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ABSTRACT

Understanding "Wage Theft": Evasion and Avoidance Responses to Minimum Wage Increases[1]

A holistic assessment of the labor market effects of minimum wage regulation requires understanding employer compliance. The economics literature has paid little attention to this issue. We investigate how minimum wage increases and the strength of enforcement regimes affect the prevalence of subminimum wage payments. We find strong evidence that higher minimum wages lead to a greater prevalence of subminimum wage payments. We consistently estimate that increases in measured underpayment following minimum wage increases average between 10 and 25 percent of realized wage gains. We interpret this as evidence that minimum wage evasion and avoidance are an important reality in the low-wage labor market. Finally, we find that enforcement regimes play an important role in shaping both baseline compliance rates and the response of compliance to increases in minimum wages.

JEL Classification: J08, J38, K42

Keywords: minimum wage, subminimum wage, compliance, noncompliance, enforcement

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Section I: Introduction

After a lull in the years following the Great Recession, many states have legislated and implemented substantial minimum wage increases. An understanding of employers' compliance with these regulated wage increases is crucial for developing a holistic assessment of their labor market effects. In this paper, we investigate two key issues regarding the magnitude and determinants of minimum wage evasion and avoidance activity. First, we estimate the extent of "noncompliance on the margin." That is, we estimate the increase in evasion and avoidance that occurred in response to recent increases in minimum wages. Second, we investigate whether changes in the prevalence of subminimum wage payment were shaped by enforcement provisions within state labor laws.

We find strong evidence that higher minimum wages increase the prevalence of workers who are paid wage rates below the minimum wage. In addition to increasing wage rates among the employed, minimum wage increases lead to a greater prevalence and larger magnitude of subminimum wage payments. We consistently find that increases in subminimum wage payments average between 10 and 25 percent of the wage gains realized following minimum wage increases. These findings suggest that compliance with minimum wage laws is the norm, but that avoidance and evasion occur with non-trivial frequency. In further analysis, we find evidence that enforcement regimes shape compliance patterns along multiple dimensions.

Empirical research on the determinants of minimum wage evasion has been limited. In the U.S. context, analyses have found that violation rates are correlated with several of the

factors that arise in classic analyses of the economics of crime (Becker, 1968).[2] Both Weil (2005) and Bernhardt, Spiller, and Theodore (2013), for example, find high violation rates in industries in which firms have a limited ability to pass labor costs on to consumers.[3] Bernhardt, Spiller, and Theodore (2013) find that firms' management structures shape compliance behavior. Goraus-Tanska and Lewandowski (2016) find that subminimum wage payment is most prevalent when countries' minimum wage rates are high relative to their average wage rates. Caliendo, Schröder, and Wittbrodt (2018), highlight that evidence from several recent papers speaks to compliance in the context of Germany's recent introduction of a statutory minimum wage. The evidence suggests of moderately high rates of non-compliance in the short-run (Caliendo et al, 2017; Bruttel, Baumann, and Dutsch, 2018).

Several papers assess the role of minimum wage enforcement institutions. Weil (2005) finds evidence that noncompliance tends to be high when the value of workers' skills is low and when enforcement technologies are strong. Bhorat, Kanbur, and Mayet (2012) find no evidence of a relationship between evasion and the number of inspectors employed to detect violations. Galvin (2016), on whose documentation of enforcement institutions we draw, finds that strict enforcement and penalty regimes reduce the prevalence of subminimum wage payment.

[2] Agan and Makowski (2018) apply the lens of the Becker model to understand the effects of the minimum wage on recidivism.

[3] These empirical findings are typically connected to insights from an earlier theoretical literature (Ashenfelter and Smith, 1979; Grenier, 1982; Chang and Ehrlich, 1985) that applies the theoretical lens of Becker's (1968) economic analysis of crime to the issue of minimum wage compliance. This literature finds that evasion and avoidance behavior will tend to be increasing in such factors as the degree to which the minimum wage exceeds the market wage, the magnitude of the elasticity of demand for a firm's output, the resources devoted to identifying violations, and the severity of the penalties associated with violation. Subsequent theoretical work has brought insights related to partial compliance (Gideon, 2001) and optimal enforcement strategies.

Our analysis advances the literature on evasion and avoidance responses to the minimum wage along two key dimensions. First, in the U.S. context there is very little existing analysis of the prevalence of subminimum wage payment on the margin. That is, little evidence reveals how the prevalence of subminimum wage payment responds to changes in the wage floor.

Second, the economics literature has done little to develop evidence on the empirical relevance of enforcement institutions. Our analysis harnesses measures of enforcement institutions and penalty regimes developed by Galvin (2016) in a recent contribution to the literature on labor law. In our empirical analysis, we find that Galvin's enforcement and penalty indices predict patterns in the prevalence of subminimum wage payment across states. This is true both of baseline patterns and of patterns in the responsiveness of subminimum wage payment to increases in minimum wage rates.

We begin our empirical analysis with an investigation of whether the prevalence of subminimum wage payment rises as the minimum wage rises.[4] We find quite strong evidence that it does. In our analysis of un-tipped hourly workers ages 16 to 25, for example, we find that each dollar of minimum wage increase predicts, on average, a wage gain of roughly $0.26 and a $0.04 increase in underpayment. A consistent finding across analysis samples is that increases in measured underpayment average between 10 and 25 percent of realized wage gains. This suggests that compliance is the norm, but that avoidance and evasion are non-trivial.

[4] We concentrate on minimum wage changes enacted from January 1, 2011, which provides an attractive empirical setting for several reasons discussed in greater detail below. We focus on the population ages 16 to 25, which is a group more likely to be on the margin of making at or near the minimum wage than are populations with greater labor force experience.

The limitations of self-reported wage data present hurdles to analyses of subminimum wage payment in the U.S. labor market. Our analysis thus considers the potential relevance of three margins along which data limitations might manifest themselves as roadblocks to interpreting our estimates as evidence of underpayment on the margin. These margins include legal exemptions for tipped workers, measurement error for salaried workers relative to wage earners, and wage imputation made necessary by survey item non-response.

Our analysis of the relevance of data limitations takes two steps. We first investigate whether minimum wage increases predict changes along these margins, and we find that they do not. We next investigate whether our estimates are affected by imposing sample restrictions that eliminate the relevance of these margins. The analysis suggests, unsurprisingly, that evasion and avoidance will tend to be overstated when imputed values are included in our analysis samples. Nonetheless, our estimates across samples of varying degrees of restrictiveness have similar implications for our estimates of aggregate noncompliance on the margin.

Our preferred estimates of the aggregate implications of subminimum wage payment use estimates from our restricted samples of hourly wage workers who do not receive tips, commissions or overtime pay and who do not have imputed wage rates. Survey weights imply that this sample represented 36.6 million individuals ages 16 to 65 in January 2011 (there were an estimated 59.7 million un-tipped hourly wage workers in total within this age range, of whom 23.1 million have imputed wage data). Between January 2011 and December 2017, we estimate that, on average across the country, each dollar of minimum wage increase generated an increase in subminimum wage payment of roughly $1.4 billion and realized wage gains, among the

employed, of roughly $5.8 billion. The increase in subminimum wage payment was thus roughly 24 percent of the value of the realized wage gains.

A key feature of U.S. minimum wage enforcement is that the process is largely driven by worker complaints (Weil and Pyles, 2005). As observed in the literature (Weil and Pyles, 2005; Gideon, 1994), complaint-based processes have important implications for both patterns of evasion and patterns of realized enforcement actions. Most relevant to our analysis, these papers highlight that a worker's incentive to complain depends in part on the complaint's implications for their employment status.

The theoretical framework presented in section II develops the empirical implications of a key insight that appears in Yaniv's (1994) analysis of workers' decisions to file complaints regarding wage violations. Specifically, we allow for the possibility that evasion may, at times, be in the mutual interest of the employer and the employee. This can be the case when the minimum wage is sufficiently high that its enforcement would preclude an employment relationship from forming or continuing. In such instances, the worker and employer might tacitly agree to what is, in effect, a black market employment arrangement.

Our theoretical framework highlights that the relationship between minimum wage evasion and enforcement institutions will vary as the minimum wage becomes increasingly binding. As the minimum wage initially binds on wage rates, it may serve primarily to overcome wage-suppressing bargaining frictions without substantially reducing employment opportunities. At such levels, workers have a strong incentive to pursue enforcement and strong enforcement regimes will tend to limit the number of violations undertaken. Modest increases in the minimum wage may thus tend to increase worker reporting, as they increase the back wages to

which underpaid workers are entitled. As the wage floor rises further, however, firms may cease to employ their least-skilled workers. Affected workers may then cease to report violations, as their job may not survive the wage floor's enforcement. In this scenario, minimum wage noncompliance will rise the most in states where enforcement regimes are moderately strong and where, consequently, noncompliance was initially rare.

Our empirical analysis finds patterns of subminimum wage payment consistent with important roles for the forces emphasized by our conceptual framework. In a cross-sectional analysis quite similar to Galvin's (2016), we find that subminimum wage payment is most common when minimum wage rates are high and when enforcement provisions are weak. We conclude by exploring whether enforcement regimes mediate the extent to which minimum wage hikes increase the prevalence of subminimum wage payment. We find that increases in subminimum wage payment are largest in states with relatively *strong* enforcement regimes. This is what our model predicts as the minimum wage begins to bind on the value of what workers produce. As the minimum wage crosses this threshold, workers cease to desire its enforcement. Increases in avoidance and evasion are large under strong enforcement regimes because evasion is more prevalent under weak enforcement regimes to begin with.

Our paper proceeds as follows. Section II presents a straightforward theory of minimum wage evasion and avoidance. Section III describes recent changes in states' minimum wage policy regimes. Section IV describes the data we analyze. Section V presents our empirical methodology. Sections VI and VII present our empirical analysis. Section VIII concludes.

Section II: Illustrative Framework

In this section we develop a simple framework that generates predictions for the relationship between the level of the minimum wage, the stringency of wage enforcement provisions, and the prevalence of subminimum wage payment. The framework focuses on two sets of decisions, namely firms' choices whether to comply with minimum wage laws and workers' choices whether to report non-complying firms.

Before describing those choices, we present our approach to describing wage and employment determination. We rely on the framework we have deployed in complementary work on the employment effects of recent minimum wage changes (Clemens and Strain, 2017; 2018a).[5] Let the value of individual i's output to firms be a_i per hour, which represents the product of the quantity and market price of his or her output. Suppose that bargaining frictions, represented by θ_i, generate the possibility that firms pay workers wage rates that may be less than the value of their output. We assume that firms employ all individuals they can hire at wage rates less than or equal to a_i, and that firms offer individual i a wage of $\theta_i a_i$ when they are unconstrained by the minimum wage.

The existence of subminimum wages implies that not all firms comply with minimum wage laws. In a complementary theoretical paper on minimum wage compliance, Yaniv (1994) breaks with earlier theoretical studies by emphasizing the complaint-driven nature of minimum wage enforcement. As Weil and Pyles (2006) report, roughly 78 percent of inspections conducted in 2004 by the Wage and Hour Division of the U.S. Department of Labor initiated from worker complaints. Like the framework we develop here, Yaniv's framework allows an

[5] Our framework is also similar to Kreiner *et al.* (2018), which studies the effect of youth minimum wages on youth employment in Denmark. A large discontinuity in Danish minimum wage regulation results in an average increase in hourly wage rates of 40 percent for workers when they turn 18 years old. Kreiner *et al.* find that this reduces employment (along the extensive margin) by one-third, driven by 18 year olds losing their jobs.

important role for the possibility that a worker would lose their job as their firm alters its employment decisions in response to minimum wage enforcement.

If the minimum wage (w_{min}) binds and firms comply with minimum wage laws, a firm will continue to employ individual i so long as $a_i \geq w_{min}$. Assuming compliance, minimum wage rates between $\theta_i a_i$ and a_i will improve a worker's earnings. Over the region $\theta_i a_i < w_{min} < a_i$, the worker thus has an interest in ensuring compliance. A worker paid less than the minimum wage, but whose productivity exceeds the minimum wage, stands to gain from filing a complaint.

Suppose, by contrast, that the minimum wage exceeds the value of the worker's output. A worker's decision to report a wage violation must account for the fact that his employer would no longer hire him if forced to pay the minimum wage. In this case, it may be in both the firm's and worker's interest to evade the law, because following the law would end the mutually beneficial employment relationship into which they had entered.

To further develop this framework, we make several simplifying assumptions regarding the information environment and the nature of employment relationships. First, we assume that firms and workers both know each worker's productivity. Second, we assume that all employment arrangements last for one period. Third, we assume that individuals will be unable to find employment, and know this, if their productivity is less than the minimum wage and they report an employer for a wage violation. Fourth, we assume that firms choose between offering an individual a wage of w_{min} or a wage of $\theta_i a_i$. In other words, we assume that firms do not

partially comply with a binding minimum wage by adjusting the offered wage rate from the initial $\theta_i a_i$ to any value other than the minimum wage.[6]

Beyond the issues discussed above, there are several factors that might affect a worker's decision to report his employer for violating minimum wage laws. From the perspective of the worker, the decision may be affected by the costs of the reporting process, the generosity of financial rewards (or back-wage payment plus damages), and an intrinsic motivation to report law breaking. We summarize these factors with the parameter c_i.

