Recent Immigrants as Labor Market Arbitrageurs: Evidence from the Minimum Wage*

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Revised Version: October 2013

Abstract

This paper investigates the local labor supply effects of changes to the minimum wage by examining the response of low-skilled immigrants' location decisions. Canonical models emphasize the importance of labor mobility when evaluating the employment effects of the minimum wage; yet few studies address this outcome directly. Low-skilled immigrant populations shift toward labor markets with stagnant minimum wages, and this result is robust to a number of alternative interpretations. This mobility provides behavior-based evidence in favor of a non-trivial negative employment effect of the minimum wage. Further, it reduces the estimated demand elasticity using teens; employment losses among native teens are substantially larger in states that have historically attracted few immigrant residents.

JEL: J23, J61, J38

Keywords: minimum wage, immigration, labor mobility, spatial equilibrium

*I am grateful for helpful comments from Rebecca Blank, Charlie Brown, Sheldon Danziger, John DiNardo, Ben Keys, Brian Kovak, Marie Mora, Terra McKinnish, Jim Sallee, David Neumark (the co-editor), two anonymous referees, and seminar participants at Colorado State University and the University of Colorado-Denver. Ramon Rodriguez provided excellent research assistance. Remaining errors are my own. I acknowledge generous support from the University of Michigan's Rackham Merit Fellowship while working on this project.

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1 Introduction

Nearly all empirical evaluations of the effect of the minimum wage focus on demand-side responses, especially changes in employment, hours, and the price of the output good.[1] In this paper, I instead focus on how minimum wage increases affect the local supply of low-skilled labor. Canonical models imply that labor mobility is a key outcome in a complete study of the effect of the minimum wage; yet comparatively little research has focused on this margin of adjustment. There are two principal reasons that supply responses are of independent interest. First, labor mobility provides an alternative method of evaluating the disemployment effect of the minimum wage.[2] Because the minimum wage could either increase or decrease expected earnings, workers' location choices among different policy regimes provide indirect information about the labor demand elasticity. This alternative empirical strategy provides a complementary approach to the standard methodology of examining local disemployment effects in response to policy changes. Second, when labor moves across affected and unaffected markets, this mobility has the potential to confound the interpretation of correlations between local employment outcomes and local policies.

Toward the goal of creating a more complete picture of the labor market effects of the minimum wage, I investigate how the location decisions of recently arrived low-skilled immigrants respond to local minimum wage policy changes. My empirical work takes advantage of questions regarding nativity and year of arrival that were added to the core of the Current Population Survey (CPS) in 1994. The inclusion of these additional variables al-

[1] For a survey of early work, see Brown (1999). Neumark and Wascher (2007) provide an extensive survey of more recent work.

[2] Note that in this paper, as in most empirical evaluations of the minimum wage, a negative effect of the minimum wage means a lower level of employment than would have been expected in the absence of the minimum (given the location of the market and the time period). This negative effect could result from a slower growth of employment rather than from actual job loss. I use the term "disemployment" throughout the paper as a shorthand for employment levels or rates that are lower than suggested by the counterfactual.

lows for descriptive analysis revealing that recently arrived low-skilled immigrants are quite likely to work in jobs with wage rates bound by the minimum wage. In fact, these workers with relatively little US labor market experience work in much the same entry-level jobs as do native-born teens.[3] Additionally, previous work suggests that immigrants' location choices respond more strongly to changes in labor market conditions than do those of natives (Borjas 2001, Jaeger 2007, Cadena 2013, Cadena and Kovak 2013). Further, teens are typically not choosing where to live independently of their larger household, which limits their ability to move in response to local demand changes.

Fortunately, the time period during which immigrants can be identified in the CPS also provides a particularly rich set of state policy regimes.[4] In response to a federal minimum wage that remained fixed in nominal terms for nearly a decade, a majority of states set higher minimums, and several enacted multiple increases. The resulting mix of policies provides significant geographic variation in both the timing and the dollar amount of the minimum wage across multiple labor markets. This exceptional variation allows me to use an empirical framework that controls for unobserved permanent state characteristics (such as distance from sending countries, climate, and the historical location of ethnic networks), a flexible general time trend to account for changes in immigrant populations common across states, and state-specific linear trends to address the ongoing diffusion of immigrants away from traditional gateway cities.[5]

[3]Smith (2012) reaches a similar conclusion that there is substantial labor market competition among members of these two groups.

[4]Burkhauser, Couch and Wittenburg (2000) demonstrate that state fixed effects and time dummies account for nearly all of the variation in the minimum wage in earlier time periods. Sabia (2009) shows that the policy environment provides much more useful variation over the time period I study in this article.

[5]Hellerstein, McInerney and Neumark (2010) demonstrate the importance of networks in job-finding for Hispanic workers with low English proficiency (likely immigrants), and they find that networks are especially important in new growth areas. This result provides an important motivation for the state-specific time trends as the relative strength of network ties across states is likely changing with the diffusion of the immigrant population across geography during this time period.

I find strong, significant evidence that low-skilled recent immigrants tend to prefer states with unchanged minimums to states experiencing increases in their wage floors. A ten percent increase in a state's minimum wage leads to a roughly eight percent decrease in the number of recently arrived immigrants who live in that state.[6] This behavior suggests that a minimum wage increase decreases expected earnings for searching workers, i.e. that an increase in the minimum wage decreases the probability that a new worker will find employment by proportionately more than it increases successful job seekers' wages.[7] As a falsification test, I repeat the analysis using immigrants with higher levels of education who generally command market wages significantly above any state's minimum wage. The location pattern of this group is roughly uncorrelated with changes in states' minimum wage policies, which supports interpreting the results for the low-skilled group as an optimizing response to changes in labor market conditions.

These results have important implications for both the minimum wage and immigration literatures. First, this mobility provides indirect evidence of a noticeable displacement effect of the minimum wage. If, as some authors have found, there is little to no effect of the minimum wage on local labor demand, then immigrants should be drawn toward states that increase their minimums. This study finds the opposite result, and implies that the disemployment effects are non-trivial, especially for searching workers.

Further, studies of the effects of the minimum wage on local labor demand often examine employment to population ratios among teenagers as the primary outcome. The evidence I present in this paper suggests that these types of analyses will underestimate the true dis-

[6]Data limitations prevent a further decomposition of this change into channels such as initial location choices or mobility subsequent to arrival. Cadena and Kovak (2013) provide a decomposition in a different context showing that each of these channels contributes to an earnings-maximizing reallocation of immigrant labor.

[7]This finding is consistent with recent work finding that a minimum wage increase tends to slow down both hiring and separation rates, which are likely of particular relevance for a new entrant (Dube, Lester and Reich 2012, Brochu and Green 2013).

employment effects of a minimum wage increase because the outflows of competing workers will tend to mitigate the incidence of demand changes on workers who remain in the affected state. In fact, I provide additional specifications showing that the estimated demand elasticities using *native teens* are substantially larger in states that have tended to attract relatively small immigrant populations.

The present study therefore complements Orrenius and Zavodny (2008) who examine the effect of minimum wages on labor market outcomes for immigrants. Their analysis reveals smaller estimated disemployment effects for immigrants than for native workers, and they present some suggestive evidence that immigrants tend to favor locating in areas with stagnant minimum wages. Their analysis, however, does not consider whether this settlement pattern is consistent with earnings-maximizing behavior nor does it address the impact of immigrants' movement on estimates of employment effects of the minimum wage among other workers.

This paper also contributes to a growing literature demonstrating that recently arrived immigrants select destinations within the United States based, in part, on differences in labor labor market conditions. Earlier cross-sectional work including Bartel (1989) and Zavodny (1999), tended to find a relatively small influence of labor market opportunities on location choices. More recent studies examining *changes* in location choices in response to changing labor market conditions tend to find more robust evidence that immigrants select locations based on expected earnings (Borjas 2001, Jaeger 2007, Cadena 2013, Cadena and Kovak 2013). The current study's use of policy-induced changes to local labor demand therefore provides further strong evidence of a causal relationship between a location's expected earnings for new entrants and the growth of its immigrant population.

The findings in this paper therefore lend additional support to the interpretation that weak correlations between immigrant inflows and local wage or employment changes result in

part from immigrants selecting locations with relatively larger unobserved demand increases for their type of labor. In fact, this mechanism has frequently been cited as a challenge to studies that rely on geography-based research designs to determine how the change in skill mix created by immigrants affects the wage distribution.[8] The extent of the selective location choices documented in this paper provides direct evidence of this phenomenon, and it re-emphasizes the importance of isolating immigration inflows that are unrelated to changes in demand.[9]

The remainder of the paper is organized as follows: Section 2 presents a straightforward conceptual framework, emphasizing that labor mobility from one market to another is a central prediction of the theory of the minimum wage; Section 3 presents the central analysis, including robustness checks and evidence that immigrant mobility affects the estimated demand elasticity among native teens; Section 4 concludes.

2 Conceptual Framework

This section adapts the two-sector model of Mincer (1976) to a geographic context in order to emphasize the importance of geographic labor mobility in evaluating the effects of a minimum wage increase on labor market outcomes. This classic model, originally motivated through a minimum wage with partial coverage, assumes that the policy change will reduce the probability that a searching worker finds employment in the covered sector, in addition to raising wages. These two changes in labor market conditions will have opposing effects on that sector's attractiveness to workers deciding in which sector they will search. An increase

[8] See Borjas, Freeman and Katz (1997), Borjas (2003) and Borjas, Grogger and Hanson (2006) for examples of papers discussing this criticism.

[9] Card (2001) popularized the use of the so-called "supply push" instrument based on the location of previous waves of immigrants from the same source countries, which is intended to isolate exactly this type of inflow.

in the minimum wage, therefore, may increase or decrease the earnings a searching worker can expect. In order to return the labor market to equilibrium, labor must flow toward the sector offering higher expected earnings until expected returns equalize in both sectors. Although the original model relied on workers reallocating across sectors, earnings-sensitive geographic mobility may also work toward equalizing returns.

There are three central lessons from the model. First, simple economic theory suggests that a reallocation of workers across sectors is one of the primary means through which the labor market responds to an increase in the minimum wage. Second, labor will flow away from a minimum wage increase for large decreases in employment probability and toward an increased wage floor for smaller decreases. Thus, examining these labor flows serves as an alternative method of evaluating whether disemployment effects are empirically large or small. Finally, comparing changes in employment rates among markets with varying policies will provide direct information on the elasticity of labor demand only under very narrow conditions.

2.1 Basic Model

Consider a set of workers who inelastically supply one unit of labor in one of two labor markets (U.S. states). Workers are free to search in either state in order to maximize their expected earnings, but each worker must choose one and only one state.[10] A geographic equilibrium requires equal expected earnings for non-employed workers in both markets.[11]

[10]Mincer originally motivated the model as describing the equilibrium wage and employment dynamics of covered and uncovered sectors within the same geographic area. The assumption that workers cannot simultaneously search for employment in both sectors is difficult to justify in this original setting, and Brown (1999) discusses some alternative modeling choices. In the present geographic context, however, this assumption more closely reflects reality as workers need to move to another state in order to search for employment covered by the higher minimum wage.

[11]Todaro (1969) describes a similar dynamic in the context of a developing country where the jobs covered by the minimum wage are located in an urban area that is geographically distant from the rural uncovered jobs.

Thus, when differences in the employment probability perfectly offset differences in wages, no worker has an incentive to move. My analysis begins at such an initial equilibrium and then determines the resulting migration incentives when only one state increases its minimum wage.[12] It is important to note that, in a growing economy, a geographic reallocation of labor can occur either by migration among those residing in the US prior to the policy change or through differential entry from abroad. Given the data limitations of the CPS (previous residence is asked only of one quarter of the sample in one month's supplement), it is difficult to determine the relative contribution of these two channels. Nevertheless, this framework emphasizes that earnings-sensitive mobile workers will tend to reduce differences in labor market outcomes, even among groups who are much less mobile.

