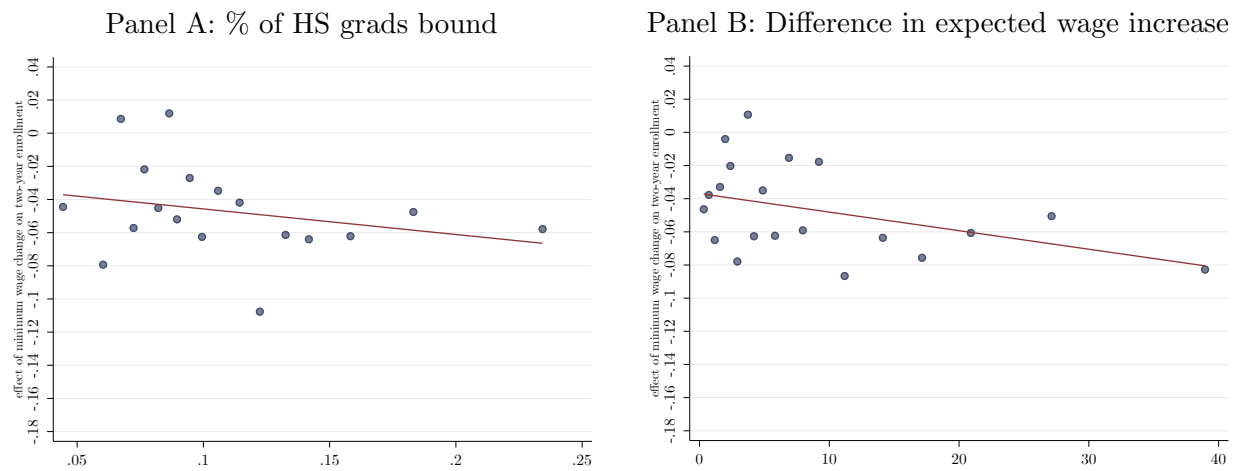
Determinants of the effect of minimum wage changes on part-time enrollment (year $t + 1$)



Notes: This figure shows a binned scatter plot of the determinants of the effects of minimum wage changes on part-time two-year enrollment against the treatment effect size from a given minimum wage change. The determinants are the percent of high school graduates bound by the new minimum wage in the year before the change happens (Panel A) and the difference in the total expected wage increase between associate degree holders and high school graduates (Panel B). The treatment effect is measured for every state that experienced a state-level minimum wage change in the years 1992-2019.

Figure A.6

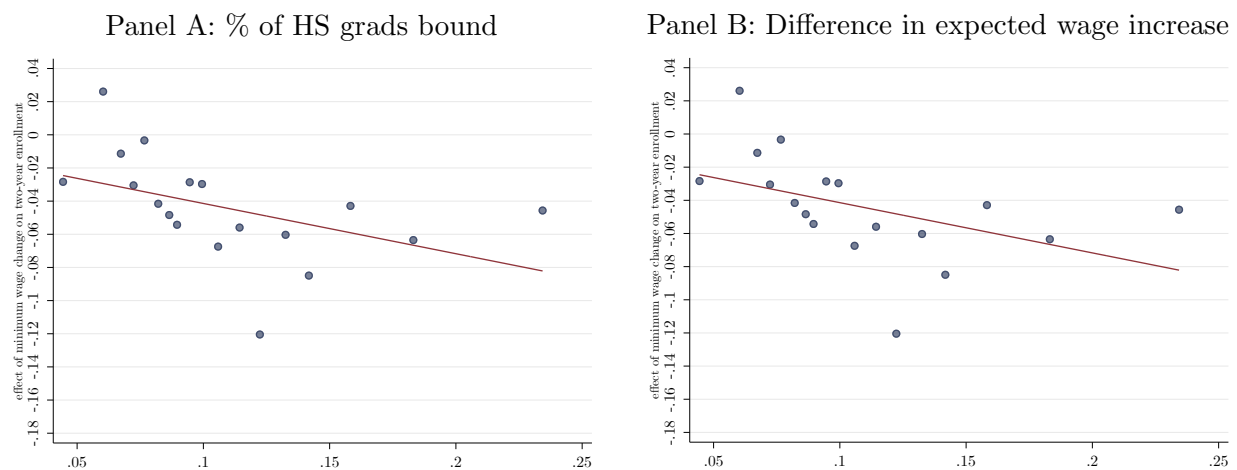
Determinants of the effect of minimum wage changes on two-year enrollment (year $t + 0$)



Notes: This figure shows a binned scatter plot of the determinants of the effects of minimum wage changes on two-year enrollment against the treatment effect size from a given minimum wage change. The determinants are the percent of high school graduates bound by the new minimum wage in the year before the change happens (Panel A) and the difference in the percent of high school grads and the percent of associate degree holders who are bound by the new minimum wage in the year before the change (Panel B). The treatment effect is measured for every state that experienced a state-level minimum wage change in the years 1992-2019.

Figure A.7

Determinants of the effect of minimum wage changes on two-year enrollment (year $t + 2$)



Notes: This figure shows a binned scatter plot of the determinants of the effects of minimum wage changes on two-year enrollment against the treatment effect size from a given minimum wage change. The determinants are the percent of high school graduates bound by the new minimum wage in the year before the change happens (Panel A) and the difference in the percent of high school grads and the percent of associate degree holders who are bound by the new minimum wage in the year before the change (Panel B). The treatment effect is measured for every state that experienced a state-level minimum wage change in the years 1992-2019.