# Is the Minimum Wage a Pull Factor for Immigrants?

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**Abstract**

This paper studies the effects of the minimum wage on immigration. I develop an analytical framework in which immigration is a function of the expected wage, which is defined as the product of immigrants' wage and employment probability in the region of destination. In the empirical analysis I exploit the state variation in expected wages stemming from the changes in the US federal minimum wage that took place in 1996-1997 and 2007-2009. I address the issue of endogeneity between immigration and the expected wage by means of an instrumental variable approach. My results provide consistent evidence that the policy induced a sizeable flow of low-skilled immigrants to the United States in both periods. This is attributable to the minimum wage increasing immigrants' attainable wages without harming their perspective employment outcomes. I corroborate these findings by showing that the policy did not have any impact on the flow of high-skilled immigrants. The positive effect of the minimum wage on low-skilled migration is also found when I consider the case of interstate mobility of immigrants. Using survey data from Mexico, I finally show that the changes in the federal minimum wage attracted only legal immigrants, while the flows of undocumented immigrants were not affected.

**Keywords**: immigration, minimum wage, expected wages

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# 1 Introduction

Does an increase in the minimum wage induce low-skilled immigration? A minimum wage can have ambiguous effects on immigration: on the one hand, it increases the average wage, hence attracting more immigrants from abroad; on the other hand, it could adversely affect employment perspectives, thereby deterring immigration. In this paper, I explore the consequences of the minimum wage on the size and skill composition of immigrant flows.

There is extensive research about the determinants of immigration. Relatively favorable employment and wage conditions in the receiving region, along with the presence of social networks, distance from the sending region and immigration policies, are characterized as the principal causes of immigration (Borjas, 1994; Clark et al., 2007; Mayda, 2010). However, studies that explore directly the role of the minimum wage on immigration are rather sparse. A seminal work is the two-sector model of Harris and Todaro (1970); recent empirical evidence comes from studies which exploit variation in the state minimum wages (Orrenius and Zavodny, 2008; Cadena, 2012; Boffy-Ramirez, 2012).

My work contributes to existing knowledge on minimum wage and immigration in two ways. First, at a more general level, I propose an analytical and empirical framework for testing the causal impact of changes in immigrants' labor market outcomes on the choice of migration. Second, I provide consistent and comprehensive evidence that the minimum wage influences the location choices of low-skilled immigrants.

I develop an analytical framework which postulates that migrants make decisions as a function of the region of destination's expected wage, defined as the product of immigrants' wage and employment probability. A rise in the minimum wage influences immigrants' decisions because it affects the two components of their expected wage. While average wages increase as a consequence of the minimum wage, employment effects are ambiguous and depend on the labor market structure (Manning, 2003). My model predicts that there is an increase or a decrease in immigration depending on whether the expected wage increases or decreases as a consequence of a rise in the minimum wage. The policy is expected to influence only the incentives of migrants for which the expected wage gains are substantial, namely the low-skilled, while it will not attract high-skilled immigrants, as they already earn a wage above the minimum.

The predictions of the model are tested empirically by using the two most recent increases in the US federal minimum wage which took place in the period 1996-1997 (from $4.25 to $5.15) and

2007-2009 (from $5.15 to $7.25). I estimate a two-stage least squares (TSLS) model, whereby the flow of low-skilled immigrants in each state is regressed on the change in the expected wage that occurred between the period before and after the minimum wage increase. To identify the causal relationship of interest, I exploit the fact that a change in the federal policy generates exogenous state variation in the expected wage depending on the gap between the old and the new minimum wage, which I measure using the "fraction of affected immigrants". This allows me to solve issues of endogeneity between immigration and the expected wage.

The paper is structured as follows. In Section 2, I briefly review studies on the minimum wage and discuss how the literature so far has explored the link between minimum wage and immigration. In Section 3, I outline the analytical framework and illustrate the estimation strategy. I provide a description of the data used in the analysis in Section 4. In Section 5, I present and discuss the results of the econometric analysis. I provide concluding remarks in Section 6.

# 2 A Review of the Literature on the Minimum Wage and Immigration

The topic of the minimum wage has been widely explored in the literature, from both a theoretical and empirical viewpoint. Neoclassical theory based on the seminal model of Stigler (1946) predicts that under a binding minimum wage firms are constrained to pay higher wages than the market clearing level. Therefore employment would be reduced to the point where the marginal revenue product of labor equals the minimum wage. The neoclassical model has been challenged by a more recent literature strand which argues that, due to the existence of frictions in the labor market, moderate increases in the minimum wage may lead to non-negative employment outcomes (Card and Krueger, 1995; Manning, 2003).

The contrast between the two theoretical strands is also embodied in the empirical studies, which are far from reaching a consensus about the employment effects of the minimum wage.[1] For example, Neumark and Wascher (1992, 2007, 2013) find a negative effect of the minimum wage on employment; on the other hand Card (1992a); Card and Krueger (1995); Dube et al. (2007, 2010) show that the effect is either zero or positive. Indeed all these studies vary substantially in terms of methodology and data used.

[1] A comprehensive survey is to be found in Neumark and Wascher (2006).

The majority of works on the minimum wage focus on the teenage population, since teenagers are typically employed in industries where the minimum wage incidence is high. Yet, a large fraction of other groups – such as immigrants – also work for low wages and hence they are substantially affected by the policy.[2] Recently, a few studies explored the effects of the minimum wage on immigrants' outcomes, finding a positive effect on wages (Cortes, 2004; Orrenius and Zavodny, 2008), but no adverse effect on employment (Orrenius and Zavodny, 2008). A corollary of these studies is that since the minimum wage influences outcomes of immigrants in the US, it will also affect the incentives to move to the US.

The first to advance the hypothesis of a link between minimum wage and mobility are Harris and Todaro (1970), who theorize that the existence of a minimum wage can explain the persistently high levels of urban unemployment in some developing countries.[3] The important feature of the Harris-Todaro framework is that agents make decisions in terms of expected earnings, defined as the proportion of the total urban labor force effectively employed. Workers continue to migrate from the rural sector (not covered by the minimum wage) until the urban expected minimum wage equals agricultural earnings; the excess labor thus remains unemployed.[4] The notion of expected earnings used in the Harris-Todaro framework acknowledges that migration and labor market outcomes of the receiving area are simultaneously determined.

To my knowledge, the first empirical assessment of the relationship between minimum wage and mobility dates back to Castillo-Freeman and Freeman (1992), who focus on the extension of the US minimum wage to Puerto Rico. Their study explores whether the policy induced emigration from the island to the United States. They document that the impact of the minimum wage in Puerto Rico increased substantially over the years, reaching 60% of the average wage in 1987. By analyzing emigration and inter-industry employment patterns, the authors conclude that the extension of the minimum wage induced an outflow of low-skilled workers to the United States, which prevented high levels of unemployment in Puerto Rico.