An unemployed searching worker's expected income is the probability of finding employment multiplied by the wage paid conditional on finding employment. The wage is assumed to be the binding minimum wage in each state.

$$\mathrm{E}[I] = p(w^m) \cdot w^m. \tag{1}$$

Here I denotes total income, w^m is the minimum wage, and p is the probability of finding employment. Mincer (1976) provides a simple parameterization of the employment probability: the ratio of vacancies to searching workers. If job vacancies are created exogenously, then this probability is:

$$p(w^m) = \frac{\delta E^m}{\delta E^m + U^m}. \tag{2}$$

Here E^m denotes the number of employees firms demand at the minimum wage and δ represents the fraction of employees who lose their jobs in any period. The set of searching

[12] This analysis differs slightly from Mincer's presentation as his assumed that the other market was entirely uncovered by any minimum wage.

workers includes both those who are recently separated, and workers who were unemployed over the previous period, U^m. Because the minimum wage binds, there will be unemployed workers in the pool of job seekers, and the resulting probability will be less than one.[13] The model appendix formally derives the conditions under which expected earnings for a searching worker are increasing in the minimum wage, and a summary is provided below.

Proposition 1. *Prior to any mobility, and with inelastic individual labor supply, an increase in one state's minimum wage will increase expected earnings and attract searching workers whenever*

$$\delta \frac{E^m}{E^m + U^m} + \frac{U^m}{E^m + U^m} > \eta. \tag{3}$$

This expression says that with an increase in the binding wage floor, labor markets with smaller demand elasticities (η) and higher turnover rates (δ) are more likely to experience an increase in expected earnings, and thus to attract geographically mobile workers. The elasticity result fits well with intuition. A less elastic demand curve means a smaller fall in desired employment, leading both to a smaller decrease in the number of vacancies in each period and a smaller increase in the number of new unemployed workers joining the pool of searchers. Together, these effects result in a smaller decrease in the probability of finding employment. A larger separation rate implies a smaller penalty to being a searching worker rather than employed and increases the probability of finding employment at any given level of firms' desired employment.

Figure 1 provides a graphical summary of how these two parameters jointly determine the effect on expected wages. The upward sloping line shows the values of η and δ such that

[13] Note that the denominator could also include new entrants to the labor market. It is reasonable to assume, however, that new entrants form employment probability expectations based on current probabilities rather than accounting for the fact that additional entrants may choose the same market.

expected earnings in the state with the increased minimum wage are unchanged. In this knife's edge case, expected earnings remain equal and no workers need to move in order to restore geographic equilibrium. For parameter pairs above the line, returning to equilibrium requires that searching workers differentially select the state with the lower minimum wage. The opposite choice is necessary for parameter pairs below the line.[14] Also of note, when turnover is complete in every period ($\delta = 1$), workers will be attracted to an increase in the minimum wage whenever labor demand is inelastic. However, when workers currently holding jobs have a higher probability of employment in the next period than do unemployed workers, an increase in the minimum wage will lead to inflows for only a restricted range of elasticities smaller than one in absolute value.

2.2 Additional Considerations

Next, I briefly discuss how relaxing a few important assumptions would affect workers' location incentives in response to the minimum wage. First, the basic search model I present has workers considering earnings from a single period. Introducing multiple periods could easily increase the importance immigrants place on the probability of finding employment beyond its role in expected earnings. If, for example, immigrants face liquidity constraints, failing to find employment quickly will have an especially high cost. Additionally, if immigrants intend to return home after a short spell of work abroad, they may be especially unwilling to risk a long period of unemployment.[15] Each of these additional considerations would result

[14]This figure is drawn for a particular value of pre-change unemployment. A larger unemployment level in the initial equilibrium would increase the intercept and decrease the slope. The point $(\delta = 1, \eta = 1)$ will always lie on the line.This general result therefore nests the particular situation examined by Mincer (1976) when neither sector has a minimum wage in the initial equilibrium. In that case, there is no unemployment prior to the implementation of the minimum wage, and workers will flow to the minimum wage state whenever $\delta > \eta$.

[15]Massey, Durand and Malone (2003) provide evidence that many Mexican immigrants have exactly these types of motivations.

in a smaller set of parameters under which minimum wage increases will attract immigrants.

The above analysis also assumes that the turnover rate is unaffected by the minimum wage. If an increase in the minimum wage reduced turnover (for efficiency wage or other reasons), the effect of the minimum wage on the probability of finding employment would be more negative and the set of parameters for which labor would flow away from the increase in the minimum would expand.[16]

Additionally, this simple framework ignores any increase in labor force participation among existing state residents. If workers have a range of reservation expected earnings levels, workers already living in a state could enter or exit the labor force in response to a change in expected earnings due to the minimum wage. Assuming that these workers respond more quickly than potential migrants do, an elastic labor supply within a state would result in a larger set of parameters for which the policy change would have no effect on the relative attractiveness of the two labor markets. The line of indifference in Figure 1 would be replaced by a larger zone of indifference surrounding the line above and below. Relaxing this assumption, however, will not reverse the sign of the prediction for parameter values above or below the line.

A somewhat different dynamic would apply when there are uncovered sectors within each local market, either due to legal exemptions or because employers pay workers (potentially unauthorized migrants) under the table. In this situation, it is reasonable to assume that the first flows in to or out of the covered sector will occur between these two sectors rather than across geography. This dynamic will tend to attenuate the effect of the minimum wage increase on expected earnings, although it will never reverse the sign.[17] Thus, the

[16]Card and Krueger (1995) provide some theoretical justifications for the possibility that the minimum wage affects turnover, and Dube et al. (2012) and Brochu and Green (2013) provide empirical evidence of moderate responses of job match creation and destruction to the minimum wage.

[17]As further explanation, consider the two cases. If the minimum wage increases expected earnings in the covered sector, labor will flow from the uncovered to the covered sector. The equilibrium wage will rise in

earnings-maximizing direction of population flows is unchanged by the existence of local uncovered sectors. I further discuss the role of unauthorized immigrant labor in evaluating the minimum wage's effect on employment in section 3.6.

Finally, the above discussion has assumed that immigrants maximize earnings rather than utility. If immigrants value their leisure time they may prefer a state with lower expected earnings as long as those earnings are accompanied by lower expected work effort. Under this modification, a given decrease in a state's employment probability will not have as large of an effect on that state's attractiveness as a destination. This modification would increase the range of elasticities for which a minimum wage increase makes a state more attractive.

2.3 Empirical Implications

This simple framework provides important implications for empirical work evaluating the effect of state minimum wage policies. Very few studies making cross-state comparisons include a direct analysis of worker mobility, leaving an important question unanswered. Further, the above discussion implies that the direction of labor flows provides an alternative means of evaluating the extent to which the minimum wage reduces demand in a local labor market. If employers' demand for low-skilled labor is relatively inelastic, then workers should flow toward a minimum wage increase in order to take advantage of the higher wages paid to successful job seekers. Alternatively, if demand is relatively elastic, then workers should flow away from minimum wage increases. Thus, examining mobility provides a complementary research strategy to previous research directly examining the disemployment effect.

Whether the relevant labor force is sufficiently geographically responsive thus becomes

the uncovered sector, but expected earnings in the covered sector will fall due to the increase in searching workers for each vacancy. The overall equilibrium change in expected earnings in the market, however, will remain positive. A similar line of reasoning implies that a minimum wage increase that decreases expected earnings in the covered sector decreases expected earnings in the local labor market as a whole.

an especially important empirical question. The typical empirical evaluation of the effect of the minimum wage focuses on teenage workers, as they are highly likely to work for wages bound by the wage floor. If teenagers were the entirety of the minimum wage labor force, the mobility issue would likely be a second-order concern. In fact, Table 1 reveals that native teens and low-skilled natives have very low rates of cross-state mobility. Further, teens' labor market prospects are likely only a small consideration in their household's location decision. In contrast, recent immigrants are likely to make long distance moves even after choosing their initial location, and a growing set of evidence implies that they are more earnings-sensitive when moving than are other low-skilled workers.[18] In the beginning of the empirical work in the next section, I provide descriptive analysis showing that recently arrived low-skilled immigrants and native teenagers work in a similar set of jobs with wages bound by the minimum. The smoothing implications of labor mobility are therefore relevant even though many workers are essentially unable to relocate in response to differences in minimum wage policy. Even absent complete equalization of expected earnings, the incidence of the minimum wage on the earnings of the local population will tend to decline as the mobility of the local population increases.

3 Empirical Analysis

This section empirically evaluates the role of immigrants' mobility in the minimum wage labor market. I begin by presenting multiple pieces of descriptive evidence demonstrating that recently arrived low-skilled immigrants and native teens compete for minimum wage jobs. Next, I discuss how numerous minimum wage increases enacted by the states during the period for which immigration status is available in the CPS (beginning in 1994) provide

[18] See Cadena and Kovak (2013) for direct evidence that immigrants are more likely to report making a long-distance moving for labor market reasons than are low-skilled natives.

an excellent source of variation for estimating the effect of these policies on local labor supply. I then use a standard state-panel methodology to determine that low-skilled, but not high-skilled, immigrant populations grow less quickly in response to these increases. Finally, I provide direct evidence that this mobility tends to attenuate the observed relationship between minimum wage increases and native teen employment rates.

3.1 Immigrants' Wages Are Bound By the Minimum Wage

The framework in the preceding section relies on the assumption that the statutory minimum represents a binding wage floor for searching workers. Figure 2 displays kernel densities of wage distributions within a narrow time window around minimum wage increases and provides straightforward evidence that this condition is satisfied.

To estimate these distributions, I select from each month of the CPS Outgoing Rotation Group (ORG) all workers who live in a state with a minimum wage that will increase within six months or with a minimum wage that increased fewer than six months ago. I pool observations from all effective minimum wage changes - changes that increase the maximum of the state or federal minimum - from 1994 to 2007. I then limit the sample to recently arrived low-skilled immigrants (fewer than ten years in the US, no high school degree), native teenagers (age 16-19), and native adult high school dropouts (age 20-55).[19] Note that the immigrant sample includes both authorized and unauthorized immigrants as the CPS data are collected without regard to a family's legal immigration status.[20] For each worker, I calculate the difference between the log of his/her hourly wage and the log of the new

[19]The survey question asks respondents when they came to the US "to stay." Short visits home are not meant to affect the reported year of arrival, although respondents may vary somewhat in how they interpret the question.

[20]The CPS certainly interviews unauthorized immigrants, and the size of the immigrant population implied by the CPS has been compared with data on legal entrants to estimate the size of the unauthorized population. See Passel (2006) as a prime example of this exercise.

minimum hourly wage. I then estimate separate kernel densities of the distribution of this difference before and after the minimum wage increase.[21] In each panel, the solid line shows the distribution for workers in months prior to the minimum wage increase, and the dotted line represents workers in the six months following the increase.

The distributions change exactly as one would expect under a binding minimum wage. Comparing the new to the old distribution among recently arrived immigrants, there is a pronounced spike at the new minimum with "missing" density just to the left of the new minimum. While minimum wage jobs make up a smaller fraction of the immigrant wage distribution when compared to native teens, the magnitude of the spike created by the minimum wage is comparable. Notably, the minimum wage has only a modest effect on the wages of native adult workers without a high school degree.[22]

In order to further quantify the extent to which these workers are bound by the minimum wage, I calculate the fraction of each group earning between the old and new minimums prior to the change taking place. Among native teen workers, 25 percent meet this criterion; the corresponding fraction among recently arrived low-skilled immigrants is 17 percent. In contrast, these percentages are 8 percent for native adults without a high school degree and and 6 percent for immigrants with more than a high school degree. It is clear from these complementary analyses that the wages of many recently arrived low-skilled immigrants are affected by changes to the wage floor. In fact, the change in the immigrant wage distribution closely mirrors the results for the "native" group on which most empirical research has focused. It is reasonable to expect, therefore, that changes to local minimum wage policy will affect expected earnings for recently arrived low-skilled immigrants.