In this environment, the worker would report his or her employer if the expected outcome resulting from enforcement is superior to receiving the wage of $\theta_i a_i$ for a period of employment. When compliance would not lead the worker to lose employment, the condition is whether $\theta_i a_i < w_{min} - c_i$. When compliance would lead the worker to lose employment, the condition is whether $\theta_i a_i < - c_i$. When compliance would result in the worker losing her job, she will only report underpayment if the financial rewards and intrinsic motivation for reporting are sufficiently large to compensate for lost wages from lost employment. The relevant conditions are summarized by: $\theta_i a_i < w_{min} \times 1\{a_i \geq w_{min}\} - c_i$.[7]

A complying firm's profit from employing individual *i* at the minimum wage is $a_i - w_{min}$. An evading firm's profit is $a_i - \theta_i a_i$ when evasion is successful. When caught, the firm pays a

[6] We could implicitly allow for partial compliance by allowing θ_i to vary over time as well as across individuals and circumstances. For example, a change in the strength of the enforcement regime could, for some workers, increase the value of θ_i such that it is greater than the previous period's value but still less than one. This change in bargaining power could be thought of as partial compliance. Importantly, the basic intuition of the predictions of our illustrative framework are not dependent on assuming away partial compliance.

[7] Looking ahead, this expression provides insight into the potential role of the partial compliance behavior we have implicitly de-emphasized. Firms can use partial compliance to deter enforcement. Because they do not know each individual's cost of reporting, which includes an individual-specific preference component, partial compliance would be set to balance between the costs of higher wage payments and the benefit of reduced reporting, which will depend in turn on the local density of the distribution of the reporting cost term, c_i.

penalty of F and no production or wage payment takes place. We assume also that firm manager *j* has an intrinsic utility loss valued at I_j dollars from violating the law. Suppose for simplicity that violations are caught in 100 percent of cases in which the worker reports, and that violations are caught in fraction *E* of cases, due to random inspections, when no report is made. If fraction p of workers would report violations, where p is a function of individual-specific productivity and individual-specific costs or benefits of reporting violations, then the probability of the firm getting caught is $z = p + (1\text{-}p)E$. The expected value of evading is thus $(1 - z)[a_i - \theta_i a_i] - zF - I_j$, and the decision to evade rests on whether: $[a_i - w_{min}] < (1 - z)[a_i - \theta_i a_i] - zF - I_j$.

The implications of enforcement for the relationship between violation rates and minimum wage increases depend primarily on how increases in the minimum wage affect the left-hand side and p, the probability that worker reports a violation. As the minimum wage rises, the gain from successful evasion rises, so the left-hand side is always increasing in the minimum wage. Over an initial range, increases in the minimum wage increase the returns to the worker from reporting a violation. Because this increases the right-hand side, the relationship between minimum wage increases and evasion rates is ambiguous over this range. Over a subsequent range, an increase in the minimum wage reduces the probability of reporting by the worker because it would eliminate employment. Over this range, increases in the minimum wage thus lead unambiguously to increases in the violation rate.

Note that if penalties (F) and the random inspection rate (E) are trivial, evasion will always be profitable for firms. If penalties and the random inspection rate are in a "moderate" range, then shifts in the probability of a worker reporting violations will be decisive. Consequently, the observed violation rate will tend to rise substantially when enforcement

provisions are moderately strong and the minimum wage rises to become strongly binding, raising the likelihood that firms and workers will arrive at an understanding that subminimum wage payment is essential in order for employment to be sustained.[8]

The average degree of underpayment (conditional on a violation occurring) depends on the densities of the distributions of the productivity and bargaining parameters across all individuals for whom underpayment occurs. Further, it depends on patterns of partial compliance by firms, from which our analysis has largely abstracted. Our framework thus has weak predictions for underpayment's average severity.

Section III: Background on Recent State Minimum Wage Changes

As we have noted in previous work (Clemens and Strain 2017, 2018a, 2018b), there was a pause in both state and federal efforts to increase minimum wages during the years immediately following the Great Recession. Since that pause, states have diverged with respect to their minimum wage policies. Many states have kept their minimum wage rates at the $7.25 federal minimum, while others have enacted increases ranging from less than $1 to in excess of $3. This policy environment provides an opportunity to conduct relatively transparent analyses of the extent to which firms have evaded these minimum wage changes.

We take two approaches to analyzing recent minimum wage variation. The first makes straightforward use of the level of each state's minimum wage on a monthly frequency. Our

[8] It is sometimes assumed that F, the penalty a firm pays when caught violating minimum wage regulation, is not large relative to the financial benefits from underpaying workers. Lott and Roberts (1995) find that F is larger than is typically thought. This is consistent with our finding that compliance with minimum wage regulation is more common that avoidance and evasion.

second approach divides states into qualitatively distinct policy regimes based on the magnitude of their minimum wage changes and on whether those changes were implemented through new legislation or through inflation indexing provisions. We consider two alternative groupings, for which the full divisions of states are presented in main table 1 and appendix table A1. We refer readers to our earlier work (Clemens and Strain, 2017; 2018b) for more detailed discussions of the factors that underlie our approach to dividing states across policy regimes.

Section IV: Data Sources

In this section we discuss the data sources and variables used in the analysis, including wage data, subminimum wage variables, macroeconomic data, and enforcement measures. The latter come from outside of the economics literature and may thus be less familiar to economists. We conclude the section with a brief discussion of summary statistics.

Wage data and the CPS MORG

We analyze data from several sources. Our wage data come from the Current Population Survey (CPS). We use several wage-related variables that are asked of individuals in two out of the eight interviews in which they participate in the CPS. The relevant interviews, during which respondents are asked supplemental questions about their earnings, take place at the end of each of two four-month waves of a respondent's participation. These interviews are collectively known as the Merged Outgoing Rotation Groups (MORG).

Several variables are relevant for estimating an individual's wage rate and for gauging the quality of the underlying data. The first key piece of information is an indicator for whether

the respondent is paid on an hourly basis. When they are, the respondent is asked for their hourly wage rate. When they are not, hourly wage rates can be inferred by dividing the individual's usual weekly earnings by their usual weekly hours. While all of the relevant information is subject to respondent reporting error, the potential for error will be greater when the hourly wage must be inferred from earnings and hours data because the hourly wage itself is not reported directly. Further, a non-trivial fraction of respondents elects not to report their earnings information when asked. The wage rates for these individuals are therefore imputed.

Our analysis tracks the relevance of several margins along which data issues have the potential to inhibit our identification of wage underpayment. The first is the margin of whether the individual is an hourly worker. The second is the margin of whether the individual has actually responded to the questions required to estimate their wage rates without imputation. The third is whether the individual receives tips or commissions, as tipped workers are typically exempt from states' general minimum wage.

Effective minimum wage rates

Our data on states' effective minimum wage rates draw on many sources. We compiled the relevant data in Clemens, Hobbs, and Strain (2018). We previously analyzed these data in Clemens and Strain (2017, 2018a, 2018b).

Subminimum wage rates

For our analysis of subminimum wage payment, we follow Goraus-Tanska and Lewandowski (2016) in describing subminimum wage payment using two variables. The first is a simple indicator for subminimum wage payment. To avoid overstating the pervasiveness of subminimum wage payment due to modest reporting error, our primary measure is an indicator

for whether the individual's self-reported wage is more than $0.25 cents less than the minimum wage effective in their state of residence during the relevant month.[9] The second is a continuous measure of the extent to which wage rates fall short of the legislated minimum.

Macroeconomic variables

Our analysis incorporates data on macroeconomic covariates that may be relevant as control variables. Specifically, we assess whether macroeconomic conditions are biasing our estimates by tracking indicators of the performance of state-level housing markets, state aggregate income, and labor markets. We proxy for variations in housing markets using a statewide median house price index from the Federal Housing Finance Agency (FHFA). We proxy for aggregate economic performance using data on aggregate state income *per capita* from the Bureau of Economic Analysis (BEA). Finally, we proxy for variations in broader labor market developments using employment among skill groups that are not directly affected by the minimum wage. As shown in Clemens and Strain (2018b), it has tended to be the case that minimum wage increases have been enacted by states that have experienced relatively strong economic recoveries over the time period under analysis.

Enforcement measures

To analyze the relevance of states' minimum wage enforcement regimes, we make use of data presented and analyzed by Galvin (2016). Galvin presents information on a broad set of characteristics associated with minimum wage enforcement regimes. He then aggregates these

[9] When the individual is an hourly worker, the relevant wage is their self-reported wage. When the individual is not an hourly worker, we calculate the wage as the individual's usual weekly earnings divided by their usual weekly hours. Because the inferred wage rates of non-hourly workers are more prone to reporting error, one of our key robustness checks involves restricting the analysis sample to hourly workers.

characteristics into two indices, constructed to take values from 0 to 1. The first of these is based exclusively on the aspects of states' regimes that have bearing on the penalties faced by violators who are caught.[10] The second is Galvin's broadest enforcement index, which incorporates information on the authority and operation of state enforcement agencies, enforcement mechanisms, and the size of the penalties associated with minimum wage violations.[11] These indices are calculated based on states' regimes as of December 2013, which falls just before the wave of minimum wage legislation around which we have built our analysis. The maps in figures 2A and 2B illustrate how Galvin's enforcement indices vary across states.

Summary statistics

Table 2 presents summary statistics on our primary analysis samples. The data illustrate several key features of the samples we analyze and the environment in which we analyze them. Columns 1, 3, and 5 present data from 2011-2013, namely the period during which few minimum wage changes took place, while columns 2, 4, and 6 present data from 2016-2017. Data on house prices, employment, and aggregate income growth are indicative of the economic recovery that took place over this time period. Columns 1 and 2 present data on the full population ages 16 to 25, while columns 3 and 4 restrict to the employed and columns 5 and 6

[10] Galvin's penalty index includes information on the maximum value of damages, civil penalties, and administrative fees public agencies or private arbitration can order an employer to pay, as well as whether an offender can face civil and criminal charges because of a wage violation. The index also details which party carries the burden of proof: whether the employer must always prove their actions were not in retaliation for complaints regarding wages or working conditions, whether the state agency or private arbiter has discretion, or whether the employer must be found a willful or repeat offender.

[11] Galvin's broader enforcement index includes the measures in the penalties index as well as details regarding how state enforcement agencies operate. They include whether state administrative agencies have subpoena power, whether agencies must exhaust administrative processes before bringing a civil suit, whether they can issue wage orders or binding interpretations of regulations, whether they have power to issue final determinations, and whether states can seek remedies in civil court on behalf of an employee. The index also incorporates information on the duration of statutes of limitations, and the payment of attorney's fees.

restrict to individuals who were employed as hourly workers, who are not tipped workers, and who responded to questions related to their wage rates so that their wage rates are not imputed.

Section V: Estimation Frameworks

This section walks through the models we estimate. The initial analysis we present can be described as a difference-in-differences estimator that uses the policy groupings described in section III and presented in detail in Tables 1 and A1. The basic specification is presented in equation (1) below:

$$S_{i,s,t} = \sum_{p(t)\neq 0} \beta_{p(t)} Policy_s \times Post_{p(t)} + \alpha_{1s} State_s + \alpha_{2t} Time_t + X_{i,s,t}\gamma + \varepsilon_{i,s,t}, \qquad (1)$$

where $S_{i,s,t}$ is a binary indicator of whether individual *i*, living in state *s*, in year *t* is working at a wage that is below his or her state's effective minimum wage rate. We use equation (1) to analyze additional outcomes including indicators as to whether an individual reports being employed, earning tips, working hourly, and whether the wage rate is imputed.

Like any standard difference-in-differences specification, equation (1) controls for sets of state and time fixed effects. The vector *X* contains sets of control variables that vary across the specifications we estimate. In various specifications, it contains the median house price index, the log of aggregate personal income per capita, employment rates among individuals more skilled than those in the analysis sample, and individual-level demographic characteristics.

We use $Policy_s$ to represent binary indicators for whether a state fits into a given policy group. As discussed above, we differentiate among states that increased their minimum wage

rates due to inflation-indexing provisions, states that enacted large statutory increases, and states that enacted small statutory increases. The coefficients of interest, $\beta_{p(t)}$, describe whether the incidence of subminimum wage payment rose more, less, or roughly the same in the active policy regimes relative to states in which no minimum wage increases occurred. Comparisons of the point estimates associated with different policy groups (e.g., the inflation indexing group vs. the group that enacted large new statutory increases) provide evidence on whether states that enacted alternative forms of minimum wage increases had different experiences.

The estimates of interest will be biased if the policy groups experienced differential shocks in factors that exert independent influence on subminimum wage payment. We thus investigate whether our estimates are robust to controlling for macroeconomic and demographic covariates. To capture the "medium run" relationship between minimum wage increases and the incidence of subminimum wage payments, we exclude data from 2014 and 2015 from the samples on which we estimate equation (1). We thus estimate differential changes from a baseline period consisting of 2011-2013 to an endline consisting of 2016-2017.

We next implement a specification that harnesses all continuous variation in state minimum wage rates. The specification is in equation (2) below:

$$S_{i,s,t} = \beta_1 MW_{s,t} + \alpha_{1s} State_s + \alpha_{2t} Time_t + X_{i,s,t}\gamma + \varepsilon_{i,s,t}. \qquad (2)$$

The dependent variable in equation (2) is a binary indicator of whether individual *i*, living in state *s*, in year *t* is working at a wage that is below his or her state's effective minimum wage rate. The key difference between β_1 and $\beta_{p(t)}$ from equation (1) is that the minimum wage variation is continuous and contemporaneous. We use data for all years from 2011 through 2017 to estimate this equation. The effects captured by equation (2) are thus "contemporaneous" and

are "per dollar of minimum wage increase." We also use equation (2) to analyze effects on hourly wages and the gap between the reported wage and the effective minimum wage.