More recently, three studies have explored the relationship between immigration and the minimum wage. Orrenius and Zavodny (2008) hypothesize that immigrants who can potentially

[2]CPS data indicate that in 1996 (2007) the fraction of individuals with earnings between the old and new federal minimum wage was 48.2% (38.4%) for teenagers, 16.7% (12.5%) for females, 15.1% (11.6%) for black and 18.0% (11.8%) for immigrants.

[3]To my knowledge, the only theoretical study which extends the Harris-Todaro framework to the context of international migration is Basu (1995).

[4]That location choices of migrants are sensitive to policy set in the region of destination is a point which is also proposed by Borjas (1999) in the context of welfare programs, albeit the results of his analysis are relatively weak in terms of statistical significance.

become unemployed might move to states with lower minimum wages. Their estimates indicate that low-educated immigrants are less likely to choose states with higher minimum wages. A similar conclusion is reached by Cadena (2012), who finds that low-skilled immigrants tend to settle in states without state minimum wages. On the contrary, Boffy-Ramirez (2012) finds that low-skilled immigrants – albeit only those that have been in the US between two and four years – are attracted by higher state minimum wages. The common factor among these three studies is the use of data on state-level minimum wages to identify the effect on migration, which might produce causality issues. First, state minimum wage laws could respond to immigration, thereby generating reverse causality.[5] Second, unobservable state-specific shocks could affect both the state law and immigration, leading to omitted variable bias. The aforementioned studies mitigate issues of endogeneity by including fixed state effects and controlling for state-level time-varying characteristics. The framework that I now outline tackles endogeneity issues directly by exploiting changes in the federal minimum as a natural experiment.

# 3 Analytical Framework and Empirical Approach

## 3.1 Model

The key feature of my model is that potential migrants make decisions as a function of the wage they expect to obtain in the region of destination, as in Harris and Todaro (1970). To keep the framework as simple as possible, I assume that immigrants belong to two skill groups, high ($h$) and low ($l$) skilled. High-skilled immigrants are those who, by definition, earn a wage above the minimum. The number of immigrants $m$ of skill group $s \in \{l, h\}$ in the region of destination are represented by the following expression:

$$m^s = F(z^s, x), \tag{1}$$

[5]Potential reverse causality is documented in the data. Using CPS, I have constructed a panel of state-level observations from 1994 to 2011 and estimated regression models of the probability that a state has a minimum wage higher than the federal floor. The main explanatory variables are the proportion of low- and high-skilled immigrants in the population, yet regressions include also the proportion of teenagers, the teenage and population unemployment rate, the log of the average wage, as well as state and year fixed effects. The estimated correlation between having a higher-than-federal state minimum wage and immigration rate of low-skilled immigrants is negative and borderline significant (-3.321, s.e. 2.002). On the other hand, the correlation with the immigration rate of high skilled immigrants is insignificant (0.717, s.e. 1.575). While this is just an association, it warns about the possibility that the legislative process of the state minimum wage is affected by immigration. For example, states might hesitate to increase the minimum wage worrying that low-skilled immigration depresses labor market outcomes.

where $z^s = w^s e^s$. The term $z$ represents the expected wage, defined as the product of the wage $w$ and the employment probability $e$ of each skill group. The term $x$ represents other factors which determine the migration into the region. Assuming that the federal minimum wage ($\bar{w}$) affects only the expected wage, its effect on immigration is represented by the following expression:

$$\frac{\partial m^s}{\partial \bar{w}} = \frac{\partial F}{\partial z^s}\frac{\partial z^s}{\partial \bar{w}}. \tag{2}$$

Under the assumption that the demand for low and high skilled workers are unrelated, the minimum wage does not affect the expected wage of high-skilled immigrants, i.e., $\partial z^h/\partial \bar{w} = 0$. As a consequence, the total effect on immigration is zero.

For low-skilled immigrants, the effect of the minimum wage on immigration depends on the sign and magnitude of the two components in the right hand side of expression (2). From the basic settings of the Harris-Todaro framework, it follows that $\frac{\partial F}{\partial z^s} > 0$, that is, an increase in the expected wage – ceteris paribus – determines an increase in immigration. On the other hand, the change in the expected wage, $\partial z^l/\partial \bar{w}$, can be positive or negative. To understand what determines the sign and magnitude of this term, note that it can be decomposed as follows:

$$\frac{\partial z^l}{\partial \bar{w}} = \frac{\partial w^l}{\partial \bar{w}} e^l + \frac{\partial e^l}{\partial \bar{w}} w^l. \tag{3}$$

This expression implies that the change in the expected wage is negative only for values of the elasticity of labor demand larger than one. This can be seen considering that $\partial z^l/\partial \bar{w} < 0 \iff \mathrm{d}e^l/\mathrm{d}w^l \times w^l/e^l < -1$. The rationale is that the minimum wage determines an increase in the expected wage, as long as the wage "gains" are not completely offset by the adverse employment effects. Which of the two effects prevails depends on the labor demand elasticity. In the next, I propose an empirical procedure to estimate expression (2).

## 3.2 Identification strategy

The relationship between immigration and the expected wage can be cast in the following regression model, which exploits cross-state variation in the variables of interest:

$$\Delta m_j = \alpha + \beta \Delta z_j + \Delta x_j + \Delta \varepsilon_j, \tag{4}$$

where the subscript $j$ indicates the state, and $\Delta m$ represents the net immigration rate, defined as the difference in the stock of immigrants (in percentage of total population) between the period before and after the minimum wage increase. The term $z$ is the log expected wage; $x$ comprises a set of covariates to control for time-varying macroeconomic fundamentals of the state; $\varepsilon$ is the error term. The key parameter to estimate is $\beta$; in practice, I test the null hypothesis that a change in the expected wage does not have an impact on immigration. Equation (4) is estimated for the "treatment group", that is, the net immigration rate of low-skilled individuals. I also conduct "placebo tests" using the net immigration rate of high-skilled individuals, for which the minimum wage should not have any effect.

The regression model is estimated using first differences, that is, by subtracting observations related to the period before the minimum wage increase from observations which refer to the period after the minimum wage increase. This specification has the advantage of eliminating unobservable factors which characterize each observational unit. For example, if immigrants move to states where individuals from the same origin have previously settled, the correlation between immigration and the minimum wage will be biased upward.

Furthermore, by focusing on the increase in the federal minimum wage, I exploit a policy which is exogenous to state conditions. On the contrary, using state minimum wages might lead to a spurious correlation between immigration and minimum wage, because immigrants tend to move, ceteris paribus, to areas with better economic conditions.

Using OLS to estimate equation (4) is still likely to generate biased estimates because the term $z$ is endogenous. There are at least two important sources of endogeneity. The first has to do with the reverse causality arising because the expected wage can be affected by immigration, besides being a cause of it. The second has to do with wages and employment – the components of the expected wage – being simultaneously affected by the minimum wage: the product of two endogenous variables is itself endogenous.