[21] I use an Epanechnikov kernel and a bandwidth of 0.05 log points.

[22] Additional results (not shown but available on request) demonstrate that there are only modest effects on the wages of immigrants who have been in the US for more than ten years, which motivates the focus on recent arrivals.

One remaining question is the extent to which these immigrants and teens are substitutes in production, which is a necessary condition for their mobility to affect teens' employment outcomes. Two important facts suggest that low-skilled recent immigrants present meaningful competition for native teens. First, these groups exhibit strong occupational overlap; a calculation using Welch's (1999) index of congruence places the occupational agreement among workers whose wages are bound by the minimum at +0.75.[23] This high degree of overlap provides direct evidence of a lack of segmentation between these two labor markets. Additionally, Smith (2012) provides evidence that low-skilled immigrants and native teenagers compete for similar jobs as immigrant inflows are associated with lower employment rates among native teenagers. Further, recently arrived low-skilled immigrants are a non-trivial share of the overall supply of workers to these types of jobs as native working teens outnumber immigrants by only a three to one ratio.[24] These immigrants therefore represent a large enough group of close substitutes to teenage labor that their mobility could plausibly affect the observed relationship between teen employment rates and the minimum wage.

3.2 State Minimum Wage Policies Provide Excellent Variation

In the principal analysis, I determine whether low-skilled immigrants tend to select locations with increasing or stagnant minimum wages, which I interpret as reflecting differences in expected earnings across space. In the ideal empirical setting, one could exogenously assign changes in both attributes to each destination and measure the resulting change in the geographic distribution of this population.

[23]This number is interpreted similarly to a correlation coefficient and ranges from -1 to +1. A similar calculation for all teens and low-skilled immigrants yields an index of 0.38.

[24]This ratio is calculated based on the number of workers who meet the sampling criteria for the kernel density analysis, i.e. they live in states within six months of a policy change.

State minimum wage policies in the recent past provide a sufficiently close approximation to this ideal design. As discussed in the conceptual framework, minimum wage policies will, in general, manipulate expected earnings. Additionally, although minimum wage increases are not entirely random events, sufficient variation both in the timing and in the magnitude of minimum wages will allow for an identification strategy that eliminates the influence of unobserved location characteristics that are fixed over time (e.g. distance from one's country of birth, climate similarity) as well as characteristics that are changing similarly over time across all locations. Any alternative interpretation of the empirical relationship between the effective minimum wage and the size of the local immigrant population would need to explain why the population changed both concurrent with policy implementation and in proportion to the size of the increase. Additionally, falsification tests using higher-skilled immigrants will help rule out coincidental changes in other location-specific amenities.

Figure 3 summarizes state and federal minimum wage policy from 1994-2007.[25] The solid line displays the inflation-adjusted level of the federal minimum wage. The graph also displays the dollar amount and effective month of each new state minimum that is higher than the federal level, represented by the state's two-letter postal abbreviation. All wage levels are adjusted to December 2007 dollars using the CPI-U. Although data limitations preclude examining the effect of the minimum wage on immigrants' behavior prior to 1994, the figure reveals a great deal of geographic variation in policies while immigrants are identifiable.[26]

[25] I limit all of the analysis to the 48 contiguous states (plus DC) because selective mobility toward or away from Alaska or Hawaii is much more difficult and expensive than is mobility among the contiguous states.

[26] Burkhauser et al. (2000) suggest that there is not much useful (state x year) variation from 1979-1997, and, importantly, (Sabia 2009) notes that the more recent policy environment (1997-2004) provides sufficient variation for meaningful inference even after removing state fixed effects and a flexible (nationwide) time trend.

3.3 Estimation Specification

The state-panel specification below is commonly used in the minimum wage and employment literature.[27]

$$Y_{st} = \alpha_0 + log(RealMW_{st})\beta_1 + X_{st}\gamma + \tau_t + \delta_s + \delta_s * \text{trend}_t + \epsilon_{st}. \quad (4)$$

I first employ this methodology to examine the locational response by immigrants. I then confirm that local changes in the minimum wage lead to moderate measured local decreases in employment. Finally, I show that the measured displacement among native teens is smaller in states where immigrants are a larger share of the minimum wage labor force.

Observations are at the state-month level (s denotes states, t denotes months), and the cell means are calculated using CPS weights, while the regressions are weighted for efficiency based on the number of survey observations in each cell.[28] In order to maintain consistency throughout the analysis, I limit the estimation sample to state-months with non-zero sampled recently arrived low-skilled immigrant observations.[29]

Standard errors are clustered at the state level, allowing for heteroskedasticity and state-level serial correlation of unknown form. X_{st} is a vector of time-varying covariates, including variables standard in the analysis of the minimum wage such as the local adult unemployment rate and the average hourly wage for adults. τ_t are time dummies (one for each month from January 1994 to December 2007), δ_s are state dummy variables and $\delta_s * \text{trend}_t$ are state-

[27]Specifying the minimum wage in logs and including dummy variables for each month of the analysis makes adjusting for inflation (at a national level) irrelevant as specifications using real or nominal minimum wage levels will yield identical results. For ease of exposition, I continue to refer to the primary variable of interest as the inflation-adjusted maximum of the state or federal minimum wage.

[28]More details of this weighting procedure are available in Appendix section A-2.1. In nearly all specifications, the weighted results are quite similar to the unweighted specifications, and I provide a complete set of unweighted results in Appendix section A-2.1.

[29]Appendix section A-2.3 addresses this sample limitation in more detail.

specific linear time trends.[30] Previous studies omit the state-specific linear time trends, and I detail reasons to prefer the results that include the trends in the discussion surrounding each set of results below. I also present results without these trends for completeness. I use this specification to estimate the effect of the minimum wage on a number of outcomes (Y_{st}), which are discussed in more detail below. Table 2 gives a complete description and descriptive statistics for each dependent variable and covariate. The real minimum wage is measured monthly and is the maximum of either the state or federal minimum wage, unadjusted for coverage rates. I include the log of the state's average wage as a separate control variable, rather than using it to form a ratio with the minimum wage.[31]

3.4 Minimum Wage Increases Lead to Immigrant Outflows

I begin by estimating Equation 4 using the log of the number of recently arrived (within the past ten years) immigrants without a HS degree living in a state in a given month as the dependent variable, with the results given in Table 3.[32] As demonstrated in Figure 2, the minimum wage is binding for a significant share of this group. The regression specification in the first column omits covariates but includes all the state and time dummies. Subsequent columns add state-specific trends and additional controls.

The dummies and state-specific trends are essential to this analysis. Importantly, they help create a more plausible counterfactual size of the immigrant population. The state dummies allow for unobserved fixed state attributes that affect the attractiveness of choosing a

[30]Note that these state-specific trends are identified by the assumption of linearity. The low-skilled immigrant population results are robust to including second order trends and to allowing for separate state-specific in the pre- and post-2000 portions of the analysis period. Higher order trends reduce the estimated coefficient and increase the standard error, but including these additional controls leaves very little panel variation in state-level minimum wage policies.

[31]Card and Krueger (1995, pp.208-239) provide compelling arguments that these choices are the preferred specification.

[32]These counts are weighted sums using the CPS-provided weights. The arrival date data are coded in 2-3 year bands, and thus the recency of arrival is coded with a slight degree of error.

particular location. The observed negative relationship, therefore, is not simply driven by higher minimum wage states lacking other amenities that these immigrants value. Similarly, the time dummies take account of the fact that the overall size of the recent low-skilled immigrant population changes from period to period. The state-specific linear trends are especially important in this specification in light of broader patterns in immigrant settlement during this time period. Over the 1990s, the immigrant population became much less concentrated among traditional destination states and cities compared to previous waves (Card and Lewis 2007). To the extent that this diffusion occurred for reasons unrelated to policy-driven differences in labor market prospects, this change presents an empirical challenge to the analysis. Without the inclusion of state trends, one might be concerned that the estimated negative relationship reflected a coincidence wherein traditional destination states implemented earlier and larger increases in the minimum wage. In fact, the specification in column 1 that omits state trends provides a substantially more negative estimate of the effect of the minimum wage on the size of the local low-skilled immigrant population. Instead, the inclusion of state trends ensures that the measured slower growth in response to a minimum wage increase represents a deviation from the general increase or decrease in a state's popularity over time.

The coefficients on the minimum wage from specifications that include state trends are around -0.8 and measure the elasticity of the size of the recently arrived low-skilled immigrant population with respect to the minimum wage. These estimates are statistically significant at conventional levels, even after allowing for heteroskedasticity and serial correlation within state panels of unknown form. The elasticity implies that when a state's minimum wage increases by ten percent, its newly arrived low-skilled immigrant population falls by eight percent relative to the counterfactual. Here the counterfactual is the level that would have been expected using the state's average recent low-skilled immigrant population, the average

deviation (across states) from that long-run average for that month, and the state's specific growth rate in the recently arrived low-skilled immigrant population. Again, this negative relative effect could result from any combination of channels of population adjustment including lower arrival rates from abroad, changes in post-arrival internal mobility patterns, and higher return migration.[33]

3.5 Falsification Test Using Higher-Education Immigrants

Despite the rich empirical specification, one may still be concerned that these geographic shifts in the immigrant population would have occurred even in the absence of the differential labor market prospects created by the minimum wage. I address this possibility by repeating the analysis using immigrants who have at least some college education. These immigrants should, in general, command market wages above the minimum wage, and thus the minimum wage should have a minimal effect on their expected earnings. Figure 4 repeats Figure 2 for this group, displaying wage distributions before and after minimum wage increases. In contrast to the wage distributions of low-skilled immigrants, these results do not reveal any substantial spike at zero to suggest that the minimum wage binds. If the results in Table 3 truly reflect immigrants responding to the labor market incentives created by the minimum wage, the geographic distribution of higher educated immigrants should respond to a much smaller degree. If, instead, the negative correlation for low-skilled immigrants results from changes in unobserved state attributes or other concurrent anti-immigrant policies, minimum

[33] Additional specifications (not shown but available upon request) reveal somewhat larger point estimates among immigrants who have lived in the US for six to ten years as compared to those who arrived in the previous five years. This difference suggests that post-arrival internal mobility and return migration may be more important than the initial location choice, but the coefficients cannot be significantly distinguished from each other at conventional levels. There are no substantial population responses among immigrants who arrived more than ten years ago or among native adults. There is a small *positive* estimated coefficient among native teens, although this is driven by younger teens (under 18), which suggests that it does not reflect location choices made in response to the minimum.

wage increases should also be associated with outflows of higher skilled immigrants.

The analysis passes this specification check, as shown in Table 4. The specification without the trends (column 1) leads to a significantly negative coefficient, which reinforces the importance of controlling for other unobserved factors affecting the relative growth of state level immigrant populations over this time period. The point estimates with the state-specific trends are smaller than 0.1 in magnitude and cannot be statistically distinguished from zero. Further, each specification (including the version without trends) yields a point estimate substantially smaller than the corresponding estimates in Table 3.[34] These results imply that changes in the location pattern of higher-skilled immigrants are unrelated to changes in the minimum wage, and they provide even more support for the interpretation that low-skilled immigrants are highly responsive to differences in labor market opportunities across geography.