After using equations (1) and (2) to estimate the overall pervasiveness of evasion and avoidance in response to recent minimum wage changes, we estimate two additional equations that focus on our conceptual framework's predictions for the role of minimum wage enforcement regimes. For this analysis, we first estimate a baseline relationship to generate descriptive facts regarding the prevalence of minimum wage violations and their correlation with both the level of the minimum wage and the stringency of states' enforcement regimes. That is, we estimate

$$S_{i,s,t} = \beta_1 MW_s + \beta_2 Enforcement\ Index_s + X_{i,s,t}\,\gamma + \alpha_t\, Time_t + \varepsilon_{i,s,t}. \qquad (3)$$

We estimate equation (3) on data extending from 2011 to 2013. We describe β_1 and β_2 as capturing cross-sectional relationships between our policy variables and subminimum wage payment. From 2011 to 2013, variation in the minimum wage and the enforcement index is cross-sectional with the exception of several inflation-indexed minimum wage changes.

Finally, we investigate whether states' enforcement regimes mediate the extent of minimum wage evasion on the margin. To do so we interact the enforcement index with the contemporaneous minimum wage and estimate:

$$S_{i,s,t} = \beta_1 MW_{s,t} + \beta_2 Enforcement\ Index_s \times MW_{s,t} + \alpha_{1s}\, State_s + \alpha_{2t}\, Time_t + X_{i,s,t}\,\gamma + \varepsilon_{i,s,t}. \qquad (4)$$

The estimate of β_2 provides evidence on whether the strength of the relationship between minimum wage increases and subminimum wage payment varies across enforcement regimes.

Section VI: Empirical Analysis of Minimum Wage Evasion on the Margin

In this section we present results from the analyses described above. We begin by presenting simple time series variation in rates of subminimum wage payment. We then present regression estimates of equations (1) through (4).

Initial evidence on the evolution of subminimum wage payment across minimum wage regimes

Figures 3 and 4 provide a graphical look at the data underlying our analysis. The figures report time series separately for the groups we categorize as "no changers," "small changers," "large changers," and "indexers" in table 1. Table 3 supplements the time series in figures 4 and 5 with tabulations and calculations of changes from a baseline period including 2011-2013 to an endline period including 2016-2017. The tabulations in column 4 of table 3 are unadjusted difference-in-differences estimates of the effects of this period's minimum wage changes.

Figure 3 presents data on the fraction of individuals who report working for wage rates that are at least 25 cents less than their respective states' effective minimum wage rates. Panels A through D present data on several subsamples of the CPS MORG files. The "full sample" in Panel A consists of all surveyed individuals ages 16 to 25. The sample in panel B is restricted to 16 to 25 year olds who are employed. The sample in Panel C is restricted to 16 to 25 year olds who were employed and who report working on an un-tipped hourly wage basis (rather than on salary). Finally, the sample in Panel D is restricted to workers who, in addition to being paid hourly, responded to the survey's wage questions such that no imputations were required.

Two consistent patterns emerge across the panels of figure 3. First, states that enacted minimum wage increases through new legislation experienced substantial increases in the

incidence of subminimum wage payment across all of the samples we analyze. The consistency of this result across samples is important because it ensures that this finding is not driven by a tendency for the BLS's imputation procedures to erroneously assign minimum wage rates that are above the federal minimum wage but below the minimum wage applicable in the state in which an individual is employed. Our restrictions also ensure that the changes we observe are not driven by shifts across the margin between hourly wage arrangements and salaried work, or by shifts into or out of tipped arrangements.

Second, we find that states that index their minimum wage rates for inflation have experienced no increase in the incidence of subminimum wage payment. Indeed, the prevalence of subminimum wage payment may have decreased in these states, even as their minimum wage rates have risen. Both the high baseline and the lack of increase in subminimum wage payment in states that index their minimum wage rates for inflation are consistent with forward looking behavior on the part of firms (Brummund and Strain, 2018).

Figure 4 presents similarly constructed series that describe the average size of the distance between an individual's wage and the effective minimum wage. These series thus augment those in the previous figure in that they account for the severity of subminimum wage payment. The patterns visible in the figure are broadly similar to those observed in the previous figure. Appendix figures A2 and A3 show that the patterns we observe in figures 3 and 4 are little changed by shifting to the categorization of states presented in appendix table A1.

Regression estimates of the pervasiveness of subminimum wage payment on the margin

This section presents estimates of equations (1) and (2). These regression models allow us to estimate the extent to which the incidence of subminimum wage payment expands as the

minimum wage rises and to place confidence bands on our estimates. Further, they provide a framework for investigating whether our estimates are sensitive to controlling for variations in states' macroeconomic conditions, for individual-level demographic characteristics of each sample, and, importantly in this setting, for margins that make it difficult to measure the prevalence of minimum wage evasion and avoidance.

We start our analysis with regressions that closely track the presentation of the data in figures 3 and 4. Specifically, tables 4 and 5 present estimates of equation (1). As in figures 3 and 4, we allow the estimates to differ across the states we categorize in table 1 as "indexers," "small statutory increases," and "large statutory increasers." The estimates show that subminimum wage payment rose substantially in states that increased their minimum wage rates through new legislation relative those that did not increase their minimum wage rates. There was no relative increase in the prevalence of subminimum wage payment in states that increased their minimum wage rates through inflation indexing provisions.

The columns of table 4 show the qualitative robustness of the results across two key margins. First, comparing columns 1 and 2 reveals that the estimates are little affected by the inclusion of either a detailed set of demographic control variables or by controlling for proxies for developments in states' labor markets, housing markets, and general macroeconomic conditions. Second, the remaining columns present evidence on the relevance of margins that complicate the measurement of subminimum wage payment. Moving from columns 1 and 2 to columns 3 and 4, we restrict the sample to individuals who are employed. The point estimates rise because subminimum wage payment can only occur among the employed. Moving to columns 5 and 6, we restrict the sample to individuals who report being un-tipped hourly wage

earners rather than salaried employees. The estimates rise modestly, reflecting the fact that minimum and near-minimum wage payment is more common among hourly wage earners than among salaried workers. Finally, in columns 7 and 8 we remove all individuals with imputed wage values. The point estimates decline modestly, likely because a moderate amount of reported subminimum wage payment stems from imputation-driven measurement error. On the most restricted sample, we estimate a 7.5 percentage point increase (averaged across the specifications in columns 7 and 8) in the probability that an individual reports earning a subminimum wage in states that enacted large minimum wage increase relative to states that enacted no minimum wage increases. Across all subsamples, the relationship between statutory minimum wage increases and subminimum wage payment is strongly positive, while inflation indexed minimum wage changes have no detectable effect on subminimum wage payment.

Table 5 presents evidence on whether the selection margins explored above were, themselves, responsive to this period's minimum wage changes. The table reports several findings of interest. First, neither indexed minimum wage increases nor small minimum wage increases had statistically significant relationships with employment, employment in tipped occupations, employment as hourly rather than salaried workers, or non-response to the CPS's wage questions. Second, large minimum wage changes had no detectable relationship with either employment in tipped occupations or on the need for wage values to be imputed. Third, employment of individuals ages 16 to 25 is negatively correlated with large minimum wage increases in the specification that controls for variations in states' macroeconomic conditions, but has no relationship with minimum wage changes in the specification that includes no such controls. The same is true for estimates of the effect of large minimum wage changes on the probability of employment as an hourly wage worker.

Our employment estimates can be compared to those reported in our earlier work (Clemens and Strain 2018a) for samples consisting of individuals ages 16 to 21 on data that extend through 2016. The estimates' sensitivity to the inclusion of controls for states' overall economic conditions is quite similar to what we find in our earlier work. As shown in that work in greater detail, this reflects the fact that overall economic growth, employment of high skilled groups, and house price appreciation, have been stronger in states that enacted large minimum wage changes than in those that enacted no minimum wage changes. Controlling for these factors thus generates more negative estimates. For interpreting results in the analysis presented here, the key point to bear in mind is that the increase in subminimum wage payment in states that enacted large minimum wage increases would, if anything, have been larger had there been no changes in low-skilled groups' employment.

Table 6 presents estimates of equation (2), which differs from equation (1) in that we code minimum wage variation continuously rather than using categorical policy groupings. The samples for this analysis include all years from 2011 to 2017. The estimates describe the marginal "leakage" of intended wage gains due to subminimum wage payment.

Table 6 shows patterns in the evolution of subminimum wage payment that are quite similar to the patterns presented in table 5. The relationship between subminimum wage payment and the level of the minimum wage is disproportionately concentrated among individuals paid as hourly workers and will tend to be overstated when samples include individuals whose wage rates were imputed by BLS. In our most restrictive samples, we find that a one-dollar minimum wage increase predicts a 4.4 percentage point increase in the

probability that hourly workers ages 16 to 25 report earning a wage that is more than $0.25 below their state's effective minimum wage.

Estimating aggregate minimum wage evasion associated with recent minimum wage increases

In this section we extrapolate from our regression estimates to gauge the aggregate prevalence of evasion as a response to recent minimum wage increases. That is, we attempt to estimate how much higher the national wage bill would have been under two conditions. The first condition is that subminimum wages be lifted to the effective minimum wage. The second condition is that the affected individuals continue to be employed.

While this might sound like a straightforward exercise, arriving at the desired estimates requires a substantial number of assumptions. With regard to regression estimates, we conduct the following exercise. We run regressions of the same form as those presented in the previous section. We then estimate the minimum wage's effects on wage rates as well as on a variable that is adjusted upward to the effective minimum wage if an individual reports being employed but earning a wage less than the effective minimum wage. A comparison of the resulting estimates tells us how much higher the typical worker's wage rate would have to be in order for full compliance to be obtained.

Several additional aspects of the problem must be considered. First, how many individuals in the U.S. population would be affected? Answering this question requires applying sample weights to our analysis samples. Importantly, we must consider whether we want our estimates to apply to individuals for whom wage rates had to be imputed. An "upper bound" estimate could incorporate these individuals while a "lower bound" estimate would exclude them. Second, we must consider the robustness of the underlying estimates to the steps we have

taken to control for variations in states' macroeconomic conditions. Third, to arrive at an annual wage bill estimate we must estimate the average annual hours of work of individuals whose wage rates would be increased by full enforcement.

The regression estimates relevant to our extrapolation exercise can be found in tables 7, 8, and 9. In these tables, we present estimates of the dollar value of both the wage gains and increases in subminimum wage payment that were associated with each dollar of increase in the minimum wage. To prevent the estimated wage gains from being driven by wage values that could not plausibly be affected by the minimum wage, we censored our hourly wage variable at $15. This moderately reduces the estimated wage increase in some specifications. Table 7 presents estimates for individuals ages 16 to 25, table 8 expands the sample to include individuals ages 16 to 35, and table 9 expands the sample to ages 16 to 65.

When analyzing our most restricted samples (hourly workers whose wage rates were not imputed by BLS and who do not receive tips) of individuals ages 16 to 25, we estimate that each dollar of minimum wage increase generates an hourly wage gain of roughly 26 cents. This estimate is relatively insensitive to whether the specification includes our sets of controls for the demographics of individuals in the samples or for changes in each state's macroeconomic conditions. When we turn to estimates that capture both the pervasiveness and severity of subminimum wage payment, we find that each dollar in minimum wage increase predicts, on average, a 4.0 cent increase in subminimum wage payment. In these particular specifications, increases in subminimum wage payment are about 15 percent of the estimated wage gains. On the sample of individuals ages 16 to 35, as reported in table 8, the corresponding averages across the two specifications are 14.8 cents and 3.1 cents, or roughly 22 percent of estimated wage

gains. On the sample of individuals ages 16 to 65, as reported in table 9, the corresponding numbers are 8.6 cents and 2.1 cents, or roughly 24 percent of estimated wage gains.

Our preferred estimates of the aggregate implications of subminimum wage payment apply directly to the samples of hourly wage workers who do not receive tips, commissions, or overtime, and for whom no data imputations are required. Sample weights imply that this sample represented 36.6 million individuals ages 16 to 65 in January 2011 (there were an estimated 59.7 million hourly wage workers in total, of whom 23.1 million have imputed wage data). On average across this full sample, a dollar of minimum wage increase predicts an additional 2.1 cent increase in subminimum wage payment. With these individuals working an average of 35 hours per week, increases in subminimum wage payment imply that wages were roughly 74 cents per week lower, on average, for the 36.6 million individuals in question. Multiplied by 52 weeks per year, the total increase in underpayment per dollar of minimum wage increase totals $1.4 billion nationwide (36.6 million x 52 weeks x 35 hours x 2.1 cents in underpayment per hour). If this estimate is extrapolated to all 59.7 million un-tipped hourly wage workers, the total implied increase in underpayment per dollar of minimum wage increase would be about $2.3 billion, or $1.4 billion x 59.7/36.6.

Underpayment is concentrated among relatively young hourly wage workers. The sample of hourly workers ages 16 to 25 with non-imputed wages, for example, accounts for roughly 8.8 million workers. On this sample, a dollar of minimum wage increase predicts an increase in subminimum wage payment of roughly 4 cents. This sample accounts for $641 million (46 percent) of the aggregate underpayment we estimate for the full working age population.

The sample of hourly workers ages 16 to 35 with non-imputed wages accounts for roughly 17.6 million workers. On this sample, a dollar of minimum wage increase predicts an increase in subminimum wage payment of roughly 3.1 cents. In total, this sample accounts for roughly $1.0 billion (71 percent) of the underpayment we estimate.

Per dollar of minimum wage increase, the wage bill gains we estimate for those who are employed are roughly $5.8 billion for the samples ages 16 to 65, $5.0 billion for the samples ages 16 to 35 and $4.3 billion for the samples ages 16 to 25. Increases in subminimum wage payment are thus equivalent to roughly 24 percent of the wage gains for the full working age population, roughly 22 percent of the wage gains for the population ages 16 to 35, and roughly 15 percent of the increase for the population ages 16 to 25.