To identify the causal effect of interest, I rely on an instrumental variable approach, that is, a variable which explains the variation of the expected wage exclusively attributable to the exogenous change in the minimum wage. I use the "fraction of affected immigrants" as instrumental variable for the expected wage. The instrument is defined as the share of immigrants who earn between the new and old minimum wage, and is thought to be correlated with expected wages but at the same time to not be affected by immigration. In the analysis, I provide exhaustive

evidence for the validity of the instrument.

My identification strategy builds upon the instrumental variable approach of Card (1992a), who uses the fraction of affected teenagers. Card employs such instrument arguing that it is correlated with the change in wages, but exogenous to changes in employment. He obtains two reduced-form equations, one for wages and one for employment, which allow to estimate the exogenous impact of wage changes on employment. In my approach, I combine the reduced-form equations for wage and employment into an equation for the expected wage. This constitutes the first stage regression of the TSLS approach. Exploiting the additive propriety of logarithms, I decompose the expected wage into a wage and an employment component:

$$\Delta z_j = \Delta e_j + \Delta w_j, \tag{5}$$

where $\Delta e$ and $\Delta w$ are the log changes of employment and wages, respectively. Following Card (1992a), the employment and wage equations can be defined as:

$$\Delta e_j = a + \eta \Delta w_j + \nu_j, \tag{6}$$

$$\Delta w_j = \alpha + \lambda B_j + \zeta_j. \tag{7}$$

The term $B$ is the fraction of affected immigrants, which is exogenously determined, and is used to estimate $\Delta w$; the predicted value is then inserted in equation (6) to obtain:

$$\Delta e_j = a + \eta\alpha + \eta\lambda B_j + \eta\zeta_j + \nu_j. \tag{8}$$

By substituting (7) and (8) into (5), it follows that:

$$\Delta z_j = c + \theta B_j + \upsilon_j, \tag{9}$$

where $c = a + (1+\eta)\alpha$, $\theta = (1+\eta)\lambda$ and $\upsilon_j = (1+\eta)\zeta_j + \nu_j$.

Equation (9) is the econometric equivalent of expression (3) and constitutes the first stage of the regression analysis. The parameter $\theta$ captures the effect of an exogenous change in the minimum wage on the expected wage. In keeping with what is stated in the theoretical framework, the

effect is negative only when the labor demand elasticity is larger than unity, i.e., $\eta < -1$.[6]

Finally, following Card and Krueger (1995), I estimate equation (4) using weighted least squares, whereby the weights are given by the number of immigrants in each state in the year before the minimum wage change. This procedure attributes relatively low importance to observations which are more likely to be noisy.

Before describing the results, I briefly outline the data used in the analysis and provide relevant statistics of the variables of interest.

# 4 Data and facts

## 4.1 Data description

The analysis focuses on the two most recent increases in the federal minimum wage. The first took place between 1996 and 1997 and occurred in two stages: from \$4.25 to \$4.75 in October 1996 and to \$5.15 in September 1997. The most recent took place between 2007 and 2009 and occurred in three stages: from \$5.15 to \$5.85 in July 2007, to \$6.55 in July 2008, and to \$7.25 in July 2009. Henceforth, I indicate with FMW1 the period related to the 1996-1997 increase and with FMW2 the period referring to the 2007-2009 increase.

To estimate the parameters of interest, I collect information on the net immigration rate, the expected wage, the fraction of affected immigrants and other variables to control for state-specific characteristics. I describe below the sources and definitions of the variables used in the analysis, which are also summarized in Table A1 in the Appendix.

The net immigration rate is constructed using the 5% Public Use Microdata Samples of the 2000 Census (IPUMS) for FMW1 and from the 2010 American Community Survey (ACS) for FMW2.[7] I aggregate the microdata to obtain state-level observations for the year before and after each minimum wage increase using person weights to ensure national representativeness. I define the net immigration rate as the difference between the stock of immigrants after and

[6] Although the minimum wage has unambiguous positive effects on the average wages (i.e., $\lambda > 0$) the final impact depends on $\eta$. If $\eta < -1$, that is, in the elastic part of the demand curve, expected wages decrease because the negative effect on employment more than compensate the positive benefits in terms of wage differentials. If $-1 < \eta < 0$, the expected wages react positively to an increase in the minimum wage, but the increase of $\lambda$ is less than proportional since $\theta < \lambda$. If $\eta \geq 0$, the positive effect of employment adds up to that of wages. This only happens if employment changes are not demand-constrained, that is, are measured along the supply curve, as in the case of monopsonistic labor markets.

[7] Census and ACS data come from the IPUMS-USA Microdata Series website (www.ipums.org/).

before the minimum wage increase, divided by the total population in each state. The stock of immigrants in the period before corresponds to the number of immigrants aged above 16 who, at the time of the Census or ACS, report arriving in the United States before the minimum wage change (i.e., until 1996 for FMW1 and until 2006 for FMW2). The stock of immigrants after the increase corresponds to the number of immigrants aged above 16 who report arriving in the United States until the year after the law change (i.e., until 1998 for FMW1 and until 2010 for FMW2). The difference between these two stocks, divided by the population in each state before the minimum wage increase, yields the net immigration rate, that is, $\Delta m_j$ in equation (4). This variable is in fact a proxy of the effective net flow of migrants, which would be calculated by subtracting immigrants outflows from inflows.[8] Yet, neither the Census nor the ACS track immigrants who leave the United States. Hence, relying on retrospective information reported at the time when data are collected is a common approach to construct measures on immigration flows (see Card, 2001 and Borjas, 2006).

I construct two variables for the net immigration rate: one referring to the flows of low-skilled immigrants, defined as those without high school diploma (WHS), and one related to the flows of high-skilled immigrants, defined as those who possess at least high school diploma (AHS). The flow of immigrants without high school diploma is the "treatment group", that is, individuals whose migration decision is influenced by the minimum wage. Immigrants with at least high school diploma are used to conduct "placebo tests", since the minimum wage should not affect the migration decision of individuals who earn above the minimum.

I draw data from the monthly CPS to construct the fraction of affected immigrants and the expected wage.[9] I aggregate CPS microdata using sample weights to obtain state-level observations for the period before and after the minimum wage increase. Since CPS come with monthly frequency, I can define with precision the period before and after the minimum wage increase. For FMW1 the period before coincides with the time window between September 1995 and August 1996, and the period after is defined between September 1997 and August 1998. For FMW2, the period before goes from July 2006 to June 2007, and the period after from July 2009 to June 2010.[10]

[8] Henceforth I will use the terms net immigration rate and net flows interchangeably.

[9] CPS data have been accessed through the NBER website www.nber.org/data/cps_basic.html.

[10] This particular timing allows to measure changes in the variables of interest exactly in the period of the minimum wage change. Since the one-year periods before and after start in the same month, seasonality issues are not a concern.