3.6 Immigrant Mobility Weakens Measured Employment Effects

Taken as a whole, the mobility results provide strong support for the hypothesis that low-skilled immigrants prefer locating in states with stagnant rather than increasing minimum wages. Having established this result, there are two important remaining questions. First, does the mobility identified above imply that local changes in employment underestimate the disemployment effect to a substantial degree? Second, are the implied total displacement effects large enough such that a preference for lower minimum wages among new immigrants can be considered earnings-maximizing behavior?

The remainder of the paper provides additional analysis to answer each of these questions. Table 5 begins by verifying the employment results from previous studies, which tend to

[34] I have limited the sample to state-months that are included in the regressions reported in Table 3. The regression coefficient for the specification reported in column (4) of Table 3 is -0.82 (0.29) when the sample is limited to state-months that have non-zero counts of both high- and low-skilled immigrants.

find that minimum wage changes lead to moderate changes in local employment.[35] These specifications are standard state-panel regressions of employment rates and average log wages on the statutory minimum wage, run separately for teens and recent low-skilled immigrants.[36] Each of these regressions includes a full set of state dummies, month dummies, and linear state trends and limits the sample to state-months that are included in the mobility results. The trends are also potentially quite important in the analysis of teen employment as the participation of teens in the labor market fell dramatically over this time period (Aaronson, Park and Sullivan 2006, Smith 2012). If this shift occurred at different rates in states pursuing different minimum wage policies, an empirical specification lacking state-specific trends may erroneously attribute differences in teen employment to differences in minimum wage policies.[37] The results for both groups are in line with typical estimates in the literature. The implied elasticity of employment with respect to the statutory minimum is around -0.1, with an implied labor demand elasticity less than 1 in absolute value.[38]

Neither of these sets of results has taken account of the mobility induced by the minimum wage. Recall from section 3.1 that teens and immigrants tend to work in very similar occupations and that they are similarly likely to have their wages affected by the minimum wage. Therefore, immigrants' movement away from minimum wage hikes is likely to increase

[35]The regression sample in Table 5 is limited to the 5381 state-month observations that are included in the regressions in Table 3. The samples are further reduced because some cells do not have valid wage observations for the specified group. Limiting the sample to state-months with valid data on both immigrant and teen wages produces results that are nearly identical to those reported in the table. Specifications that include all state-months with valid teen wages and employment are shown in Table 6.

[36]Prior to calculating average log wages, I drop observations with wage rates below one dollar or greater than 100 dollars per hour.

[37]In the end, the results reveal a somewhat larger demand elasticity with the trends, and I provide a complete set of results in Appendix Table A-3.

[38]The estimated wage effect among immigrants changes qualitatively between the weighted and the unweighted specifications, with the unweighted version substantially weaker. To address this issue, I include Figure A-1 in the Appendix, which shows the heteroskedasticity directly and emphasizes the need to weight for efficiency. Further, note that the standard error falls considerably when weighting, which suggests that the weighted version is, in fact, more efficient.

the probability that teens successfully find employment following a policy change by reducing the competition for each vacancy. Thus, the measured local employment effect will be attenuated relative to a zero-mobility counterfactual, even among native teens. Further, this attenuation should be greater when highly responsive immigrants represent a larger share of the local supply of low-skilled labor.

To address this hypothesis, Table 6 presents an interaction model allowing for different local employment effects of the minimum wage depending on how much of a state's minimum wage labor force is comprised of recently arrived low-skilled immigrants. I begin by constructing a variable for each state-month that is the ratio of the size of the recently arrived low-skilled immigrant population to the sum of recently arrived low-skilled immigrants and native teens: $\phi_{st} = \left(\frac{\text{Pop}_{st}^{Immig}}{\text{Pop}_{st}^{Immig} + \text{Pop}_{st}^{Teen}} \right)$. I then take the average of this variable ($\bar{\phi_s}$) over the entire study time period. This variable therefore measures the "permanent" tendency of low-skilled immigrants to choose each state, and it does not change with fluctuations in population in response to the minimum wage. Values range from less than 0.01 (one percentage point) in states like Vermont and Montana to more than 0.25 in states that have tended to attract large immigrant populations such as California, Texas, Florida, and New York. I then include the interaction of this variable with the state's prevailing log minimum wage as an additional explanatory variable in the wage and employment regressions for native teens. Note that, by construction, the average immigrant share is constant within a state over time, and the "main effect" of this variable is subsumed by the state fixed effects.

For this set of interaction specifications, I include all state-months with valid values for native teen average log wages and employment to population ratios. For reference, the results for the non-interacted version of the specification are provided in the first two columns of Table 6. There is a similar wage effect and a slightly more negative employment relationship as compared to the results in Table 5 that excluded state-months without sampled recent

immigrants.

The results in column (3) reveal that employment effects among native teens are stronger in states that have tended to attract few immigrants. The main effect of -0.116 implies that, in a state without any low-skilled immigrants, a ten percent increase in the minimum wage would lead to a decline in the teen employment to population ratio of 1.16 percentage points, or roughly 2.7 percent compared to an average employment rate of 43 percent. This elasticity is noticeably larger than the average elasticity for all states shown in column (1).[39] In addition, although the interaction term is only statistically significantly different from zero at the ten percent level, it is large and positive. This positive coefficient implies that states with larger immigrant concentrations experience less negative employment changes among teens when the minimum wage increases. Column (4) reveals that the effect of the minimum wage on teen wages is roughly constant across immigrant concentrations, although the point estimate of the interaction term implies that minimums are slightly more binding in states with higher immigrant shares.

Figure 5 combines the results found in columns (3) and (4) to provide a visual representation of how the demand elasticity calculated among native teens varies over the entire range of immigrant concentrations observed over this time period. Specifically, this line shows the relationship between the immigrant share ($\bar{\phi_s}$) and $\frac{(-0.116+0.332*\bar{\phi_s})/0.43}{0.161+0.096*\bar{\phi_s}}$, where the numerator is the implied employment elasticity with respect to the statutory minimum and the denominator is the corresponding wage elasticity. The demand elasticity ranges from above 1.5 in absolute value for states with very few immigrants to less than 0.5 in states with the greatest immigrant concentrations.[40] For reference, the vertical line shows the average immigrant

[39]The results are nearly identical running a similar specification with the log of the employment to population ratio to calculate an elasticity directly.

[40]California is somewhat of an outlier at 0.37, which is 7 percentage points higher than the next highest state. There are, however, eight states with values between 0.20 and 0.30. The qualitative results of this interaction model are robust to excluding California (the interaction term for the employment rate remains

share (0.13), and the implied demand elasticity just below unity at this concentration level is quite consistent with the specifications that do not include an interaction term (see columns (1) and (2) of Table 6).

Again, although the interaction term in the employment regression is only marginally statistically significant, the point estimate suggests that immigrants' mobility has a substantial effect on the extent to which a minimum wage increase affects the local teen employment rate. Abstracting from other potentially offsetting general equilibrium effects, these results imply that the standard methodology would estimate a roughly 50 percent larger demand elasticity in the absence of this cross-market movement of labor. Importantly, this finding is the opposite of what one would expect if immigrants primarily served as a *de facto* uncovered input. If employers responded to minimum wage increases by substituting toward immigrant labor, this behavior would tend to create a *larger* estimated effect on teen employment in areas with greater immigrant concentrations. Instead, this finding implies that the central role of immigrants in the minimum wage labor market is as arbitrageurs, moving away from increases in the minimum and improving employment outcomes for remaining workers in the affected states.

Finally, it is important to note that this set of results implies that low-skilled immigrants' location choices are consistent with earnings maximizing behavior. Recall from Figure 1 that labor has an incentive to flow away from a minimum wage increase whenever labor demand is elastic, regardless of the turnover rate. The results summarized in Figure 5 suggest that the elasticity of demand is, in fact, greater than one, although immigrants' mobility reduces the measured impact on native teenagers. Thus, the entire set of empirical results supports one of the possibilities outlined in the conceptual framework: sufficiently elastic labor demand leads to workers flowing away from the minimum wage, and local employment effects are

above 0.3), although the standard error increases somewhat.

smaller when the local labor force is more mobile.

4 Conclusions and Policy Implications

This paper demonstrates that recently arrived low-skilled immigrants serve as very elastic marginal workers, willing to selectively locate in destinations with better labor market prospects. Traditional models of local labor markets predict that such a mobile factor will tend to equalize the returns to factors across space. In fact, canonical models of the effects of the minimum wage have this type of mobility as a primary feature. This paper finds that these immigrants are quite earnings-sensitive and geographically flexible, which tends to reduce the degree to which local demand changes are reflected in local outcomes. This smoothing result has a number of implications for interpreting previous work, for the design of future policies, and for future research.

First, researchers and state policymakers should realize that policies designed to affect a single labor market will likely have spillover effects on other markets, even if the policies are targeted toward low-skilled workers who are not very responsive to differences in labor market conditions across space (Wozniak 2010). In the case of the minimum wage, the flow of immigrants away from minimum wage hikes mitigates the local negative employment consequences that would have occurred without offsetting mobility. On the other hand, a program that increases a worker's expected earnings is likely to attract more immigrants, potentially limiting the benefit that accrues to existing residents. Future research on labor market policies should explicitly examine the mobility incentives the policies create and whether migration flows respond accordingly.

Additionally, the mobility documented in this paper provides a plausible reconciliation for the often cited but seemingly contradictory findings that local increases in the minimum

wage and local supply increases due to immigration each have small effects on labor market outcomes. If labor markets were closed, these two results would have conflicting implications for the demand elasticity for low-skilled labor (pp. 172–173, Borjas 2012). Specifically, a small effect of the minimum wage on employment implies that demand is fairly inelastic, while a mild impact of immigrant inflows on native wages implies that demand is fairly elastic. When immigrants select labor markets with the highest returns, however, the resulting mobility tends to equalize returns across geography. This dynamic will tend to reduce the estimated impact of immigration inflows on wages as well as the estimated impact of the minimum wage on employment.

Finally, this paper provides further evidence that low-skilled immigration can help mitigate the spatial inequality that can result from geographically varied labor market shocks and low mobility rates among low-skilled natives (Bound and Holzer 2000, Borjas 2001). Earnings-sensitive location choices among immigrants can therefore prevent native workers from experiencing the full effect of negative shocks in one local market, as they will instead be diffused throughout the country. Future research should continue to investigate this understudied smoothing benefit accruing from low-skilled immigration.