Section VII: Evidence on the Economics of the Effects of Enforcement Regimes on the Prevalence of Minimum Wage Evasion

This section presents evidence on the economics of the relationship between minimum wage evasion and the stringency of states' minimum wage enforcement regimes. The model presented in section II highlighted that the effects of enforcement regimes may differ with regard to their effects on overall evasion rates and their effects on minimum wage evasion on the margin. We thus begin this section with an exploration of the cross-sectional relationship between enforcement regimes and evasion. We then analyze the manner in which enforcement regimes mediate the pervasiveness of minimum wage evasion on the margin.

Cross-sectional evidence on the relevance of enforcement regimes

This section presents estimates of equation (3), which describes the baseline relationship between subminimum wage payment, the level of the minimum wage, and the stringency of a state's minimum wage enforcement provisions. These estimates appear in table 10. Because the estimates are purely cross-sectional, they are prone to a variety of biases that our panel empirical methods are designed to address. We thus emphasize a descriptive interpretation of the estimates. Consistent with the framework from section II, we find that the incidence of subminimum wage payment is positively correlated with the level of the minimum wage and negatively correlated with the stringency of a state's enforcement institutions.

The estimates on the effective minimum wage imply that that a $1 difference in the minimum wage predicts a 2.5 percentage point difference in the probability that individuals report making a subminimum wage. This is modestly smaller than the estimates we obtain using panel variation. The magnitude of the point estimate on the Galvin enforcement indices vary depending on whether the level of the effective minimum wage is controlled for in the specification. Looking to the point estimate from column 5, the estimate of -.039 implies that moving from an enforcement index of 0 to an enforcement index of 1 would predict a 3.9 percentage point difference in the probability that an individual reports earning a subminimum wage. While the economic magnitude of this difference is substantial, the estimate lacks precision. Because most states' indices lie between 0.05 and 0.55, moving from the low to the high end of the range would predict a roughly 1.9 percentage point difference in the probability of reporting a subminimum wage. The estimate from the broader enforcement index, reported in column 4, is somewhat larger in magnitude.

Analysis of whether enforcement regimes mediate evasion responses on the margin

Finally, we turn to estimates of equation (4), through which we investigate whether there is evidence that states' enforcement regimes mediate the responsiveness of subminimum wage payment to minimum wage increases. A slice of the variations underlying our estimates can be found in figures 5 and 6. We note two items of interest from figure 5. First, it shows the overall medium-run relationship between minimum wage changes and the prevalence of subminimum wage payment. On the x-axis, we plot the value of each states' minimum wage changes from the first two years of our sample (2011-2012) to the last two years (2016-2017). On the y-axis we plot the change in the fraction of hourly workers ages 16 to 25 with non-imputed wage rates who report earning wage rates below their states' minimum wage. We then distinguish between states with above and below median values of the Galvin enforcement index and plot separate best fit lines for these two groups of states. The slopes differ non-trivially, with strong enforcement states experiencing relatively large increases in subminimum wage payment for each dollar of minimum wage increase. Figure 6 presents a similar picture for our measure that incorporates the severity of each violation in dollar terms.

Tables 11 and 12 present estimates of equation (4), which utilizes the full scope of the available variations in states' minimum wage rates. The point estimates capture the same phenomenon observed in figures 5 and 6. Increases in the minimum wage predict increases in the prevalence of subminimum wage payment, and they do so to a greater degree in states with strong enforcement regimes than in states with weak enforcement regimes. This is consistent with our model's prediction for cases in which minimum wage increases bind on the value of what some workers produce and, as a consequence, these workers cease to pursue enforcement.

Section VIII: Discussion and Conclusion

A holistic assessment of the labor market effects of minimum wage regulation requires understanding employer compliance. This paper attempts to further economists' understanding of minimum wage avoidance and evasion by investigating two key issues. We first study the degree of noncompliance in the face of marginal increases in the minimum wage. We then study how the strength of enforcement regimes affects the prevalence of subminimum wage payments.

We find strong evidence that higher minimum wages lead to a greater prevalence of subminimum wage payments. Among hourly workers ages 16 to 25, for example, we find that each dollar of minimum wage increases predicts an average wage gain of $0.26 and an average increase in underpayment of $0.04. These results are in keeping with our broader findings. We consistently estimate that increases in measured underpayment average between 10 and 25 percent of realized wage gains following minimum wage hikes. Extrapolating to the national level, our findings suggest that a one dollar increase in the minimum wage leads to an additional $1.4 billion in subminimum wage payments and an additional $5.8 billion in wage payments to those who remain employed. We interpret this as evidence that compliance with minimum wage regulation is the norm, but that avoidance and evasion are an important reality of the low-wage labor market.

Using measures of enforcement institutions developed by Galvin (2016), we find that strong enforcement regimes predict relatively lower rates of noncompliance. In states with strong enforcement regimes, we also find that increases in minimum wages lead to more substantial increases in subminimum wage payments. Our theoretical framework suggests that this finding

may reflect the dynamics of compliance and enforcement. The enforcement of U.S. minimum wage violations is driven by worker complaints (Weil and Pyles, 2005). Workers will be more likely to report a violation if doing so will result in pay increases, and less likely to report a violation if doing so could result in job loss. The former outcome is more likely if the wage remains close to the value of a worker's output, while the latter is more likely if the wage rises significantly above the value of a worker's output. In a strong-enforcement state, then, workers may be less likely to report noncompliance if minimum wages are high, and more likely to report if the wage floor is relatively low.

Our results suggest that minimum wage increases both raise wages among the employed and increase the prevalence of subminimum wage payments. Aggressive measures to enforce compliance may increase compliance but may also risk reducing employment. These considerations point to a tension policy makers must weigh as they consider the appropriate level of the statutory wage floor. The rule of law requires that employers pay workers what they are owed under minimum wage laws. At the same time, enforcing the minimum wage may preclude some workers and employers from entering into mutually beneficial employment relationships. Put differently, evasion may, in some cases, mitigate the minimum wage's employment effects. The tradeoff between economic efficiency and respect for the rule of law is not a tradeoff to be taken lightly. Our findings highlight that an appreciation of this tradeoff, along with empirical assessments of the prevalence and drivers of subminimum wage payments, is important in fully evaluating the labor market effects of minimum wages.

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Table 1: List of States with Statutory Minimum Wage Increases and Inflation-Indexed Increases using Changes from 2013 to 2015 and $1 Cutoff

Statutory increasers of $1 or more	Statutory increasers under $1
Alaska	Arkansas
California	Connecticut
District of Columbia	Delaware
Massachusetts	Hawaii
New Jersey	Maryland
New York	Michigan
Rhode Island	Minnesota
South Dakota	Nebraska
	West Virginia
Indexers	
Arizona	
Colorado	
Florida	
Missouri	
Montana	
Ohio	
Oregon	
Vermont	
Washington	

Notes: Data on minimum wage indexing provisions come from the National Council of State Legislatures. The states labeled as Indexers link annual updates to their minimum wage rates to a measure of inflation. Data on minimum wage changes come from the U.S. Department of Labor. States are counted as statutory increasers of under $1 if the combined statutory increase in the minimum wage from January 1, 2013 through January 1, 2015 was under $1. States are counted as statutory increasers of $1 or more if the combined statutory increase in the minimum wage was $1 or more.

Table 2: Sample Summary Statistics: CPS MORG and Supplemental Data for 2011-2013 and 2016-2017

	(1)	(2)	(3)	(4)	(5)	(6)
Years	2011-2013	2016-2017	2011-2013	2016-2017	2011-2013	2016-2017
Sample	Ages 16-25		Employed Ages 16-25		Restricted Sample	
Paid Subminimum Wage	0.0330	0.0429	0.0683	0.0818	0.0599	0.0683
	(0.179)	(0.203)	(0.252)	(0.274)	(0.237)	(0.252)
Subminimum Payment ($)	0.0447	0.0669	0.0938	0.129	0.0499	0.0607
	(0.388)	(0.476)	(0.558)	(0.655)	(0.387)	(0.400)
Employment	0.484	0.525	1	1	1	1
	(0.500)	(0.499)	(0)	(0)	(0)	(0)
Age	20.50	20.54	21.66	21.64	21.23	21.13
	(2.873)	(2.916)	(2.477)	(2.554)	(2.506)	(2.607)
Black	0.152	0.152	0.117	0.133	0.118	0.128
	(0.359)	(0.359)	(0.321)	(0.340)	(0.322)	(0.334)
High School Degree	0.243	0.251	0.278	0.295	0.292	0.302
	(0.429)	(0.434)	(0.448)	(0.456)	(0.455)	(0.459)
Some College Education	0.333	0.325	0.406	0.379	0.430	0.406
	(0.471)	(0.468)	(0.491)	(0.485)	(0.495)	(0.491)
Galvin Enforcement Index	0.245	0.244	0.245	0.243	0.248	0.248
	(0.0904)	(0.0903)	(0.0884)	(0.0884)	(0.0880)	(0.0855)
Galvin Only Penalties Index	0.286	0.284	0.285	0.283	0.291	0.290
	(0.138)	(0.137)	(0.135)	(0.135)	(0.135)	(0.132)
House Price Index	333.2	412.7	329.9	408.2	324.5	401.2
	(103.3)	(129.7)	(101.6)	(127.3)	(96.75)	(123.8)
Income Per Capita ($1000s)	43.88	49.84	43.84	49.62	43.54	49.29
	(6.380)	(7.430)	(6.303)	(7.260)	(6.085)	(6.991)
Effective Minimum Wage ($)	7.541	8.369	7.531	8.336	7.539	8.327
	(0.426)	(1.181)	(0.423)	(1.169)	(0.433)	(1.166)
Observations	149893	93677	73733	49050	34399	21151

Notes: This table reports summary statistics for three sample groups. Columns 1 and 2 report averages and standard deviations (in parentheses) of each of the variables for our full sample of individuals ages 16 to 25. Columns 3 and 4 report averages and standard deviations (in parenthesis) for our subsample of employed individuals ages 16 to 25. Columns 5 and 6 report averages and standard deviations (in parenthesis) for our most restricted subsample of employed individuals ages 16 to 25 who are paid by the hour, do not receive tips, commissions, or overtime, and do not have imputed wage rates. Entries for employment, age, race, and education summarize data from the Current Population Survey Merged Outgoing Rotation Groups (CPS MORG). The enforcement and only penalties indices come from Galvin (2016) and are discussed further in the paper. The house price index variable uses data from the quarterly all transactions state index published by the Federal Housing Finance Agency (FHFA). The income per capita variable uses average annual data by state from the Bureau of Economic Analysis (BEA). The effective minimum wage variable is the maximum of the state and federal minimum wage for large employers and uses data from the U.S. Department of Labor.

Table 3: Unadjusted Differences across Policy Regimes using CPS MORG Data for 2011-2013 and 2016-2017

	(1)	(2)	(3)	(4)
	2011-2013	2016-2017	Change	Change Relative to Non-increasers
Paid Subminimum Wage				
Non-Increasers	0.0278	0.0169	-0.011	
Indexers	0.0611	0.0551	-0.006	0.005
Increase < $1	0.0309	0.0730	0.042	0.053
Increase >= $1	0.0232	0.0695	0.046	0.057
Subminimum Payment ($)				
Non-Increasers	0.0430	0.0345	-0.008	
Indexers	0.0588	0.0693	0.011	0.019
Increase < $1	0.0439	0.0936	0.050	0.058
Increase >= $1	0.0380	0.114	0.076	0.085
Employment Ages 16-25				
Non-Increasers	0.496	0.533	0.037	
Indexers	0.497	0.552	0.055	0.018
Increase < $1	0.516	0.559	0.043	0.007
Increase >= $1	0.440	0.477	0.037	-0.004
Prime Age Employment				
Non-Increasers	0.760	0.783	0.023	
Indexers	0.757	0.787	0.030	0.007
Increase < $1	0.770	0.800	0.030	0.007
Increase >= $1	0.746	0.777	0.031	0.008
House Price Index				
Non-Increasers	280.2	331.8	51.6	
Indexers	291.4	394.8	103.4	51.8
Increase < $1	305.2	358.1	52.9	1.3
Increase >= $1	467.5	597.8	130.3	78.7
Income per Capita ($1000s)				
Non-Increasers	40.93	45.82	4.89	
Indexers	40.81	46.77	5.96	1.07
Increase < $1	45.27	50.96	5.69	0.80
Increase >= $1	50.68	59.12	8.44	3.55

Notes: This table reports changes in employment rates and wage violations for each our of our four policy groups (non-increasers, indexers, increase < $1, and increase >= $1) between our pre and post periods. Prime age adults are defined as individuals between the ages of 26 and 54. This table also reports mean values of economic control variables (house price index and income per capita) for each of our four policy groups. Data sources are more fully described in the note to Table 2. Column 1 reports the average value between 2011 and 2013 for each row, column 2 reports the average value for 2016-2017, and column 3 reports the difference between the two. Column 4 reports the change in the average value for each row relative to the relevant non-increaser value. Averages are weighted by state population.