I construct expected wages by calculating the product of immigrants' log hourly wages and log employment population ratio. Hourly wages are derived using responses of immigrants who report an hourly wage and are paid by the hour.[11] The employment population ratio corresponds, in each state, to the percentage of working-age immigrants who are employed. I define the fraction of affected immigrants as the proportion of immigrant wage workers who – in the year before the minimum wage increase – earn between the old and the new minimum wage, that is, between \$4.25 and \$5.15 in the period September 1995 to August 1996, and between \$5.15 and \$7.25 in the period July 2006 to June 2007.

Finally, I derive information on state-level characteristics to use as control variables in the analysis. I draw data on the employment population rate (which refers to the overall adult civilian population) from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment (GPS).[12] I obtain historical data on immigration to construct a variable representing the growth in the percentage of foreign-born individuals between 1960 and 1970 in each state.[13]

## 4.2 Summary statistics and stylized facts

It is useful to provide an overview of the immigration patterns and of the impact of the minimum wage. Table 1 reports the net immigration rates for both immigrants without high school diploma and those with at least high school diploma. Figures are presented both at the aggregate level and decomposed by sex, age and region of origin. The composition of immigrant flows becomes relatively more skilled over time: during FMW1, more than 40% of the flows are composed by immigrants without high school diploma, while this percentage is below 30% during FMW2. While flows of high-skilled immigrants are balanced in terms of sex composition, males tend to be over-represented among low-skilled immigrants although the gap is somewhat smaller during FMW2. Furthermore, more than half of the flows are composed by young immigrants. The majority of immigrants without high school diploma originate from Central and South America, while most of immigrants with at least high school diploma come from other origins.

[11] To mitigate measurement issues, I exclude observations which refer to the top and bottom 1% of the wage distribution. In unreported results I also carry out the analysis including respondents who report an hourly rate but are paid at a different frequency. Inferences are substantially identical.

[12] GPS data were accessed at www.bls.gov/gps/.

[13] Historical data on foreign-born individuals in the United States are extracted from the US Census Bureau website (www.census.gov/population/www/documentation/twps0029/tab13.html).

Table 1: Demographic characteristics of immigrant flows

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | FMW1 | | FMW2 | |
| | Net immig. rate (×1000) | | Net immig. rate (×1000) | |
| | WHS | AHS | WHS | AHS |
| US average | 4.510 | 6.572 | 3.210 | 7.971 |
| Males | 2.520 | 3.353 | 1.735 | 3.891 |
| Females | 1.990 | 3.219 | 1.475 | 4.080 |
| Aged 16-30 | 2.906 | 3.503 | 1.632 | 4.202 |
| Aged over 30 | 1.604 | 3.069 | 1.577 | 3.769 |
| Central & South America | 3.424 | 2.013 | 2.050 | 2.275 |
| Other origins | 1.086 | 4.559 | 1.160 | 5.696 |

Source: Census 2000 (col (1)-(2)) and American Community Survey 2010 (col (3)-(4)). Notes: WHS indicates immigrants without high school diploma; AHS indicates immigrants with at least high school diploma. The net immigration rate is constructed using the difference between the stock of immigrants who entered the United States until the year after the minimum wage change and the stock of immigrants who entered the United States until the year before the change. This difference is divided by the state civilian adult population of the year before the change, obtained from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

Table 2 describes the labor market situation of immigrants before and after the minimum wage increase. During FMW1, the expected wage increases by about 14%, while during FMW2, it is essentially unchanged. The growth in the expected wage during FMW1 seems attributable to the increase in both the hourly wages and the employment population ratio (by about 9% and 5%, respectively). During FMW2, on the other hand, while hourly wages increase by about 7%, the employment population ratio decreases by a similar amount. Yet, it is important to emphasize that these are raw statistics. Changes in immigrants' outcomes might not be entirely a consequence of the minimum wage, but could also be related to other factors, such as macroeconomic conditions in the state. In fact, the state employment population ratio exhibits a pattern similar to the immigrants' employment population ratio: it increases by 1.2% during FMW1, but decreases by 4.2% during FMW2, at the peak of the global recession.

Statistics on the fraction of affected immigrants are reported in the last row. In the year before the first minimum wage increase, 18% of immigrants earned a wage between the old and the new minimum wage. In the year after, this proportion was substantially reduced to 5%.[14] In the year before the second minimum wage increase, the fraction of affected immigrants was somewhat lower, about 12%. One of the explanations is that during the 2000s several states

[14]The fact that the fraction of affected immigrants is not exactly zero after the introduction of the new minimum wage is also documented in some studies about teenage employment. Card and Krueger (1995) attribute this to a potential lag in the adjustment of wages to the new minimum wage, or reporting delay in the CPS. Another possibility is the existence of sub-minimum wages.

Table 2: Labor market characteristics of immigrants

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | FMW1 | | FMW2 | |
| | Before increase | After increase | Before increase | After increase |
| Immigrants' expected wages (log) | 1.639 | 1.779 | 2.082 | 2.082 |
| | (0.098) | (0.093) | (0.074) | (0.069) |
| Immigrants' hourly wage | 8.640 | 9.468 | 12.313 | 13.202 |
| | (0.787) | (0.716) | (0.83) | (0.841) |
| Immigrants' employment population ratio | 0.597 | 0.627 | 0.654 | 0.610 |
| | (0.043) | (0.038) | (0.039) | (0.035) |
| State employment population ratio | 0.620 | 0.632 | 0.628 | 0.586 |
| | (0.032) | (0.029) | (0.023) | (0.027) |
| Fraction of affected immigrants | 0.180 | 0.051 | 0.118 | 0.032 |
| | (0.064) | (0.022) | (0.039) | (0.021) |

Source: CPS, except the state employment population ratio, obtained from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment (GPS). Notes: CPS data refer to state averages of the adult immigrant population (aged over 16) for the periods September 1995-August 1996 (col (1)), September 1997-August 1998 (col (2)), July 2006-June 2007 (col (3)) and July 2009-June 2010 (col (4)). The fraction of affected immigrants corresponds to the share of immigrants who earn hourly wages at or above \$4.25 and below \$5.15 (FMW1) or hourly wages at or above \$5.15 and below \$7.25 (FMW2). Hourly wages are constructed using information from wage earners paid by the hour; figures exclude the top and bottom 1% of the wage distribution for each period. Immigrants' employment population ratio is calculated by dividing the number of employed immigrants by the adult immigrant population in each state. The state employment population ratio refers to the adult civilian population in the state. Figures in col (1)-(2) refer to employment population rate for the years 1996 and 1998, respectively. Figures in col (3)-(4) correspond to the average of the employment population rate for the years 2006 and 2007 and for the years 2009 and 2010, respectively.

set their own minimum wage above the federal level; in these states the fraction of affected immigrants was essentially zero.[15] However, during FMW2 the fraction of affected immigrants was also substantially reduced in the period after the minimum wage change. The increase in the minimum wage induces a sharp decline in the fraction of affected immigrants, implying that this variable can be thought as a functional exogenous predictor for the impact of the minimum wage (Card, 1992a).