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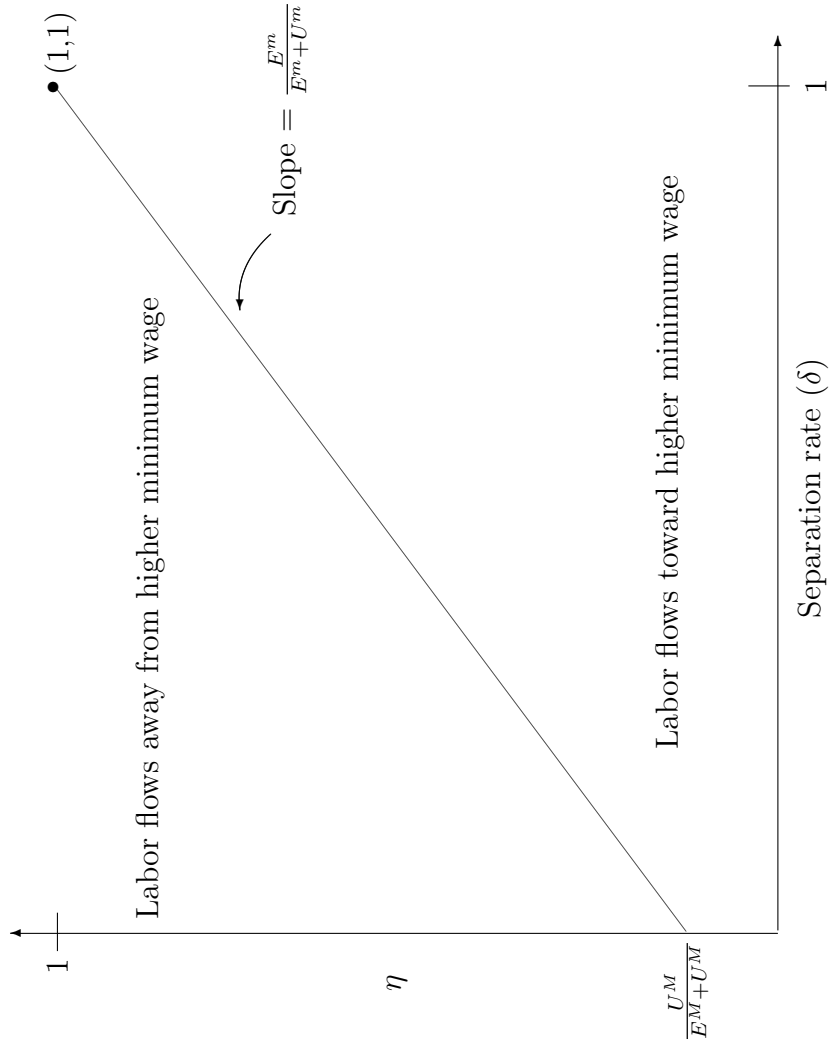
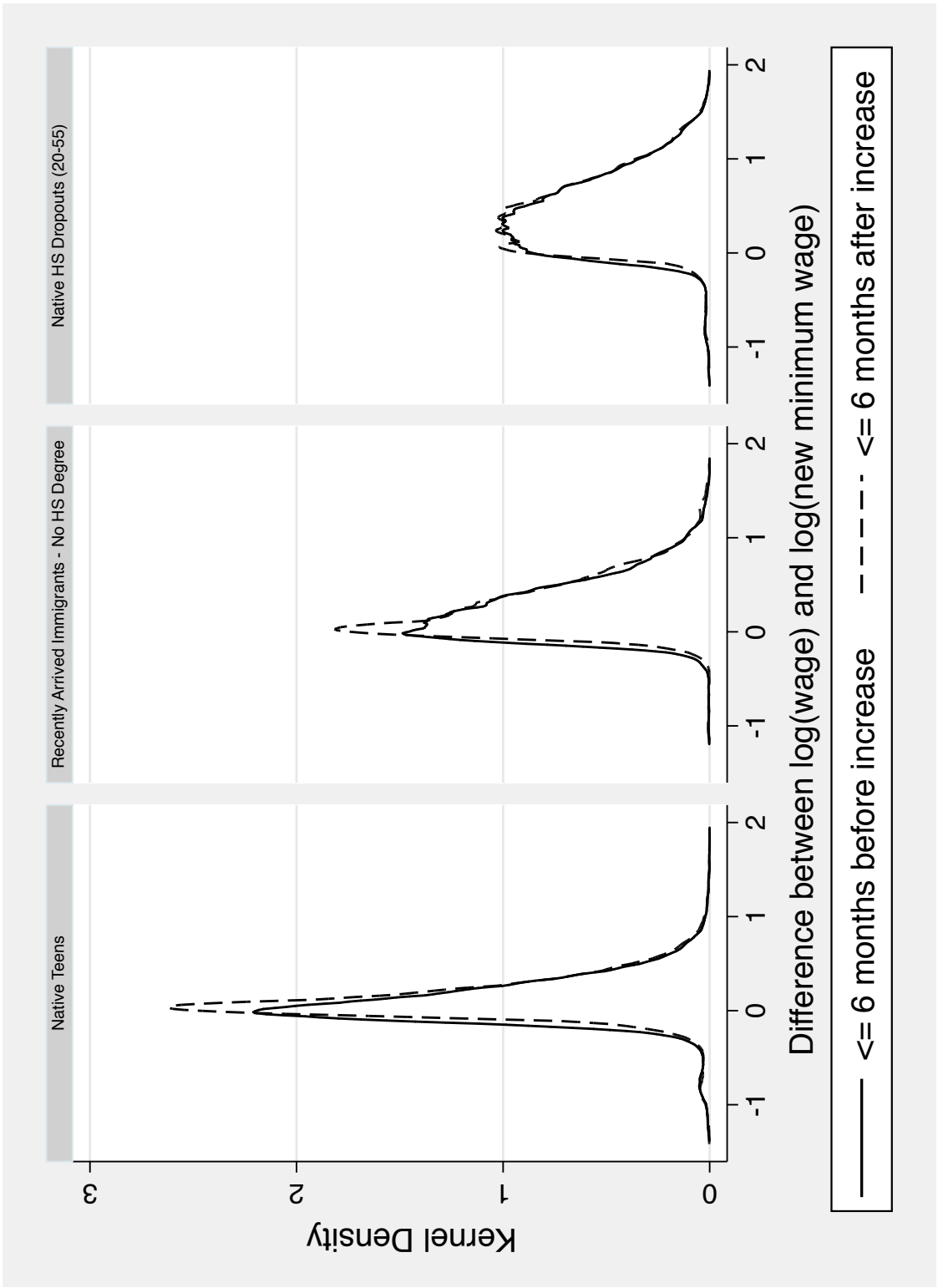


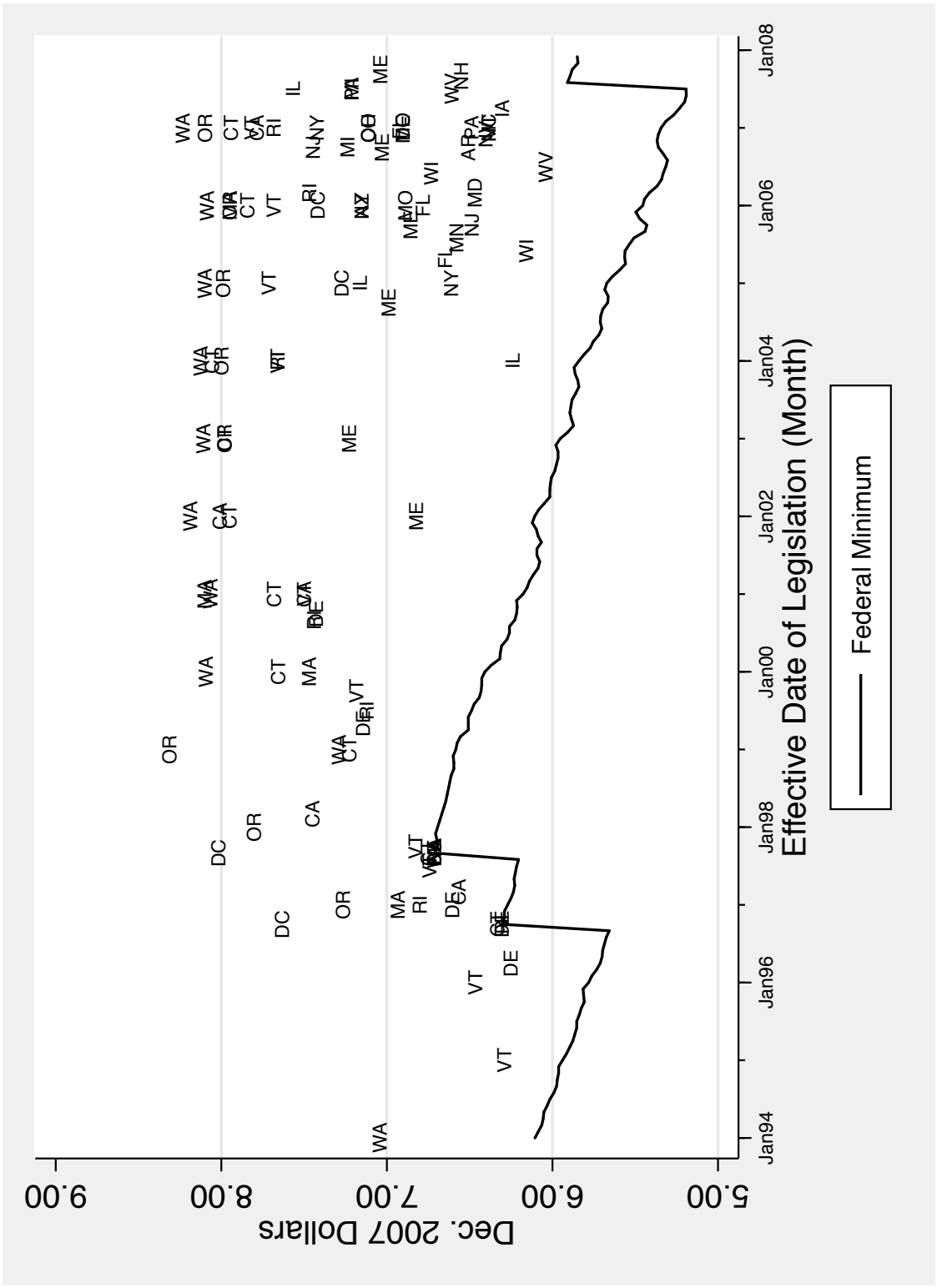
Figure 1: Predicted Worker Flows as a Function of the
Labor Demand Elasticity (η) and the Separation Rate (δ)
(1,1)
Slope = $\frac{E^m}{E^m+U^m}$
Labor flows away from higher minimum wage
Labor flows toward higher minimum wage
1
η
$\frac{U^M}{E^M+U^M}$
1
Separation rate (δ)

Figure 2: Kernel Density Estimates of Wage Distributions Before and After Minimum Wage Changes



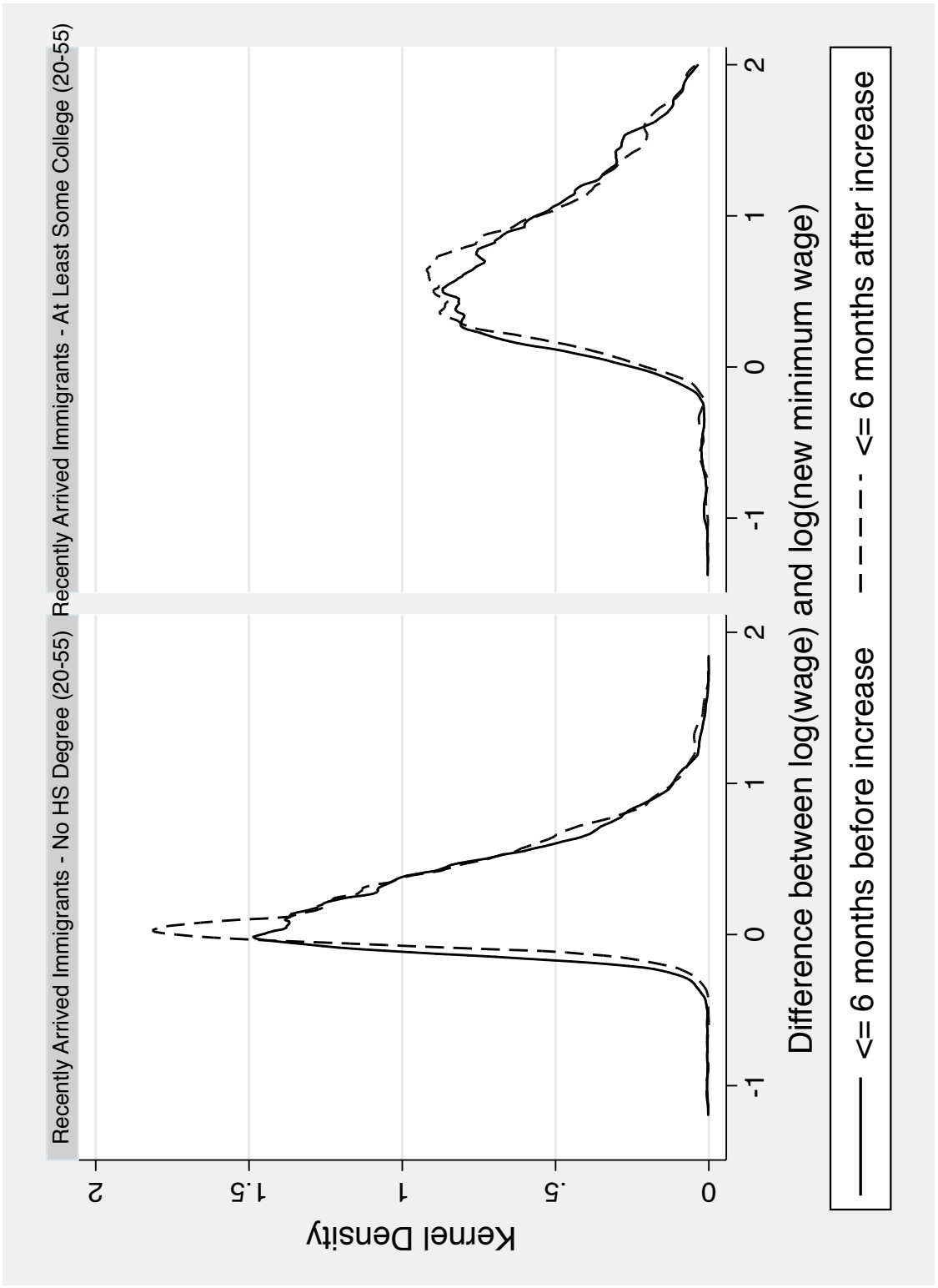
Source: Author's calculations from CPS Merged Outgoing Rotation Group Files 1994-2007. Results are weighted using earner study weights. Outliers with log wage differences outside of [-1.5,2] are dropped.