Table 4: Relationship between Minimum Wage Increases and Payment of Subminimum Wages Across Samples of the CPS MORG Using Minimum Wage Policy Categories

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	All		Employed		Hourly		Not Imputed	
Large Statutory Increaser x Post	0.0494***	0.0394***	0.1008***	0.0858***	0.1337***	0.1105***	0.0855***	0.0635***
	(0.005)	(0.004)	(0.009)	(0.007)	(0.011)	(0.008)	(0.010)	(0.010)
Small Statutory Increaser x Post	0.0468***	0.0472***	0.0839***	0.0835***	0.1099***	0.1082***	0.0794***	0.0759***
	(0.006)	(0.006)	(0.010)	(0.010)	(0.014)	(0.013)	(0.010)	(0.010)
Indexer x Post	0.0063	-0.0004	0.0066	-0.0044	0.0066	-0.0091	-0.0094	-0.0223*
	(0.005)	(0.004)	(0.008)	(0.007)	(0.014)	(0.012)	(0.013)	(0.012)
Ln(Income per Capita)		-0.0392		-0.1106		-0.1334		0.0389
		(0.048)		(0.090)		(0.126)		(0.074)
House Price Index Divided by 1000		0.1518***		0.2730***		0.3722***		0.2478***
		(0.033)		(0.062)		(0.092)		(0.082)
State prime-age emp-to-pop ratio		0.0015		-0.0072		-0.0098		-0.0415
		(0.014)		(0.029)		(0.030)		(0.032)
Age and education controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	243,570	243,570	122,783	122,783	85,505	85,505	55,550	55,550

Notes: This table reports regression results examining the effect of minimum wage increases on payment of subminimum wages. The dependent variable is an indicator for whether an individual's reported hourly earnings are less than the effective minimum wage. The sample is from the CPS MORG and consists of all individuals ages 16 to 25. Columns 1 and 2 include all individuals ages 16 to 25, columns 3 and 4 include individuals who are employed, columns 5 and 6 include all individuals who are employed, paid by the hour, and do not receive overtime, tips or commissions, and columns 7 and 8 include all individuals who are employed, paid by the hour, do not receive overtime, tips or commissions, and do not have imputed wage rates. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include year and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Relationship between Minimum Wage Increases and Worker Characteristics in the CPS MORG Using Minimum Wage Policy Categories

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Employed		Tipped or Overtime		Hourly		Not Imputed	
Large Statutory Increaser x Post	0.0000	-0.0247**	0.0003	-0.0066	-0.0086	-0.0188*	0.0010	-0.0025
	(0.015)	(0.010)	(0.006)	(0.005)	(0.015)	(0.011)	(0.010)	(0.010)
Small Statutory Increaser x Post	0.0062	0.0065	0.0000	0.0006	0.0068	0.0086	0.0003	0.0005
	(0.019)	(0.009)	(0.006)	(0.005)	(0.017)	(0.010)	(0.017)	(0.013)
Indexer x Post	0.0189	0.0132	0.0059	0.0031	0.0088	0.0080	0.0160	0.0186
	(0.012)	(0.008)	(0.005)	(0.004)	(0.010)	(0.010)	(0.013)	(0.012)
Ln(Income per Capita)		0.4117***		0.0492		0.3528**		0.3682***
		(0.150)		(0.073)		(0.154)		(0.094)
House Price Index Divided by 1000		0.0101		0.0550		-0.0461		-0.1463*
		(0.097)		(0.044)		(0.103)		(0.074)
State prime-age emp-to-pop ratio		0.1083**		0.0005		0.0935**		0.0824**
		(0.044)		(0.022)		(0.043)		(0.035)
Age and education controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	243,570	243,570	243,570	243,570	243,570	243,570	243,570	243,570

Notes: This table reports results examining the effect of minimum wage increases on worker characteristics. The sample is from the CPS MORG and consists of all individuals ages 16 to 25. Columns 1 and 2 report results with an indicator for whether an individual is employed, columns 3 and 4 report results with an indicator for whether an individual receives tips or overtime pay, columns 5 and 6 report results with an indicator for whether an individual is paid by the hour, and columns 7 and 8 report results with an indicator for whether an individual does not have imputed wage rates. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year, and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Relationship between Minimum Wage Increases and Payment of Subminimum Wages Across Samples of the CPS MORG Using Continuous Minimum Wage Changes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	All		Employed		Hourly		Not Imputed	
Effective Minimum Wage	0.0256***	0.0264***	0.0507***	0.0531***	0.0667***	0.0696***	0.0423***	0.0441***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Ln(Income per Capita)		-0.0338		-0.0843		-0.1098		-0.0142
		(0.039)		(0.078)		(0.105)		(0.073)
House Price Index Divided by 1000		-0.0054		-0.0182		-0.0340		-0.0518
		(0.038)		(0.086)		(0.115)		(0.116)
State prime-age emp-to-pop ratio		0.0084		0.0073		0.0089		-0.0023
		(0.015)		(0.030)		(0.033)		(0.027)
Age and education controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	336,000	336,000	167,336	167,336	119,867	119,867	77,105	77,105

Notes: This table reports regression results examining the effect of minimum wage changes on the probability an individual reports earning a wage $0.25 or more below the effective minimum wage. The samples are from the CPS MORG and consists of all individuals ages 16 to 25. Columns 1 and 2 include all individuals ages 16 to 25, columns 3 and 4 include individuals who are employed, columns 5 and 6 include all individuals who are employed, paid by the hour, and do not receive tips, commissions, or overtime, and columns 7 and 8 include all individuals who are employed, paid by the hour, do not receive tips, commissions or overtime, and do not have imputed wage rates. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year, and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Relationship between Minimum Wage Increases and Average Hourly Wage Increases among Individuals Ages 16-25 Using Continuous Minimum Wage Changes

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Hourly Wage		Subminimum Payment		Compliance Wage	
Effective Minimum Wage	0.2575***	0.2606***	0.0376***	0.0400***	0.2951***	0.3006***
	(0.026)	(0.036)	(0.004)	(0.005)	(0.025)	(0.036)
Ln(Income per Capita)		0.6849		0.0232		0.7080
		(0.875)		(0.131)		(0.816)
House Price Index Divided by 1000		-0.3141		-0.0904		-0.4045
		(0.919)		(0.106)		(0.864)
State prime-age emp-to-pop ratio		0.7139**		0.0209		0.7347**
		(0.305)		(0.063)		(0.281)
Age and education controls	No	Yes	No	Yes	No	Yes
Observations	77,105	77,105	77,105	77,105	77,105	77,105

Notes: This table reports regression results examining the effect of minimum wage increases on wage gains and subminimum payment. The sample is from the CPS MORG and consists of all individuals ages 16 to 25 who are employed, paid by the hour, do not receive tips, commissions, or overtime, and do not have imputed wage rates. Columns 1 and 2 report the effect of minimum wage changes on reported hourly wages, columns 3 and 4 report the effect of minimum wage changes on average underpayment, and columns 5 and 6 estimate how much higher the wage effects from columns 1 and 2 would have been had all individuals receiving subminimum wage rates received the effective minimum instead. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year, and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Relationship between Minimum Wage Increases and Average Hourly Wage Increases among Individuals Ages 16-35 Using Continuous Minimum Wage Changes

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Hourly Wage		Subminimum Payment		Compliance Wage	
Effective Minimum Wage	0.1775***	0.1486***	0.0274***	0.0306***	0.2049***	0.1792***
	(0.024)	(0.027)	(0.002)	(0.003)	(0.024)	(0.027)
Ln(Income per Capita)		1.3065**		0.0090		1.3155**
		(0.645)		(0.089)		(0.629)
House Price Index Divided by 1000		-0.5837		-0.0954		-0.6791
		(0.629)		(0.062)		(0.595)
State prime-age emp-to-pop ratio		0.5162*		0.0142		0.5303*
		(0.285)		(0.037)		(0.277)
Age and education controls	No	Yes	No	Yes	No	Yes
Observations	151,360	151,360	151,360	151,360	151,360	151,360

Notes: This table reports regression results examining the effect of minimum wage increases on wage gains and subminimum payment. The sample is from the CPS MORG and consists of all individuals ages 16 to 35 who are paid by the hour, do not receive tips, commissions, or overtime, and do not have imputed wage rates. Columns 1 and 2 report the effect of minimum wage changes on reported hourly wages among the employed, columns 3 and 4 report the effect of minimum wage changes on average underpayment, and columns 5 and 6 estimate how much higher the wage effects from columns 1 and 2 would have been had all individuals receiving subminimum wage rates received the effective minimum instead. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year, and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 9: Relationship between Minimum Wage Increases and Average Hourly Wage Increases among Individuals Ages 16-65 Using Continuous Minimum Wage Changes

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Hourly Wage		Subminimum Payment		Compliance Wage	
Effective Minimum Wage	0.0939***	0.0861***	0.0207***	0.0211***	0.1146***	0.1073***
	(0.022)	(0.024)	(0.002)	(0.002)	(0.022)	(0.024)
Ln(Income per Capita)		0.6955		0.0346		0.7301
		(0.556)		(0.063)		(0.547)
House Price Index Divided by 1000		-0.2844		-0.0291		-0.3135
		(0.528)		(0.045)		(0.511)
State prime-age emp to pop ratio		0.2727		-0.0013		0.2714
		(0.197)		(0.027)		(0.191)
Age and education controls	No	Yes	No	Yes	No	Yes
Observations	325,125	325,125	325,125	325,125	325,125	325,125

Notes: This table reports regression results examining the effect of minimum wage increases on wage gains and subminimum payment. The sample is from the CPS MORG and consists of all individuals ages 16 to 65 who are paid by the hour, do not receive tips, commissions or overtime, and do not have imputed wage rates. Columns 1 and 2 report the effect of minimum wage changes on reported hourly wages, columns 3 and 4 report the effect of minimum wage changes on average underpayment, and columns 5 and 6 estimate how much higher the wage effects from columns 1 and 2 would have been had all individuals receiving subminimum wage rates received the effective minimum instead. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 10: Relationship between Minimum Wage Increases, Enforcement and Payment of Subminimum Wages Using Continuous Minimum Wage Changes and CPS MORG Data from 2011-2013

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Paid Subminimum Wage				
Effective Minimum Wage			0.0235***	0.0266***	0.0263***
			(0.007)	(0.008)	(0.008)
Enforcement Index	-0.0160			-0.0552	
	(0.036)			(0.038)	
Only Penalties Index		-0.0194			-0.0390*
		(0.021)			(0.023)
Ln(Income Per Capita)	0.0019	0.0031	-0.0209	-0.0146	-0.0156
	(0.025)	(0.025)	(0.019)	(0.017)	(0.017)
House Price Index Divided by 1000	-0.0464	-0.0442	-0.0582	-0.0471	-0.0479
	(0.048)	(0.048)	(0.042)	(0.042)	(0.041)
State prime-age emp-to-pop ratio	-0.0925**	-0.0966**	-0.0331	-0.0385	-0.0421
	(0.042)	(0.039)	(0.050)	(0.041)	(0.037)
Age and education controls	Yes	Yes	Yes	Yes	Yes
Observations	34,399	34,399	34,399	34,399	34,399

Notes: This table reports regression results examining the relationship between minimum wages and penalties for noncompliance on payment of subminimum wages. Data are restricted to 2011 to 2013, which corresponds with the "baseline" period during which the only minimum wage changes to be implemented by states were associated with inflation indexation provisions. The dependent variable is an indicator for whether an individual's reported hourly earnings are less than the effective minimum wage. The sample is from the CPS MORG and consists of all individuals ages 16 to 25 who are employed, paid by the hour, do not receive tips commissions or overtime, and do not have imputed wage rates. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year, and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Relationship between Minimum Wage Increases, Enforcement and Wage Violations Using Continuous Minimum Wage Changes and Only Penalties Index

	(1)	(2)	(3)	(4)
Dependent Variable	Paid less than effective minimum wage		Subminimum payment	
Effective Minimum Wage	0.0151*	0.0137	0.0146**	0.0139*
	(0.009)	(0.009)	(0.007)	(0.007)
Effective Minimum Wage x Only Penalties Index	0.0672***	0.0823***	0.0423***	0.0537***
	(0.020)	(0.024)	(0.015)	(0.014)
Ln(Income per Capita)		-0.0834		-0.0338
		(0.072)		(0.105)
House Price Index Divided by 1000		-0.1091		-0.1117
		(0.094)		(0.075)
State prime-age emp-to-pop ratio		-0.0039		0.0200
		(0.027)		(0.053)
Age and education controls	No	Yes	No	Yes
Observations	77,111	77,111	77,111	77,111

Notes: This table reports regression results examining the effect of minimum wage increases and penalties for noncompliance on payment of minimum wages and the magnitude of wage violations. In columns 1 and 2, the dependent variable is a dichotomous indicator for whether an individual reports an hourly wage $0.25 or more below the effective minimum wage in their state of residence. In columns 3 and 4, the dependent variable is the difference between the reported hourly wage and the effective minimum wage. The sample is from the CPS MORG and consists of all individuals ages 16 to 25 who are employed, paid by the hour, do not receive tips, overtime, or commissions, and do not have imputed wage rates. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year, and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

Table 12: Relationship between Minimum Wage Increases, Enforcement and Wage Violations Using Continuous Minimum Wage Changes and Full Enforcement Index

	(1)	(2)	(3)	(4)
Dependent Variable	Paid less than effective minimum wage		Subminimum Payment	
Effective Minimum Wage	0.0010	-0.0050	0.0080	0.0031
	(0.013)	(0.014)	(0.013)	(0.012)
Effective Minimum Wage x Enforcement Index	0.1272***	0.1615***	0.0913**	0.1213***
	(0.040)	(0.046)	(0.034)	(0.030)
Ln(Income per Capita)		-0.0963		-0.0385
		(0.076)		(0.127)
House Price Index Divided by 1000		-0.1147		-0.1376
		(0.090)		(0.088)
State prime-age emp-to-pop ratio		-0.0033		0.0201
		(0.027)		(0.063)
Age and education controls	No	Yes	No	Yes
Observations	77,111	77,111	77,111	77,111