In summary, Table 2 indicates that the incidence of the minimum wage is substantial and that immigrants' outcomes are affected by the policy. However, the extent to which the minimum wage directly affects the expected wage, and how this in turn influences immigration patterns, are ultimately empirical questions. I explore these in the next section.

# 5 Results

I organize the results of my analysis as follows. In subsection 5.1 I outline the benchmark results. I show the details of the first stage regression and the decomposition of the expected wage in subsection 5.2. In subsection 5.3 I conduct placebo tests. I carry out several robustness

[15] In the year before FMW1, only three states had minimum wage above \$5.15; in the year before FMW2, there were eight states with a minimum wage above \$7.25.

and sensitivity checks in subsection 5.4. In subsection 5.5 I provide regression results broken down by demographic characteristics of immigrants. Finally, I show how the minimum wage affects the internal mobility of immigrants (subsection 5.6) and explore whether it influences the flows of undocumented immigrants (subsection 5.7).

## 5.1 Benchmark results

Table 3 reports the TSLS and, for comparison, OLS estimates for both FMW1 and FMW2. In column (1), I estimate a model which includes only the expected wage. In column (2), I introduce the state employment population ratio, and in column (3), I add the growth in the percentage of foreign-born individuals between 1960 and 1970. Since the models are estimated using first differences, all time-invariant characteristics in each state are already accounted for. Hence, the additional covariates in columns (2) and (3) control for the potential impact of unobservable events which could have occurred during the period before and after the minimum wage increase. For example, the state employment population ratio captures changes in macroeconomic conditions which might be correlated with both immigration and the expected wage. The historical immigration variable accounts for time-varying factors which affect the location choice of immigrants – for example, changes in the strength of immigrants' social networks. OLS estimates are reported in column (4).

The point estimates in the first three columns are very similar in size; in fact, they are not statistically different from each other. The estimate in column (3) implies that one standard deviation increase in the expected wage induces a 0.62 standard deviation increase in the flows of immigrants without high school diploma. A numerical example is helpful. Consider the state of New York, which during FMW1 exhibits an increase in the expected wage (as predicted by the first stage) close to the mean US level (14.6%). Had the state of New York experienced an increase in the expected wage like that of California (18.0%), the flow of immigrants without high school diploma would be 8.037‰ instead of 6.140‰ – a 30% larger flow.

The partial $R^2$ for the three specifications suggests that the instrument is relevant. The value of the robust first stage $F$-statistic indicates that there are no substantive concerns about the weakness of the instrument. Furthermore, the Durbin-Wu-Hausman (DWH) test for endogeneity rejects the null hypothesis that the OLS estimator is consistent (under the assumption that the instrument is valid). To further document the presence of endogeneity, I report OLS esti-

mates in column (4). As it can be seen, failing to address the endogeneity of the expected wage would yield an essentially zero effect, suggesting the presence of a downward bias in the OLS estimates. This bias is consistent with the reverse causality implied by immigration decreasing the expected wage. More individuals migrating in response to the minimum wage will decrease both immigrants' wage and employment.

Table 3: Regression estimates – immigrants without high school diploma

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | FMW1 | | | | FMW2 | | | |
| | TSLS | | | OLS | TSLS | | | OLS |
| Change in expected wages | 0.058 | 0.061 | 0.057 | 0.005 | 0.044 | 0.043 | 0.035 | 0.007 |
| | (0.017) | (0.020) | (0.023) | (0.008) | (0.023) | (0.021) | (0.017) | (0.004) |
| Change in state employment population ratio | | –0.085 | –0.074 | 0.085 | | –0.033 | 0.003 | 0.032 |
| | | (0.114) | (0.123) | (0.047) | | (0.034) | (0.029) | (0.024) |
| Immigration growth 1960-1970 | | | 0.001 | 0.003 | | | 0.004 | 0.003 |
| | | | (0.002) | (0.003) | | | (0.001) | (0.001) |
| Constant | –0.002 | –0.001 | –0.001 | 0.005 | 0.004 | 0.003 | 0.004 | 0.005 |
| | (0.002) | (0.002) | (0.002) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Partial $R^2$ | 0.22 | 0.22 | 0.21 | | 0.06 | 0.08 | 0.09 | |
| $F$-stat first stage | 12.76 | 17.13 | 11.60 | | 3.70 | 4.28 | 5.01 | |
| DWH test | 6.49 | 7.11 | 6.43 | | 5.25 | 6.20 | 4.66 | |
| CLR statistic | 31.75 | 31.72 | 27.50 | | 8.80 | 9.37 | 7.95 | |
| CLR critical values | 4.50 | 4.46 | 3.58 | | 4.05 | 3.69 | 4.13 | |
| CLR lower bound 95% CI | 0.032 | 0.030 | 0.034 | | 0.014 | 0.014 | 0.010 | |
| CLR upper bound 95% CI | 0.109 | 0.125 | 0.111 | | 0.187 | 0.139 | 0.131 | |
| N | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 51 |

Source: CPS, Census 2000 (FMW1) and ACS 2010 (FMW2). Notes: Robust standard errors in parentheses. The dependent variable is the net immigration rate of immigrants without high school diploma, defined as the difference between the stocks of immigrants without high school diploma who entered the United States until the year after the minimum wage change and of those who entered the United States until the year before the change, divided by the state civilian adult population of the year before the change. Expected wages are defined as the product of log hourly wage and log employment population ratio of immigrants. State employment population ratio is derived from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment (GPS). Changes are calculated between the year after and the year before the minimum wage change. The immigration growth refers to the growth in the share of foreign-born in the state between 1960 and 1970. In col (1)-(3) and col (5)-(7), the change in expected wages is instrumented by the fraction of affected immigrants in the year before the minimum wage change. The partial $R^2$ and first stage $F$-stat statistics refer, respectively, to the partial $R^2$ developed by Shea (1997) and the robust rank Wald $F$-statistic developed by Kleibergen and Paap (2006). The $DWH$ test correspond to the chi-squared values of the Durbin-Wu-Hausman test statistic for endogeneity. The CLR statistic and critical values refer to the conditional likelihood-ratio test for weak instruments developed by Moreira (2003). The CLR confidence intervals are obtained following the procedure described by Moreira and Poi (2003). All models are weighted by the stock of immigrant population in each state before the minimum wage change.

The results for FMW2 are qualitatively very similar, albeit the point estimates are lower – between 0.044 and 0.035 across specifications in columns (5) to (7). One potential reason for the lower estimates is that the instrument is somewhat weaker, as showed by the partial $R^2$ and in particular by the $F$-statistic. One of the consequences of a weak instrument is that the TSLS estimates are biased towards the OLS which, yet again, yields an essentially zero estimate as showed in column (8). This suggests that the actual, unbiased effect during FMW2 could be larger than the estimated. Although I cannot precisely assess how close the actual FMW2 estimates are to those for FMW1, I can still provide inference about the estimated impact even

in the presence of a weak instrument. I follow the method developed by Moreira (2003) who derives a conditional likelihood-ratio (CLR) test in presence of weak identification. In the table I report the CLR statistic and its critical values. In all cases I can reject the null hypothesis that the parameter of interest equals zero. Furthermore, following the procedure described by Moreira and Poi (2003), I compute 95% confidence intervals based on the values of the CLR statistic. These are reported in the last two rows of Table 3. The CLR confidence intervals for FMW2 substantially overlap with those for FMW1, albeit the latter are somewhat narrower. These additional tests confirm the presence of a positive effect during FMW2.