Figure 3: State and Federal Minimum Wage Policy 1979-2007



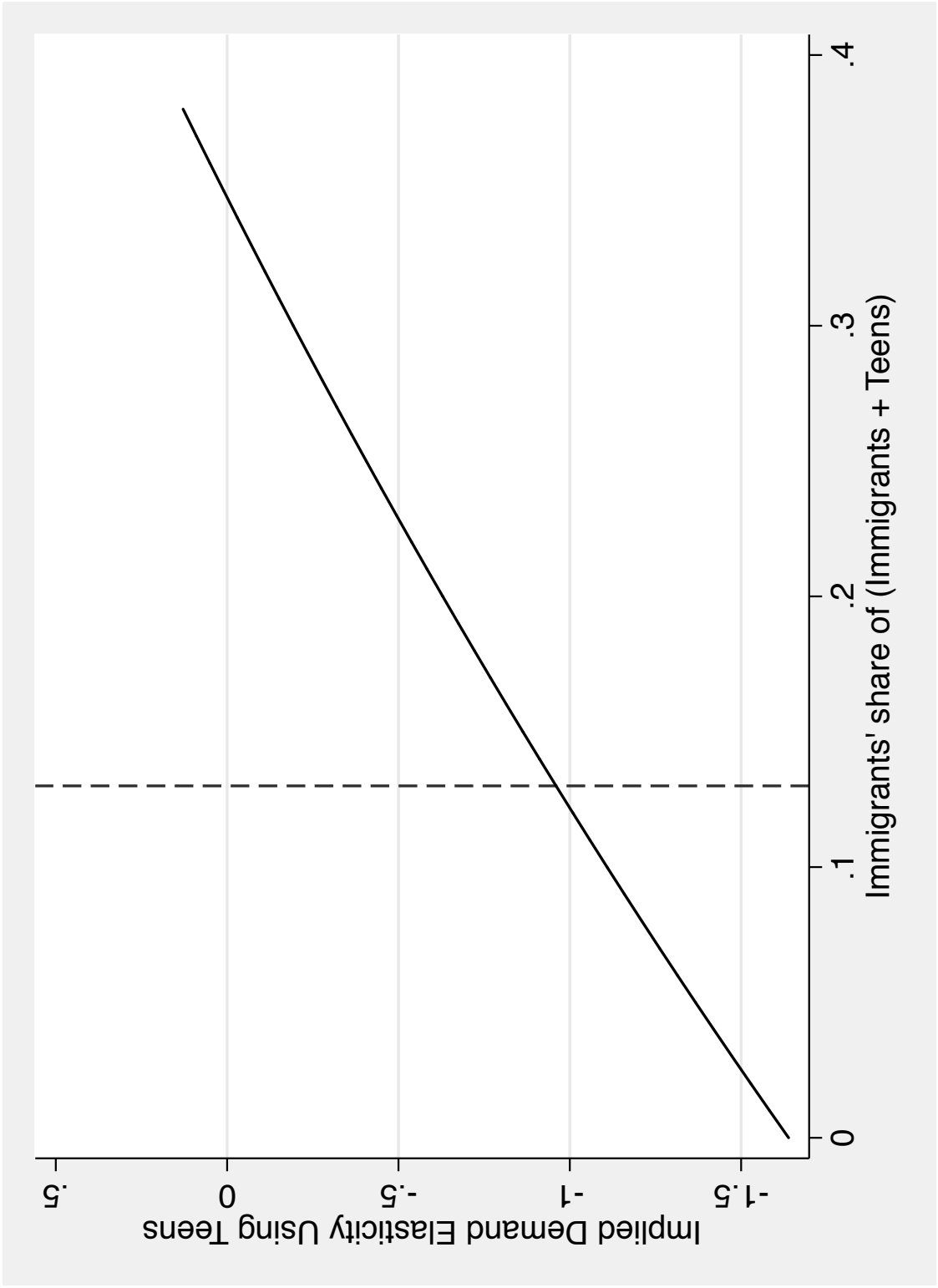
Note: State abbreviations represent the level and effective date of state minimum wage legislation. Source: UKCPR data and January Monthly Labor Review 1980-2008.

Figure 4: Falsification Test: Kernel Density Estimates of Wage Distributions Before and After Minimum Wage Changes



Source: Author's calculations from CPS Merged Outgoing Rotation Group Files 1994-2007. Results are weighted using earner study weights. Outliers with log wage differences outside of [-1.5,2] are dropped.

Figure 5: Implied Demand Elasticity Using Native Teens as a Function of Immigrant Share



This figure shows the relationship between the demand elasticity (the ratio of the elasticity of the teen employment rate with respect to the minimum wage and the wage elasticity with respect to the minimum) and a state's long-run immigrant share of (teenage workers + immigrants). The relationship is based on the regressions in columns (3) and (4) of Table 6. The implied elasticity is shown from immigrant shares of 0 to 0.37, which is the full range of the state average immigrant share variable. The vertical line at 0.13 provides the average immigrant share for reference.

Table 1: Place of Residence Five Years Ago

	Same State	Different State	Abroad
Native Teens	92.7%	6.4%	0.9%
Native Adults, No HS Degree	91.7%	6.9%	1.5%
Immigrant Adult, No HS Degree, Arrived to stay 6-10 years ago	85.5%	8.8%	5.7%
Immigrant Adult, No HS Degree, Arrived to stay 1-5 years ago	31.2%	3.9%	64.9%

Source: Author's Calculations from 2000 Census PUMS.

Table 2: Variable Definitions and Descriptive Statistics

Variable Label	Variable Definiton	Mean	SD
Immigration Outcome			
Log Immigrant Count	Log of number of recent arrival immigrants (in US <10 years), no HS degree	10.41	1.43
Employment Outcomes			
Teen Emp/Pop	State's employment to population ratio, teenagers	0.43	0.14
Immigrant Emp/Pop	State's employment to population ratio, immigrants arriving within 10 years, HS Degree or Less	0.68	0.29
Combined Emp/Pop	State's employment to population ratio, teens or new low-skilled immigrants	0.48	0.12
Independent Variables			
Log Real Minimum Wage	Log of the higher of the state or federal minimum wage, December 2007 Dollars	1.83	0.10
Log Real Native Adult Wage	Log hourly wage, native men 20-54, December 2007 Dollars	2.86	0.12
Unemployment Rate	Statewide unemployment rate, Adult men 20-54, CPS	4.48	2.59
State Dummies	Dummy variables for each state	n/a	n/a
Date Dummies	Dummy variables for each month, Jan 1994-Dec 2007	n/a	n/a
State Trends	State-specific linear monthly time trends	n/a	n/a

All variables calculated from monthly CPS Outgoing Rotation Group January 1994-December 2007 unless otherwise noted. The sample includes all state-months in the contiguous US with a non-zero count of newly arriving immigrants with less than a high school degree.

Table 3: Log Immigrant Counts as a Function of the Minimum Wage
Recent Arrivals 18-54, No HS Degree

	(1)		(2)		(3)	
Log Real Minimum Wage	-1.407	**	-0.815	**	-0.815	**
	(0.292)		(0.277)		(0.277)	
Log Real Native Adult Wage					0.059	
					(0.146)	
Unemployment Rate					-0.001	
					(0.003)	
Constant	14.895	**	13.802	**	13.637	**
	(0.576)		(0.519)		(0.647)	
State Dummies	Yes		Yes		Yes	
Date Dummies	Yes		Yes		Yes	
State-Specific Trends	No		Yes		Yes	
Number of State-Months	5381		5381		5381	
Within-State R-squared	0.95		0.95		0.95	

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. Regressions are weighted for efficiency based on a non-parametric estimation of the variance of the error terms as a function of the number of observations in a state-month cell.

Table 4: Falsification Test: Log Immigrant Counts as a Function of the Minimum Wage
Recent Arrivals 18-54, At Least Some College

	(1)		(2)		(3)	
Log Real Minimum Wage	-0.485	**	-0.046		-0.048	
	(0.137)		(0.149)		(0.148)	
Log Real Native Adult Wage					0.035	
					(0.114)	
Unemployment Rate					-0.001	
					(0.003)	
Constant	12.795	**	11.925	**	11.839	**
	(0.241)		(0.333)		(0.526)	
State Dummies	Yes		Yes		Yes	
Date Dummies	Yes		Yes		Yes	
State-Specific Trends	No		Yes		Yes	
Number of State-Months	4898		4898		4898	
R-squared	0.94		0.95		0.95	

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. Regressions are weighted for efficiency based on a non-parametric estimation of the variance of the error terms as a function of the number of observations in a state-month cell.

Table 5: Demand Elasticity Estimates - Teen and Recent Immigrant Samples

	Native Teens				Recently Arrived HS Dropout Immigrants, 25-54			
	(1)		(2)		(3)		(4)	
	Emp/Pop		Log Wage		Emp/Pop		Log Wage	
Log Real Minimum Wage	-0.052		0.177	**	-0.047		0.169	**
	(0.040)		(0.045)		(0.048)		(0.053)	
Log Real Native Adult Wage	-0.020		-0.031		-0.016		-0.040	
	(0.021)		(0.025)		(0.034)		(0.032)	
Unemployment Rate	-0.002	*	-0.001	*	0.001		-0.002	
	(0.001)		(0.001)		(0.001)		(0.001)	
State FE	YES		YES		YES		YES	
Date Dummies	YES		YES		YES		YES	
State Trends	YES		YES		YES		YES	
Number of State-Months	5360		5360		4812		4812	
R-squared	0.56		0.72		0.26		0.63	
Mean of Employment/Population	0.421				0.688			
Implied Employment Elasticity wrt Statutory Minimum	-0.12				-0.07			
Implied Demand Elasticity			-0.70				-0.40	

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. The sample includes state-month cells from the sample in Table 3 with valid observations for both average log(wage) and the employment to population ratio. Regressions are weighted for efficiency based on a non-parametric estimation of the variance of the error terms for each dependent variable as a function of the number of observations in a state-month cell.