Notes: This table reports regression results examining the effect of minimum wage increases and enforcement on payment of subminimum wages and the magnitude of wage violations. In columns 1 and 2, the dependent variable is a dichotomous indicator for whether an individual reports an hourly wage at least $0.25 below the effective minimum wage in their state of residence. In columns 3 and 4, the dependent variable is the difference between the reported hourly wage and the effective minimum wage. The sample is from the CPS MORG and consists of all individuals ages 16 to 25 who are employed, paid by the hour, do not receive tips, commissions, or overtime, and do not have imputed wage rates. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include month, year, month-year, and state fixed effects. Age and education controls consist of a dummy variable for each education group and age. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1

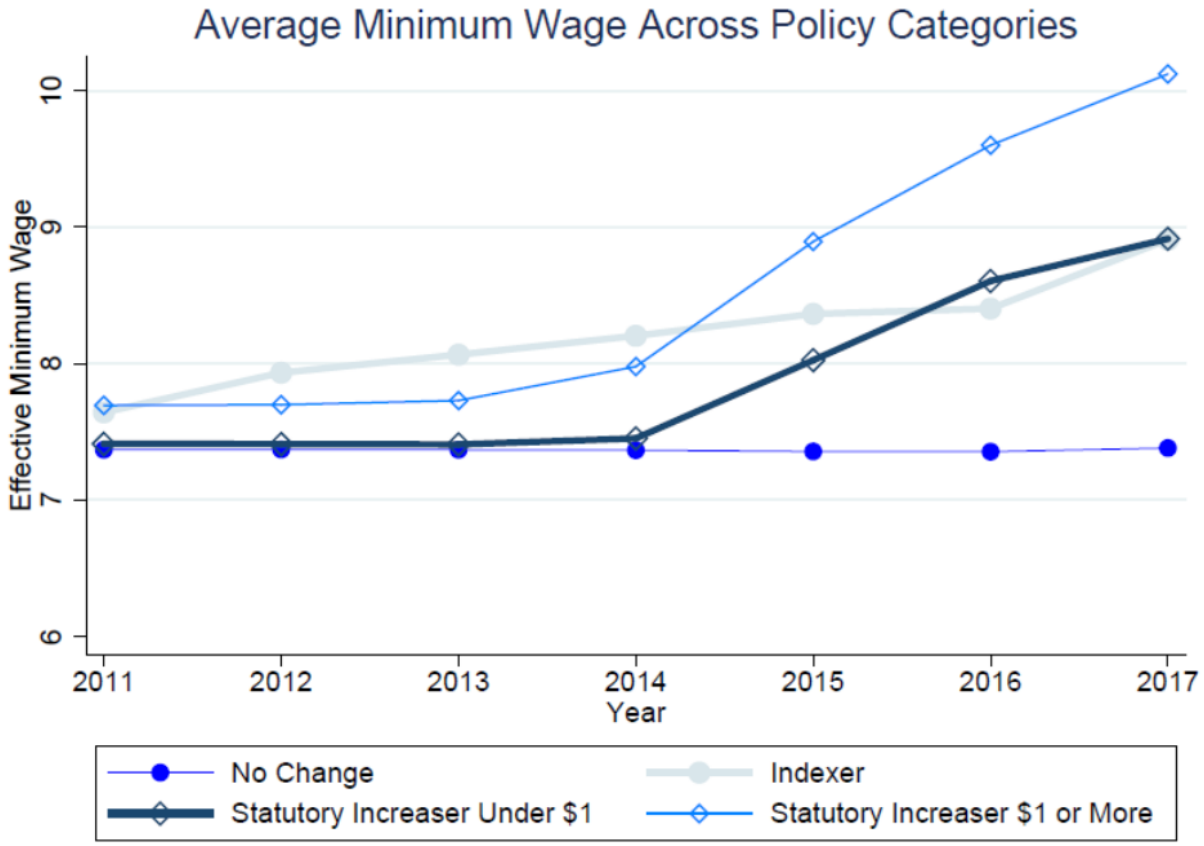

Figure 1. Average Minimum Wage across Policy Categories: This figure plots the average annual effective minimum wage for states in each of our four policy categories from January 2011 to January 2017. States are defined as statutory increasers under $1 if the combined statutory increase in their minimum wage between January 2013 and January 2015 was under $1. States are defined as statutory increasers of $1 or more if the combined statutory increase in their minimum wage was $1 or greater. Indexers are states that index their minimum wage to inflation. The effective minimum wage is defined as the maximum of the state and federal minimum wage. Data on minimum wage rates come from the U.S. Department of Labor. Data on minimum wage policies come from the National Conference of State Legislatures. Averages are weighted by state population.

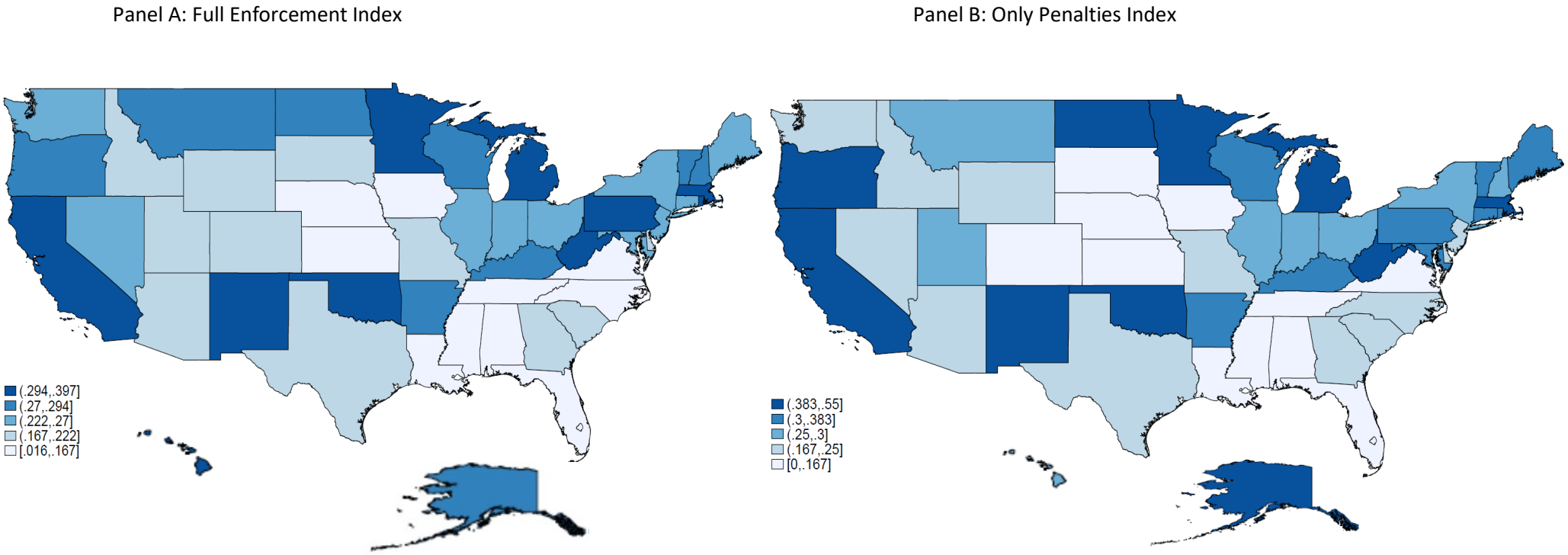

Figure 2. Maps of Minimum Wage Enforcement Indices by State: This figure plots average values of the Galvin (2016) minimum wage enforcement index and only penalties index by state based on enforcement regimes as of December 31, 2013. Higher values indicate more stringent enforcement regimes. The minimum wage index on the left includes both information regarding the claims process as well as laws regarding criminal and civil penalties levied in the event of violation. The only penalties index, mapped in the figure on the right, only includes civil and criminal penalties levied in the event an employer is found guilty of a violation.

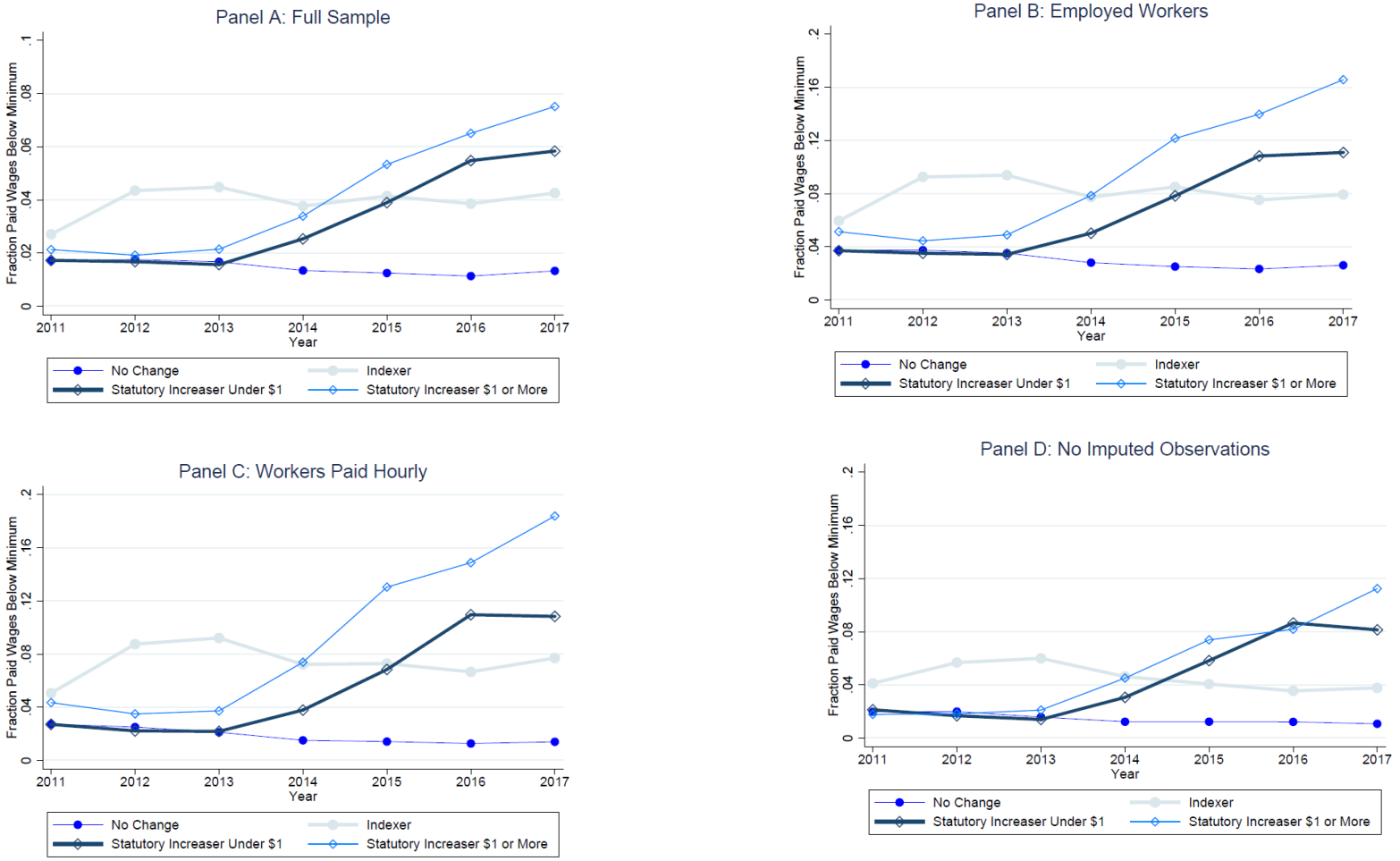

Figure 3. Incidence of Subminimum Wage Payment across Policy Categories: This figure plots the fraction of workers who are paid less than the effective minimum wage for each of our four policy groups, broken out across four subsamples, from 2011 to 2017. Data come from the Current Population Survey Merged Outgoing Rotation Groups (CPS MORG). Subminimum payment is the difference between the effective minimum wage and the hourly wage reported in the CPS MORG. Panel A plots the share of individuals reporting a noncompliance wage for our entire sample, defined as individuals ages 16 to 25 who report being paid less than the effective minimum wage when they are interviewed. Panel B plots the share of employed individuals reporting a noncompliance wage. Panel C plots the share of individuals reporting a noncompliance wage for workers paid by the hour who do not receive tips commissions or overtime pay. Panel D plots the share of individuals reporting a noncompliance wage for individuals paid by the hour, who do not receive tips, commissions or overtime, and who do not have imputed wage rates. States are defined as statutory increasers under $1 if the combined statutory increase in their minimum wage between January 2013 and January 2015 was under $1. States are defined as statutory increasers of $1 or more if the combined statutory increase in their minimum wage was $1 or greater. Indexers are states that index their minimum wage to inflation. Averages are weighted by state population.