The findings that immigrants are more likely to settle in states with higher minimum wages seems to contradict the results by Orrenius and Zavodny (2008) and Cadena (2012), who found that immigrants tend to settle in states with lower state minimum wages. Yet, as discussed, their results could be affected by the endogeneity between the minimum wage and immigration. As Table 3 shows, failing to account for this endogeneity leads to underestimating the positive effect of the minimum wage on immigration.

## 5.2 First stage and decomposition

In Table 4 I provide estimates of the first stage regression. The aim is to unveil the mechanism on how the fraction of affected immigrants influences the expected wage, and to discuss the separate contributions of the wage and employment effects. The first panel presents the results from the first stage of the TSLS regression – that is, the estimates of equation (9). Columns (1) to (3) correspond to columns (1) to (3) of Table 3; similarly columns (4) to (6) are the first stage estimates of columns (5) to (7) in Table 3. The first remark is that the fraction of affected immigrants is a strong predictor for the change in the expected wage. The estimate in column (3) implies that an increase of one standard deviation in the fraction of affected immigrants is associated with a 0.44 standard deviation increase in the expected wage. Columns (5) to (7) show that the effect during FMW2 is somewhat smaller, but statistically significant. The first stage results also provide additional evidence about the validity of the instrumental variable strategy. The inclusion of the historical immigration variable in the first stage does not affect the estimate of the fraction of affected immigrants. This suggests that the instrument is unlikely to be endogenous with immigration.

Table 4: Regression estimates – expected wages and decomposition

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | FMW1 | | | FMW2 | | |
| | I: Expected wages | | | | | |
| Fraction of affected | 0.448 | 0.403 | 0.419 | 0.318 | 0.333 | 0.352 |
| immigrants | (0.125) | (0.097) | (0.123) | (0.165) | (0.161) | (0.157) |
| Change in state employment | | 2.648 | 2.619 | | 1.161 | 0.961 |
| population ratio | | (1.154) | (1.199) | | (0.328) | (0.517) |
| Immigration growth | | | –0.013 | | | –0.026 |
| 1960-1970 | | | (0.045) | | | (0.039) |
| Constant | 0.061 | 0.038 | 0.035 | –0.031 | 0.009 | –0.002 |
| | (0.022) | (0.022) | (0.025) | (0.025) | (0.028) | (0.030) |
| $R^2$ | 0.22 | 0.38 | 0.38 | 0.05 | 0.18 | 0.19 |
| | II: Hourly wages | | | | | |
| Fraction of affected | 0.347 | 0.341 | 0.340 | 0.430 | 0.420 | 0.432 |
| immigrants | (0.092) | (0.095) | (0.124) | (0.147) | (0.122) | (0.119) |
| Change in state employment | | 0.312 | 0.315 | | –0.811 | –0.941 |
| population ratio | | (1.141) | (1.155) | | (0.239) | (0.377) |
| Immigration growth | | | 0.001 | | | –0.017 |
| 1960-1970 | | | (0.052) | | | (0.034) |
| Constant | 0.030 | 0.028 | 0.015 | 0.020 | –0.013 | –0.020 |
| | (0.020) | (0.024) | (0.035) | (0.020) | (0.022) | (0.024) |
| $R^2$ | 0.20 | 0.20 | 0.20 | 0.18 | 0.29 | 0.29 |
| | III: Employment population ratio | | | | | |
| Fraction of affected | 0.101 | 0.062 | 0.079 | –0.112 | –0.087 | –0.081 |
| immigrants | (0.118) | (0.083) | (0.085) | (0.160) | (0.076) | (0.078) |
| Change in state employment | | 2.335 | 2.304 | | 1.972 | 1.902 |
| population ratio | | (0.557) | (0.583) | | (0.258) | (0.292) |
| Immigration growth | | | –0.014 | | | –0.009 |
| 1960-1970 | | | (0.020) | | | (0.022) |
| Constant | 0.031 | 0.010 | 0.007 | –0.051 | 0.022 | 0.018 |
| | (0.019) | (0.016) | (0.016) | (0.017) | (0.013) | (0.014) |
| $R^2$ | 0.03 | 0.32 | 0.32 | 0.02 | 0.52 | 0.52 |
| N | 51 | 51 | 51 | 51 | 51 | 51 |

Source: CPS, Census 2000 (FMW1) and ACS 2010 (FMW2). Notes: Robust standard errors in parentheses. Dependent variables are: changes in immigrants' log expected wage (panel I), changes in immigrants' log hourly wage (panel II) and changes in immigrants' log employment population ratio (panel III). Expected wages are defined as the product of log hourly wages and log employment population ratio of immigrants. The employment population ratios are derived from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment (GPS). Changes refer to differences between the year after and the year before the minimum wage change. The fraction of affected immigrants corresponds to the share of immigrants who earn, before the minimum wage change, hourly wages at or above \$4.25 and below \$5.15 (FMW1) or hourly wages at or above \$5.15 and below \$7.25 (FMW2). The immigration growth refers to the growth in the share of foreign-born in the state between 1960 and 1970. All models are weighted by the stock of immigrant population in each state before the minimum wage change.

In the remaining two panels, I report estimates of the two components of the expected wage: immigrants' hourly wage and employment population ratio. The additive property of OLS implies that the coefficients in the second and third panel add up to those in the first panel. The wage effect is always positive – with a large statistically significant effect. The employment effect for FMW1 is positive, albeit economically small and statistically insignificant. For FMW2, the estimated employment effect is negative but yet again not statistically significant.[16]

[16]My findings corroborate the evidence from the studies on teenage employment by Card (1992a,b) and Card and Krueger (1994). For comparison purposes, I have analysed the wage and employment effect for teenagers. I estimated regression models similar to those in Table 4 using teenage wages and employment as dependent variable and the fraction of affected teenagers as main explanatory variable. I found positive and statistically significant wage effects (11.8% for FMW1 and 16.0% for FMW2). On the

## 5.3 Placebo tests

In this subsection, I provide further evidence of the validity of my identification strategy. A first appealing falsification test consists on testing the hypothesis that minimum wage affects immigration of individuals who should not be influenced by it. I estimate the same regression model of Table 3 using the flows of immigrants with at least high school diploma as dependent variable. My analytical framework postulates that the migration decision of high-skilled individuals should not be affected by the minimum wage, since the policy does not influence their expected wage. As a consequence, one would not expect to find a correlation between the flows of high-skilled immigrants and the expected wage.[17] Table 5 shows in fact that the effect is statistically and economically negligible. In addition, I find that what determines the flows of high skilled immigrants are changes in the macroeconomic conditions and in immigration patterns. The OLS estimates are very similar to the TSLS. This confirms that endogeneity is essentially an issue for low-skilled immigrants, because it is their flows which affect their expected wage. This is further demonstrated by the fact that for immigrants with at least high school diploma the Durbin-Wu-Hausman test cannot reject the hypothesis that OLS estimates are consistent.