Table 6: Demand Elasticity Estimates Among Teens by State Immigrant Share

	(1)		(2)		(3)		(4)	
	Emp/Pop		Log Wage		Emp/Pop		Log Wage	
Log Real Minimum Wage	-0.067	+	0.176	**	-0.116	**	0.164	**
	(0.035)		(0.041)		(0.036)		(0.058)	
(Log Real Minimum Wage)*(State Average Immigrant Share)	--		--		0.333	+	0.086	
					(0.176)		(0.254)	
Log Real Native Adult Wage	-0.032	+	-0.021		-0.031	+	-0.021	
	(0.018)		(0.018)		(0.017)		(0.018)	
Unemployment Rate	-0.002	**	-0.001		-0.002	**	-0.001	
	(0.001)		(0.001)		(0.001)		(0.001)	
State FE	YES		YES		YES		YES	
Date Dummies	YES		YES		YES		YES	
State Trends	YES		YES		YES		YES	
Number of State-Months	8209		8209		8209		8209	
R-squared	0.54		0.72		0.54		0.72	
Mean of Employment/Population	0.43				0.43			
Implied Employment Elasticity wrt Statutory Minimum	-0.16				See Figure 6			
Implied Demand Elasticity			-0.88				See Figure 6	

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. The sample includes state-month cells with valid observations for both average log(wage) and the employment to population ratio. Regressions are weighted for efficiency based on a non-parametric estimation of the variance of the error terms for each dependent variable as a function of the number of observations in a state-month cell. The average immigrant share is a state-level average calculated over all months; it does not vary over time.

Appendix - For Online Publication

A-1 Model Appendix

A-1.1 Derivation of Proposition 1

To determine whether a state's increase in the minimum wage will increase expected earnings for workers searching in that state, I take the derivative of expected earnings with the respect to the minimum wage and evaluate the resulting expression at the previous minimum (w_0^m).

$$\frac{\partial \mathrm{E}[I^m]}{\partial w^m} = p(w_0^m) + w_0^m \left[\frac{\partial p}{\partial w^m} \middle| w^m = w_0^m \right], \tag{A-1}$$

When this derivative is positive, expected earnings increase and workers will have an incentive to locate in the state that increased its minimum. Searching workers will flow toward the other state when this expression is negative.

Proposition 1 states that when total labor supply is fixed and no workers migrate between states and no new workers enter the following inequality implies that expected earnings will increase in the state increasing its minimum wage:

$$\delta \frac{E^m}{E^m + U^m} + \frac{U^m}{E^m + U^m} > \eta. \tag{A-2}$$

Proof. The derivative of expected earnings depends on the initial probability of finding employment, the initial wage, and the derivative of the probability at the initial wage.

$$\frac{\partial \mathrm{E}[I^m]}{\partial w^m} = p(w_0^m) + w_0^m \left[\frac{\partial p}{\partial w^m} \middle| w^m = w_0^m \right], \tag{A-3}$$

Evaluating the derivative of the probability of finding employment yields

$$p(w^m) = \frac{\delta E^m}{\delta E^m + U^m}. \tag{A-4}$$

$$\frac{\partial p}{\partial w^m} = \frac{-\delta E^m(\delta \frac{\partial E^m}{\partial w^m} + \frac{\partial U^m}{\partial w^m}) + (\delta E^m + U^m)(\delta \frac{\partial E^m}{\partial w^m})}{(\delta E^m + U^m)^2}. \tag{A-5}$$

Distributing through the parentheses yields

$$= \frac{-\delta^2 E^m \frac{\partial E^m}{\partial w^m} - \delta E^m \frac{\partial U^m}{\partial w^m} + \delta^2 E^m \frac{\partial E^m}{\partial w^m} + \delta U^m \frac{\partial E^m}{\partial w^m}}{(\delta E^m + U^m)^2}. \tag{A-6}$$

$$= \frac{-\delta E^m \frac{\partial U^m}{\partial w^m} + \delta U^m \frac{\partial E^m}{\partial w^m}}{(\delta E^m + U^m)^2}. \tag{A-7}$$

With inelastic labor supply and no movement from state to state, $\frac{\partial E^m}{\partial w^m}$ and $\frac{\partial U^m}{\partial w^m}$ are equal in magnitude and of opposite signs. Thus,

$$\frac{\partial p}{\partial w^m} = \frac{\delta(E^m + U^m)\frac{\partial E^m}{\partial w^m}}{(\delta E^m + U^m)^2}. \tag{A-8}$$

Plugging this expression back into the derivative of expected earnings yields

$$\frac{\partial \mathrm{E}[I^m]}{\partial w^m} = \frac{\delta E^m}{\delta E^m + U^m} + w_0^m \frac{\delta(E^m + U^m)\frac{\partial E^m}{\partial w^m}}{(\delta E^m + U^m)^2}. \tag{A-9}$$

This expression will be positive whenever

$$\frac{\delta E^m}{\delta E^m + U^m} > -w_0^m \frac{\delta(E^m + U^m)\frac{\partial E^m}{\partial w^m}}{(\delta E^m + U^m)^2}. \tag{A-10}$$

Rearranging gives

$$1 > -\frac{\partial E^m}{\partial w^m}\frac{w_0^m}{E^m}\left(\frac{E^m + U^m}{\delta E^m + U^m}\right). \tag{A-11}$$

Letting η denote the labor demand elasticity, this simplifies to

$$\frac{\delta E^m}{E^m + U^m} + \frac{U^m}{E^m + U^m} > \eta. \tag{A-12}$$

□

A-1.2 Higher Turnover Implies Smaller Probability Effects

Here I formally demonstrate that labor markets with higher turnover rates experience smaller declines in the probability that a searching worker finds employment for a given change in the minimum wage. To show:

$$\frac{\partial p^2}{\partial w \partial \delta} < 0 \tag{A-13}$$

Proof. Equation A-8 gives the first derivative of the employment probability with respect to the minimum wage. Taking the cross derivative with respect to δ yields:

$$\frac{\partial p^2}{\partial w \partial \delta} = \frac{-\delta^2 (E^m + U^m)\frac{\partial E^m}{\partial w}(\delta E^m + U^m) + (\delta E^m + U^m)^2 \frac{\partial E^m}{\partial w}}{(\delta E^m + U^m)^4}. \tag{A-14}$$

The denominator is always positive. The sign thus depends on the sign of the numerator. It will be negative whenever

$$(\delta E^m + U^m)^2 \frac{\partial E^m}{\partial w} < \delta^2 (E^m + U^m)\frac{\partial E^m}{\partial w}(\delta E^m + U^m). \tag{A-15}$$

Dividing both sides by $\frac{\partial E^m}{\partial w}(\delta E^m + U^m)$, which is negative, yields

$$\delta E^m + U^m > \delta^2 E^m + \delta^2 U^m. \tag{A-16}$$

This inequality holds by inspection for all values of $\delta < 1$. □

A-2 Empirical Appendix

A-2.1 Efficiency Weights and Additional Analysis

Throughout the analysis, I present regressions that are weighted to address the heteroskedasticity inherent in a generated dependent variable that averages individual data at the state-month level with varying cell sizes. Although the standard textbook treatment suggests weighting by cell size directly, both Dickens (1990) and Solon, Haider and Wooldridge (2013) note that in the presence of correlated error terms, these weights will be incorrect and may *reduce* efficiency. The key insight is that the variance may not decline linearly with cell size when the underlying individual error terms are not independent. Dickens (1990) provides a particular feasible estimation strategy to address this concern, but it requires assuming a particular form of the non-independence (homoskedasticity across states in the variance of the additive state-specific error term). Instead, I remain agnostic about the particular structure of the error terms, and I non-parametrically estimate the variance of the residuals as a function of the cell size. I then re-run the regression weighting by the inverse of the predicted variance based on each observation's cell size. I repeat this procedure separately for each dependent variable.

To do so, I begin by running an unweighted regression of the outcome on the full specification, including state fixed effects, time dummies, state-specific linear trends, and and the controls. I then calculate squared residuals from this regression and examine the heteroskedasticity as a function of the cell size. Figure A-1 provides an example of this procedure using average log(wage) data among recent low-skilled immigrants, and it reveals the substantial difference in variances across cell sizes. Each "x" represents the cell size and squared residual from a particular state-month observation from this unweighted regression. The solid line shows the fitted values from a local linear regression to estimate the average vari-

ance of the residual as a function of a state-month's cell size. There is a clear pattern of higher variances in cells with fewer underlying individual observations.

I address this heteroskedasticity by re-running the regression and weighting each observation by the inverse of the predicted residual variance based on its cell size. As suggested in Dickens (1990) and Solon et al. (2013), I iterate this procedure a total of three times. The weighted results presented in the main tables and figures are thus based on these efficiency weights. Tables A-1 and A-2 provide unweighted versions of the main immigrant supply results for completeness. Note that weighting always reduces the estimated standard errors, which suggests that this procedure produces an efficiency gain.

In addition to the question of weighting, the results presented in the main tables are merely a subset of potential specifications that could be run. In Tables A-3 and A-4, I report the results of the unweighted specifications as well as an expanded set of these specifications. In particular, Table A-3 includes specifications that use omit state trends. Finally, Table A-5 provides results of the interaction specification without efficiency weights.

A-2.2 State Minimum Wage Changes

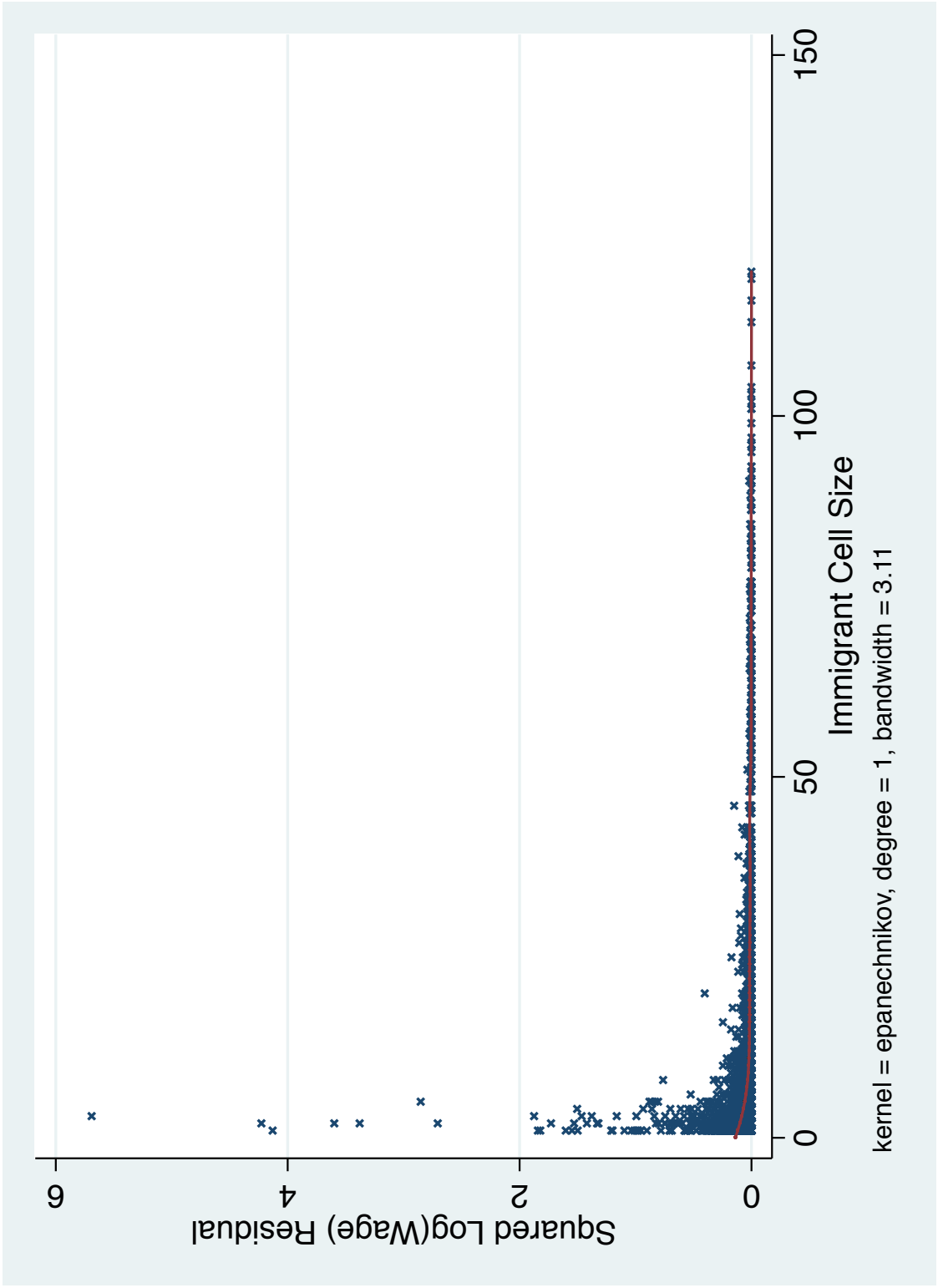
Table A-6 provides a detailed summary of the state policies shown in Figure 3. The first column displays the percentage of months between January 1994 and December 2007 that each state's minimum exceeded the federal minimum. The majority of states (31) had higher minimums than the federal level for at least part of the period. The second column shows the average gap between the state and federal minimums in months when the state minimum was binding. These differences are sizable, with most 15 to 25 percent higher. The final column indicates the number of times the effective minimum wage increased in a state. Over this time period, there were a total of 206 increases in the effective minimum wage, both through state law changes and differentially binding federal changes. The large number of