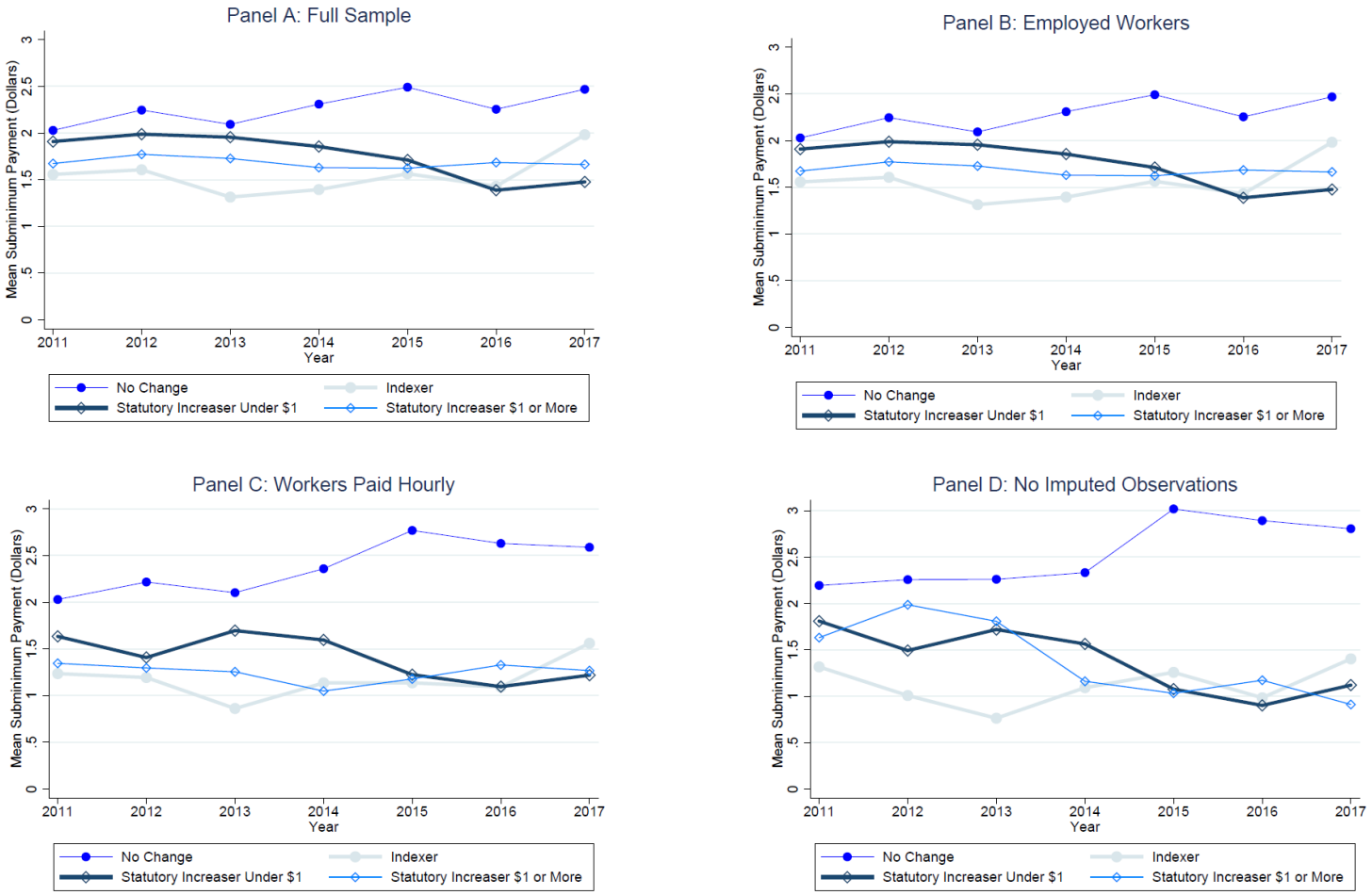

Figure 4. Average Value of Subminimum Wage Payment across Policy Categories: This figure plots average wage subminimum payment for each of our four policy groups, broken out across four subsamples, from 2011 to 2017 for individuals who are paid less than the effective minimum wage. Data come from the Current Population Survey Merged Outgoing Rotation Group (CPS MORG). Subminimum payment is the difference between the effective minimum wage and the hourly wage reported in the CPS MORG. Panel A plots mean subminimum wage payment for our entire sample, defined as individuals ages 16 to 25 who report being paid less than the effective minimum wage when they are interviewed. Panel B plots mean subminimum payment for all employed workers. Panel C plots mean subminimum payment for workers paid by the hour, who do not receive tips, commissions or overtime. Panel D plots mean subminimum payment for individuals paid by the hour, who do not receive tips commissions or overtime, and who do not have imputed wage rates. States are defined as statutory increasers under $1 if the combined statutory increase in their minimum wage between January 2013 and January 2015 was under $1. States are defined as statutory increasers of $1 or more if the combined statutory increase in their minimum wage was $1 or greater. Indexers are states that index their minimum wage to inflation. Averages are weighted by state population.

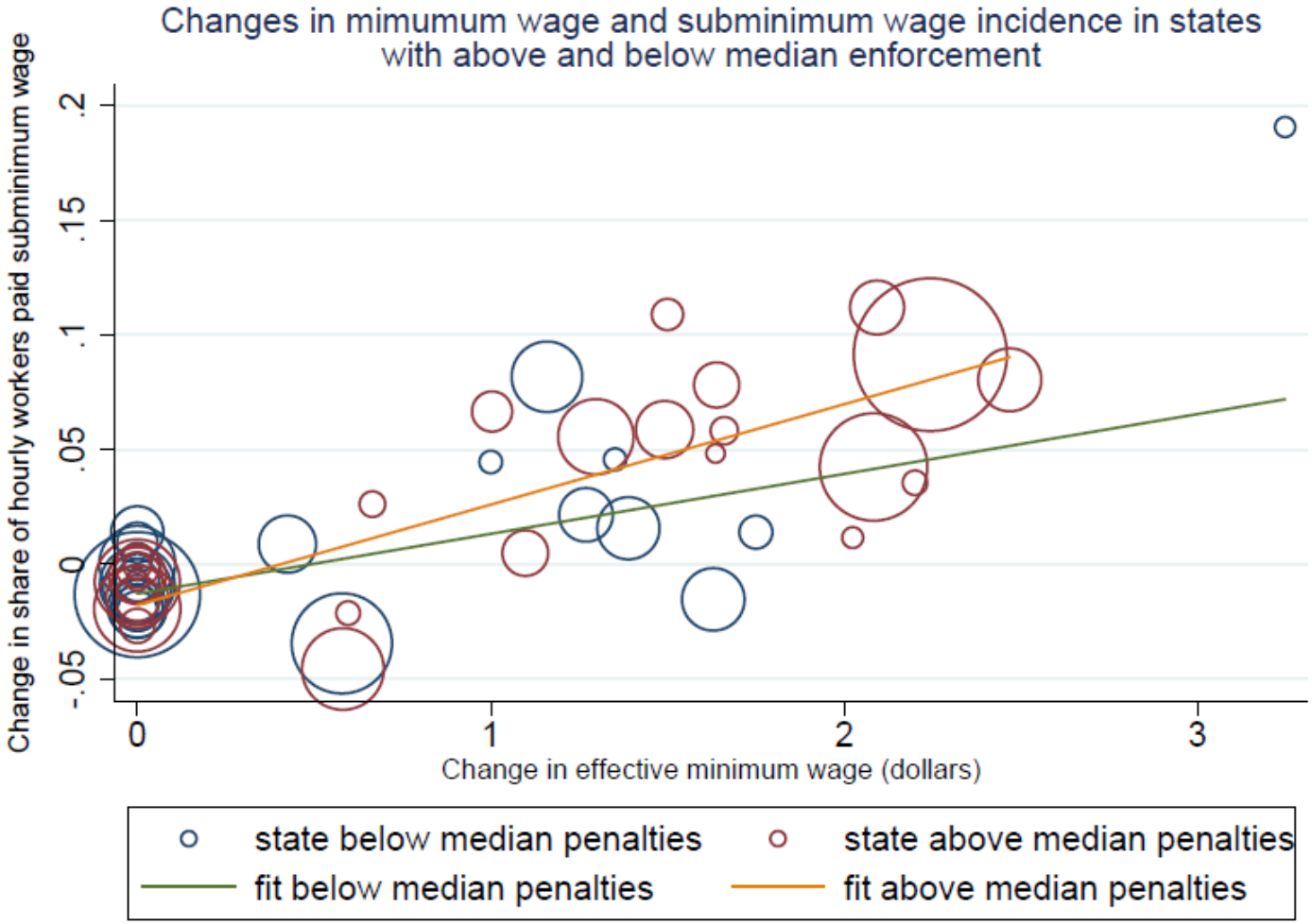

Figure 5. Change in Subminimum Wage Incidence and Change in Effective Minimum Wage: This figure plots the difference in the share of hourly workers against the difference in the effective minimum wage between 2011-2012 and 2016-2017 by state. Blue dots represent states with values of the Galvin (2016) wage theft penalty index below the median and red dots are states above the median. Dot sizes are proportional to state population. Best fit lines are weighted by state population.

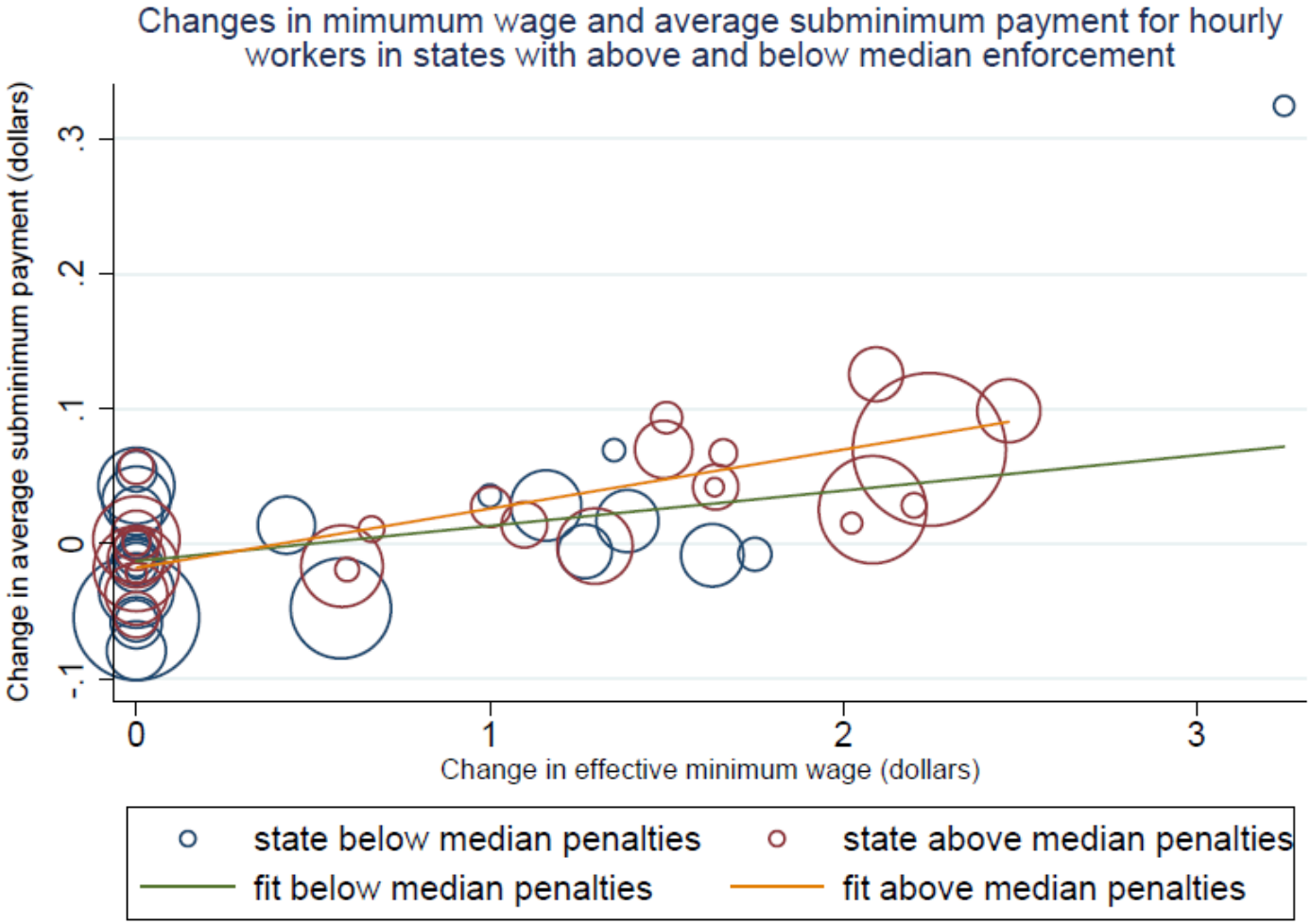

Figure 6. Change in Average Subminimum Wage Payment and Change in Effective Minimum Wage: This graph plots the difference in average subminimum wage payment among all hourly workers in the CPS MORG against the difference in the minimum wage between 2011-2012 and 2016-2017 by state. Blue dots represent states with values of the Galvin (2016) wage theft penalty index below the median and red dots are states above the median. Dot sizes are proportional to state population. Best fit lines are weighted by state population.

Table A1: List of States with Statutory Minimum Wage Increases and Inflation-Indexed Increases using Changes from 2013 to 2017 and $2 Cutoff

Statutory increasers of $2 or more	Statutory increasers under $2
Alaska	Arkansas
Arizona	Colorado
California	Connecticut
District of Columbia	Delaware
Hawaii	Maine
Massachusetts	Maryland
Minnesota	Michigan
New York	Nebraska
	New Jersey
	Oregon
Indexers	Rhode Island
Florida	South Dakota
Missouri	Vermont
Montana	Washington
Ohio	West Virginia
Oregon	

Notes: Data on minimum wage indexing provisions comes from the National Council of State Legislatures. The states labeled as Indexers link annual updates to their effective minimum wage rates to a measure of inflation. Data on minimum wage changes comes from the U.S. Department of Labor. States are counted as statutory increasers of under $2 if the combined statutory increase in the minimum wage from January 2013 through January 2017 was under $2. States are counted as statutory increasers of $2 or more if the combined statutory increase in the minimum wage was $2 or more.