A second falsification test relates to considering a period when the minimum wage did not change, since one would presume the expected wage to be uncorrelated with immigration flows. In unreported results, I perform additional placebo regressions which include the same variables of Table 4 constructed with data for the year before and two years before the minimum wage increase, but using as instrument the fraction of affected immigrants measured at the time of the policy change (i.e., the same instrument in Table 4). The rationale is that the instrument should not predict any change in expected wages during a period when the minimum wage did not change. This conjecture is corroborated by the results: the first stage regressions are very weak for both the periods before FMW1 and before FMW2. This yields essentially no correlation between the expected wages and the flows of immigrants without high school diploma in the second stage. Unsurprisingly, the same result is obtained for the flows of high-skilled immigrants.

other hand, I find a small negative employment effect for FMW1 (in level: -2.2%) and a small positive effect for FMW2 (in level: 3.3%). In both cases estimates are not statistically significant.

[17] This, unless the minimum wage has substantial spillover effects, that is, there is a large increase in the wage of immigrants who already earn above the minimum before the minimum wage increase. Even if this is the case, however, spillover effects will arguably influence only a small fraction of high-skilled individuals. The results from the robustness check in which I include high school graduates in the treatment group (see subsection 5.4) confirm this conjecture.

Table 5: Regression estimates – immigrants with high school diploma or above

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | FMW1 | | | | FMW2 | | | |
| | TSLS | | | OLS | TSLS | | | OLS |
| Change in expected wages | 0.011 | 0.007 | –0.007 | –0.007 | –0.007 | –0.005 | –0.021 | 0.005 |
| | (0.020) | (0.019) | (0.017) | (0.007) | (0.034) | (0.031) | (0.034) | (0.008) |
| Change in state employment population rate | | 0.098 | 0.145 | 0.144 | | 0.042 | 0.116 | 0.090 |
| | | (0.061) | (0.053) | (0.044) | | (0.069) | (0.066) | (0.043) |
| Immigration growth 1960-1970 | | | 0.005 | 0.005 | | | 0.007 | 0.008 |
| | | | (0.002) | (0.002) | | | (0.003) | (0.002) |
| Constant | 0.007 | 0.007 | 0.008 | 0.008 | 0.010 | 0.012 | 0.015 | 0.014 |
| | (0.003) | (0.002) | (0.002) | (0.001) | (0.001) | (0.003) | (0.003) | (0.002) |
| DWH test | 0.17 | 0.60 | 0.00 | | 0.15 | 0.08 | 0.70 | |
| N | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 51 |

Source: CPS, Census 2000 (FMW1) and ACS 2010 (FMW2). Notes: Robust standard errors in parentheses. The dependent variable is the net immigration rate of immigrants with at least high school diploma, defined as the difference between the stocks of immigrants with at least high school diploma who entered the United States until the year after the minimum wage change and of those who entered the United States until the year before the change, divided by the state civilian adult population of the year before the change. Expected wages are defined as the product of log hourly wage and log employment population ratio of immigrants. State employment population ratio is derived from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment (GPS). Changes are calculated between the year after and the year before the minimum wage change. The immigration growth refers to the growth in the share of foreign-born in the state between 1960 and 1970. In col (1)-(3) and col (5)-(7), the change in expected wages is instrumented by the fraction of affected immigrants in the year before the minimum wage change. The $DWH$ test correspond to the chi-squared values of the Durbin-Wu-Hausman test statistic for endogeneity. All models are weighted by the stock of immigrant population in each state before the minimum wage change.

## 5.4 Robustness checks

I conducted additional checks to ensure the robustness of the results.[18] In these tests, I estimate specifications in which: a) immigrants who have high school diploma are included in the flows of low-skilled instead of in the flows of high-skilled immigrants; b) the expected wage is deflated using the current price index; c) the lagged change in state employment population ratio is used as explanatory variable; d) the immigration stock in 1960 is used instead of the immigration growth between 1960 and 1970 as control variable; e) the fraction of affected population is used as instrumental variable; f) the fraction of affected immigrants is defined as the share of immigrants whose earnings are between the old federal minimum wage and the state minimum wage in the year after the minimum wage change; g) states which at the time of the policy change had a state minimum wage above the federal are excluded; and h) the sample is restricted to the top 35 immigration states. In all specifications the benchmark results are confirmed; furthermore, all placebo tests demonstrate that the minimum wage does not affect the flows of high-skilled immigrants.

[18]Results from these tests are available upon request.

## 5.5 Analysis by demographic characteristics

Table 6 provides a breakdown of the benchmark estimates by demographic characteristics. I decompose the flows of immigrants by sex, age group and region of origin, and perform the same analysis of Table 3. The estimates in row 1 and 2 include all covariates used in Table 3.[19] For both FMW1 and FMW2, the impact of the minimum wage is larger for males than for females. Interestingly, while during FMW1 the minimum wage attracts more young immigrants, during FMW2 the effect is similar for the group aged 16-30 and the group over 30. Finally, the minimum wage affects only the flows from Central and South America, the majority of which belong to the low-skilled group.

Table 6: Decomposition by demographic group – immigrants without high school diploma

| | Sex | | Age | | Origin | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| FMW1 | 0.033 | 0.025 | 0.044 | 0.013 | 0.062 | –0.005 |
| | (0.013) | (0.010) | (0.016) | (0.007) | (0.023) | (0.005) |
| FMW2 | 0.023 | 0.012 | 0.017 | 0.018 | 0.038 | –0.003 |
| | (0.011) | (0.007) | (0.008) | (0.010) | (0.021) | (0.010) |

Source: CPS, Census 2000 (FMW1) and ACS 2010 (FMW2). Notes: Robust standard errors in parentheses. The dependent variable is the net immigration rate of immigrants without high school diploma, defined as the difference between the stocks of immigrants without high school diploma who entered the United States until the year after the minimum wage change and of those who entered the United States until the year before the change, divided by the state civilian adult population of the year before the change. Col (1): Males; col (2): Fermales; col (3): Aged 16-30; col (4): Aged over 30; col (5) Central and South America; col (6) Other origins. Models in the first row correspond to the decomposition of the flows estimated in col (3) of Table 3; models in the second row correspond to the decomposition of the net immigration rate estimated in col (7) of Table 3. All models are weighted by the stock of immigrant population in each state before the minimum wage change.