changes allows for precise estimates of the effect of the minimum wage, even when using an estimation strategy that accounts for the influence of unobserved state attributes, overall time trends and state-specific time trends.

A-2.3 Observations Dropped due to Insufficient Immigrant Counts

As discussed in the text, several state-month observations are dropped because the CPS ORG does not contain any immigrants in the sample. This results in an unbalanced panel with some states contributing more observations than others. Table A-7 provides the percentage of potential observations each state contributes to the regression samples.

Figure A-1: Heteroskedasticity Due to Differing State-Month Cell Size



Note: All analysis is limited to the continental US.

Table A-1: Log Immigrant Counts as a Function of the Minimum Wage - Unweighted Recent Arrivals 18-54, No HS Degree

	(1)		(2)		(3)	
Log Real Minimum Wage	-1.161	**	-0.769	*	-0.770	*
	(0.357)		(0.375)		(0.375)	
Log Real Native Adult Wage					-0.078	
					(0.174)	
Unemployment Rate					0.002	
					(0.004)	
Constant	11.965	**	11.259	**	11.468	**
	(0.661)		(0.672)		(0.867)	
State Dummies	Yes		Yes		Yes	
Date Dummies	Yes		Yes		Yes	
State-Specific Trends	No		Yes		Yes	
Number of State-Months	5381		5381		5381	
R-squared	0.79		0.80		0.80	

Standard Errors clustered by state in parentheses. + $p<0.10$, * $p<0.05$, ** $p<0.01$. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. Each state-month cell is given equal weight.

Table A-2: Falsification Test: Log Immigrant Counts as a Function of the Minimum Wage - Unweighted Recent Arrivals 18-54, At Least Some College

	(1)		(2)		(3)	
Log Real Minimum Wage	-0.221		-0.110		-0.113	
	(0.254)		(0.205)		(0.207)	
Log Real Native Adult Wage					-0.268	
					(0.169)	
Unemployment Rate					0.007	+
					(0.004)	
Constant	10.751	**	10.533	**	11.245	**
	(0.467)		(0.366)		(0.610)	
State Dummies	Yes		Yes		Yes	
Date Dummies	Yes		Yes		Yes	
State-Specific Trends	No		Yes		Yes	
Number of State-Months	4898		4898		4898	
R-squared	0.85		0.85		0.85	

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. Each state-month cell is given equal weight.

Table A-3: Effects of the Minimum Wage on Teens - Specification Alternatives

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Weighted				Unweighted			
	Emp/Pop	Log Wage	Emp/Pop	Log Wage	Emp/Pop	Log Wage	Emp/Pop	Log Wage
Log Real Minimum Wage	-0.052	0.177 **	-0.022	0.191 **	-0.055	0.180 **	-0.032	0.167 **
	(0.040)	(0.045)	(0.028)	(0.035)	(0.038)	(0.050)	(0.030)	(0.036)
Log Real Native Adult Wage	-0.020	-0.031	-0.020	-0.008	-0.030	-0.022	-0.026	-0.003
	(0.021)	(0.025)	(0.023)	(0.024)	(0.023)	(0.025)	(0.025)	(0.024)
Unemployment Rate	-0.002 *	-0.001 *	-0.002 **	-0.002 **	-0.001 +	-0.001 +	-0.002 **	-0.002 *
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State FE	YES	YES	YES	YES	YES	YES	YES	YES
Date Dummies	YES	YES	YES	YES	YES	YES	YES	YES
State Trends	YES	YES	NO	NO	NO	NO	NO	NO
Number of State-Months	5360	5360	5360	5360	5360	5360	5360	5360
R-squared	0.56	0.72	0.54	0.72	0.29	0.60	0.27	0.59
Mean of Employment/Population	0.42		0.42		0.43		0.43	
Implied Employment Elasticity wrt Statutory Minimum	-0.12		-0.05		-0.13		-0.07	
Implied Demand Elasticity		-0.70		-0.27		-0.71		-0.44

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. Columns (1) and (2) and (5) and (6) include only those state-months included in the estimation of the immigrant supply elasticities. Weighted regressions are weighted for efficiency based on a non-parametric estimation of the variance of the error terms as a function of the number of observations in a state-month cell.

Table A-4: Effects of the Minimum Wage on Low-Skilled Immigrants - Specification Alternatives

	(1)	(2)	(3)	(4)
	Weighted		Unweighted	
	Emp/Pop	Log Wage	Emp/Pop	Log Wage
Log Real Minimum Wage	-0.047	0.169 **	-0.030	0.018
	(0.048)	(0.053)	(0.063)	(0.065)
Log Real Native Adult Wage	-0.016	-0.040	-0.044	-0.056
	(0.034)	(0.032)	(0.043)	(0.055)
Unemployment Rate	0.001	-0.002	0.001	-0.003
	(0.001)	(0.001)	(0.001)	(0.002)
State FE	YES	YES	YES	YES
Date Dummies	YES	YES	YES	YES
State Trends	YES	YES	YES	YES
Number of State-Months	4812	4812	4812	4812
R-squared	0.26	0.63	0.16	0.32
Mean of Employment/Population	0.69		0.74	
Implied Employment Elasticity wrt Statutory Minimum	-0.07		-0.04	
Implied Demand Elasticity		-0.40		-2.24

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. Weighted regressions are weighted for efficiency based on a non-parametric estimation of the variance of the error terms as a function of the number of observations in a state-month cell.

Table A-5: Demand Elasticity Estimates Among Teens by State Immigrant Share - Unweighted

	(1)		(2)		(3)		(4)	
	Emp/Pop		Log Wage		Emp/Pop		Log Wage	
Log Real Minimum Wage	-0.067	+	0.176	**	-0.126	**	0.160	**
	(0.034)		(0.046)		(0.040)		(0.056)	
(Log Real Minimum Wage)*(State Average Immigrant Share)	--		--		0.475	*	0.127	
					(0.198)		(0.264)	
Log Real Native Adult Wage	-0.041	*	-0.018		-0.040	*	-0.017	
	(0.020)		(0.017)		(0.020)		(0.017)	
Unemployment Rate	-0.002	**	-0.000		-0.002	**	-0.000	
	(0.001)		(0.001)		(0.001)		(0.001)	
State FE	YES		YES		YES		YES	
Date Dummies	YES		YES		YES		YES	
State Trends	YES		YES		YES		YES	
Number of State-Months	8209		8209		8209		8209	
R-squared	0.50		0.64		0.50		0.64	
Mean of Employment/Population	0.42				0.42			
Implied Employment Elasticity wrt Statutory Minimum	-0.16				Varies			
Implied Demand Elasticity			-0.91				Varies	

Standard Errors clustered by state in parentheses. + p<0.10, * p<0.05, ** p<0.01. Author's calculations from Merged Outgoing Rotation Group CPS files, January 1994-December 2007. The sample includes state-month cells from the sample in Table 3 with valid observations for both average log(wage) and the employment to population ratio. Each state-month cell receives equal weight. The average immigrant share is a state-level average calculated over all months; it does not vary over time.

Table A-6: State Minimum Wage Policies 1994-2007

State	Percent of Months Above Federal Minimum	Average Difference (when higher)	Number of Changes in Nominal Minimum
Alabama	0%	n/a	3
Arkansas	9%	17%	3
Arizona	14%	28%	3
California	74%	24%	7
Colorado	7%	26%	3
Connecticut	100%	20%	10
DC	100%	23%	4
Delaware	70%	17%	7
Florida	19%	23%	5
Georgia	0%	n/a	3
Iowa	5%	12%	3
Idaho	0%	n/a	3
Illinois	29%	22%	5
Indiana	0%	n/a	3
Kansas	0%	n/a	3
Kentucky	0%	n/a	3
Louisiana	0%	n/a	3
Massachussets	79%	24%	5
Maryland	13%	16%	3
Maine	43%	22%	8
Michigan	9%	31%	4
Minnesota	17%	17%	3
Missouri	14%	24%	4
Mississippi	0%	n/a	3
Montana	7%	13%	3
North Carolina	7%	13%	3
North Dakota	0%	n/a	3
Nebraska	0%	n/a	3
New Hampshire	2%	11%	4
New Jersey	42%	20%	3
New Mexico	0%	n/a	3
Nevada	8%	14%	3
New York	21%	26%	5
Ohio	7%	26%	3
Oklahoma	0%	n/a	3
Oregon	98%	27%	8
Pennsylvania	7%	23%	4
Rhode Island	85%	19%	7
South Carolina	0%	n/a	3
South Dakota	0%	n/a	3
Tennessee	0%	n/a	3
Texas	0%	n/a	3
Utah	0%	n/a	3
Virginia	0%	n/a	3
Vermont	87%	20%	10
Washington	90%	28%	11
Wisconsin	18%	18%	4
West Virgina	11%	14%	4
Wyoming	0%	n/a	3

Note: All analysis is limited to the continental US.

Table A-7: Percent of State-Month Observations Included in the Regression Sample

State	Percent of Months Included In Regression Sample
Alabama	36%
Arkansas	60%
Arizona	99%
California	100%
Colorado	91%
Connecticut	67%
DC	88%
Delaware	60%
Florida	100%
Georgia	83%
Iowa	71%
Idaho	80%
Illinois	100%
Indiana	49%
Kansas	68%
Kentucky	35%
Louisiana	24%
Massachussets	90%
Maryland	74%
Maine	20%
Michigan	79%
Minnesota	67%
Missouri	36%
Mississippi	36%
Montana	9%
North Carolina	93%
North Dakota	18%
Nebraska	77%
New Hampshire	35%
New Jersey	98%
New Mexico	82%
Nevada	98%
New York	100%
Ohio	62%
Oklahoma	59%
Oregon	90%
Pennsylvania	83%
Rhode Island	89%
South Carolina	38%
South Dakota	36%
Tennessee	50%
Texas	100%
Utah	82%
Virginia	80%
Vermont	13%
Washington	84%
Wisconsin	63%
West Virgina	6%
Wyoming	41%

Note: All analysis is limited to the continental US.