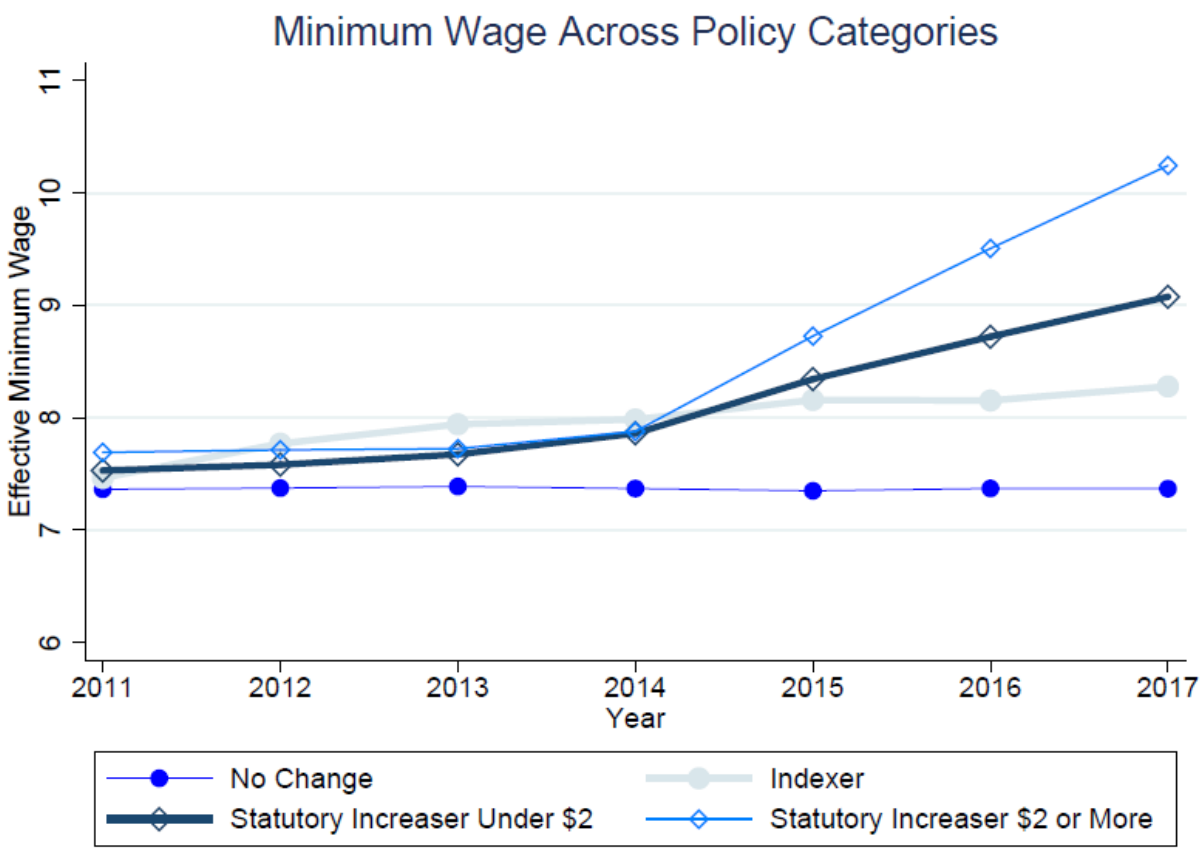

Figure A1. Average Minimum Wage across Policy Categories: This figure plots the average annual effective minimum wage for states in each of our four policy categories from January 2011 to January 2017. States are defined as statutory increasers under $2 if the combined statutory increase in their minimum wage between January 2013 and January 2017 was under $2. States are defined as statutory increasers of $2 or more if the combined statutory increase in their minimum wage was $2 or greater. Indexers are states that index their minimum wage to inflation. The effective minimum wage is defined as the maximum of the state and federal minimum wage. Data on minimum wage rates come from the U.S. Department of Labor. Data on minimum wage policies come from the National Conference of State Legislatures. Averages are weighted by state population.

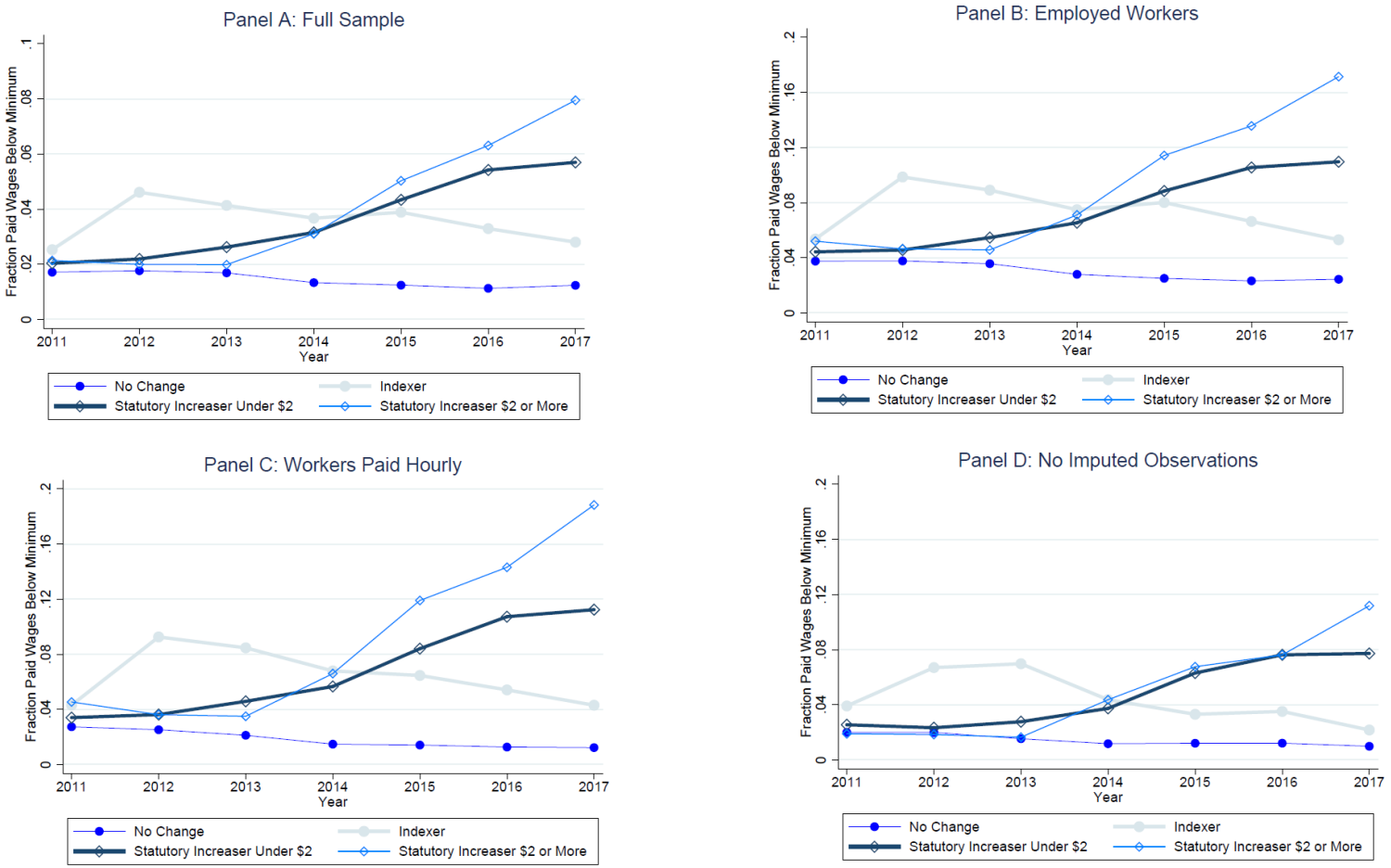

Figure A2. Incidence of Subminimum Wage Payment across Policy Categories: This figure plots the fraction of workers who are paid less than the effective minimum wage for each of our four policy groups, broken out across four subsamples, from 2011 to 2017. Data come from the Current Population Survey Merged Outgoing Rotation Group (CPS MORG). Wage theft is the difference between the effective minimum wage and the hourly wage reported in the CPS MORG. Panel A plots the share of individuals reporting a noncompliance wage for our entire sample, defined as individuals ages 16 to 25 who report being paid less than the effective minimum wage when they are interviewed. Panel B plots the share of employed individuals reporting a noncompliance wage. Panel C plots the share of individuals reporting a noncompliance wage for workers paid by the hour. Panel D plots the share of individuals reporting a noncompliance wage for individuals who do not have imputed wage rates. States are defined as statutory increasers under $2 if the combined statutory increase in their minimum wage between January 2013 and January 2017 was under $2. States are defined as statutory increasers of $2 or more if the combined statutory increase in their minimum wage was $2 or greater. Indexers are states that index their minimum wage to inflation. Averages are weighted by state population.

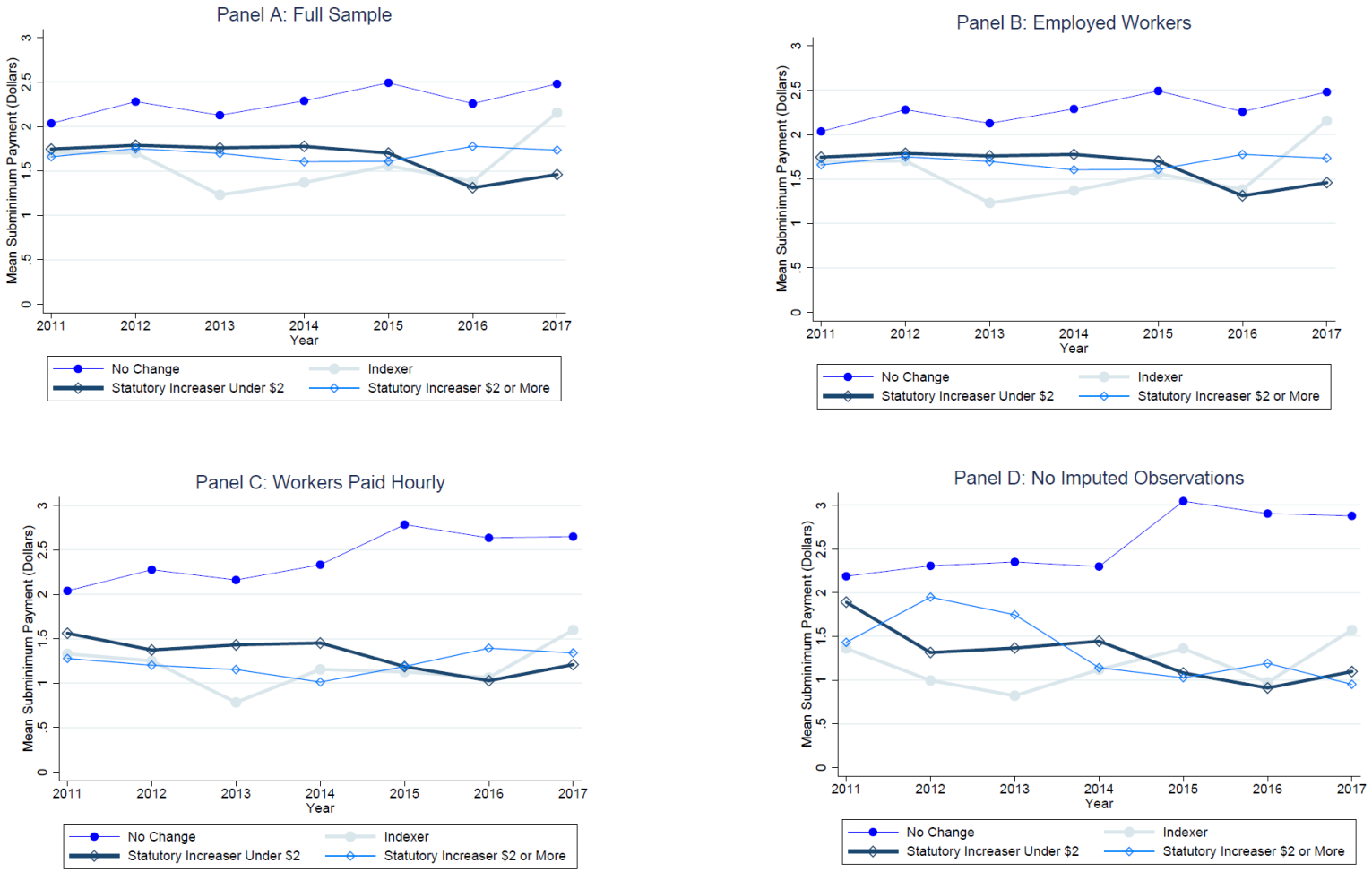

Figure A3. Average Value of Subminimum Wage Payment across Policy Categories: This figure plots average subminimum wage payment for each of our four policy groups, broken out across four subsamples, from 2011 to 2017 for individuals who are paid less than the effective minimum wage. Data come from the Current Population Survey Merged Outgoing Rotation Group (CPS MORG). Wage theft is the difference between the effective minimum wage and the hourly wage reported in the CPS MORG. Panel A plots average wage theft for our entire sample, defined as individuals ages 16 to 25 who report being paid less than the effective minimum wage when they are interviewed. Panel B plots the mean of wage theft for the employed. Panel C plots the mean of wage theft for workers paid by the hour. Panel D plots the mean of wage theft for individuals who do not have imputed wage rates. States are defined as statutory increasers under $2 if the combined statutory increase in their minimum wage between January 2013 and January 2017 was under $2. States are defined as statutory increasers of $2 or more if the combined statutory increase in their minimum wage was $2 or greater. Indexers are states that index their minimum wage to inflation. Averages are weighted by state population.