## 5.6 Internal mobility

If the minimum wage affects international migration patterns, it is plausible to expect that mobility of low-skilled immigrants who already live in the country is also affected. According to the predictions of my model, immigrants who already reside in the United States will be more likely to move to states where the change in the expected wage is larger. I hence explore whether an exogenous change in the minimum wage affects the internal mobility of low-skilled immigrants. Due to data availability I can only test this hypothesis for FMW1. The reason is

[19] Models without covariates yield very similar results.

that the analysis for FMW1 is based on the 5% sample of the Census, which provides sufficient number of observations to capture the internal mobility of immigrants and is hence more reliable than the 1% sample of the ACS used for FMW2.

From the IPUMS microdata, I derive information on the state of residence of immigrants five years before the Census. This means that I can compare the state of residence of immigrants in year 2000 (after the minimum wage increase) with the state of residence in 1995 (before the minimum wage increase). This allows the construction of an origin-destination indicator based on a "five-year" mobility period for each individual.[20] I aggregate at the state level the information on the state of residence for both the period before and after the minimum wage, obtaining a variable on interstate mobility. This provides a total of 1,275 state-to-state flows (corresponding to the number of pairwise combinations, i.e., $\binom{51}{2}$). This "net flow" measure is similar to the one used for the case of international migration, except that with internal migration I do observe actual inflows and outflows for each state. The net migration rate is constructed by dividing the net flow by half of the joint population of the origin and destination states. In the same fashion, I calculate "interstate differences" for all variables used in the analysis, that is, the fraction of affected immigrants, the expected wages and the remaining covariates. The effect of the minimum wage on internal migration is therefore identified by correlating the interstate differences in the expected wage with the interstate flows of immigrants. As before, the model is estimated using first differences. I report the results of the analysis in Table 7.

Since the dependent variable refers to interstate flows, the estimates are expected to be much smaller when compared to those in Table 3. For the sake of representation, I multiply all regression coefficients by 100.

Columns (1) to (3) show that low-skilled immigrants are more likely to move to states where the change in expected wages is larger. The effect is economically stronger in the specification which includes all covariates.[21] Diagnostic tests for the first stage show that the instrument is relevant. Furthermore, the endogeneity test rejects the null hypothesis that OLS is consistent.

[20] Using such a broad definition of migration has its own limitations – for example, one does not know where the immigrants resided in an intermediate period, say, 1998. Yet, for the scope of my analysis, relying on a five-year definition is indeed better than using the alternative available definition of migration, based on one-year period.

[21] The estimates of the historical immigration exhibits a negative correlation with internal mobility. This means that immigrants who live in the United States are more likely to move in "new immigration states", rather than in states where the concentration of foreign-born has been historically high. This result is consistent with the findings of Card and Lewis (2007), who document that the Mexican population has been redistributing across the United States since the 1990s.

Table 7: Regression estimates – interstate mobility of immigrants (coefficients × 100)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | WHS | | | | AHS | | | |
| | TSLS | | | OLS | TSLS | | | OLS |
| Change in expected wages | 0.102 | 0.102 | 0.138 | 0.012 | –0.001 | 0.001 | 0.063 | 0.015 |
| | (0.039) | (0.039) | (0.050) | (0.010) | (0.040) | (0.040) | (0.046) | (0.010) |
| Change in state employment population ratio | | 0.084 | 0.009 | 0.317 | | 0.309 | 0.177 | 0.295 |
| | | (0.141) | (0.166) | (0.091) | | (0.148) | (0.126) | (0.113) |
| Immigration growth 1960-1970 | | | –0.013 | –0.002 | | | –0.023 | –0.019 |
| | | | (0.008) | (0.006) | | | (0.011) | (0.010) |
| Constant | –0.002 | –0.002 | –0.003 | –0.003 | 0.001 | 0.002 | 0.001 | 0.001 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Partial $R^2$ | 0.07 | 0.08 | 0.05 | | 0.07 | 0.08 | 0.05 | |
| $F$-stat first stage | 32.80 | 38.95 | 22.21 | | 32.80 | 38.95 | 22.21 | |
| DWH test | 5.95 | 8.29 | 10.53 | | 0.23 | 0.03 | 1.47 | |
| N | 1,275 | 1,275 | 1,275 | 1,275 | 1,275 | 1,275 | 1,275 | 1,275 |

Source: CPS and Census 2000. Notes: Robust standard errors in parentheses; coefficients are multiplied by 100. WHS indicates immigrants without high school diploma; AHS indicates immigrants with at least high school diploma. The dependent variable is the net migration rate of immigrants without high school diploma (col (1)-(4)) and of immigrants with at least high school diploma (col (5)-(8)), defined as the difference between the number of immigrants who moved from state $i$ to state $j$ and the number of immigrants who moved from state $j$ to state $i$ between 1995 and 2000. This difference is divided by the average of the joint population of state $j$ and $i$. Expected wages are defined as the product of log hourly wage and log employment population ratio of immigrants; state employment population ratio is derived from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment (GPS). Changes are calculated between the year after and the year before the minimum wage change. The immigration growth refers to the growth in the share of foreign-born in the state between 1960 and 1970. In col (1)-(3) and col (5)-(7), the change in expected wages is instrumented by the fraction of affected immigrants in the year before the minimum wage change. The partial $R^2$ and first stage $F$-stat statistics refer, respectively, to partial $R^2$ developed by Shea (1997) and the robust rank Wald $F$-statistic developed by Kleibergen and Paap (2006). The $DWH$ test correspond to the chi-squared values of the Durbin-Wu-Hausman test statistic for endogeneity. All models are weighted by the stock of immigrant population in each state before the minimum wage change.

In fact, column (4) shows that the OLS estimate would be biased downward, as is the case of international migration.

Columns (5) to (8) contain the estimates for immigrants with at least high school diploma. As is the case with international migration, one would not expect the internal mobility of this group to be affected by the minimum wage. The effect is in fact both economically and statistically insignificant. Furthermore, endogeneity tests cannot reject that the OLS is the appropriate model. Yet again, other variables different than the expected wage are important predictors of internal mobility.

## 5.7 Minimum wage and undocumented migration

In this subsection, I explore whether the change in the federal minimum wage affects undocumented and legal migration in the same manner. To this aim, I access data from the "Encuesta sobre Migración en la Frontera Norte de México" (Emif Norte), a survey conducted at the north border of Mexico. The Emif Norte collects data on individuals who return or are deported from the United States to Mexico and of individuals who migrate from other regions of

Mexico to either work in the northern region or to transit towards the United States.[22] I use the example of Mexico for two reasons. First, migration from Mexico to the United Stats is mostly composed by low-skilled individuals, a group whose mobility is more likely to be affected by the minimum wage. Second, unauthorized migration from Mexico is a large scale phenomenon (Hanson, 2006), and hence – under a policy viewpoint – it is crucial understanding whether, and to what extent, a change in the US minimum wage affects the flows of undocumented migrants. Furthermore, the data from the Emif Norte allow me to investigate whether minimum wage influences immigration from the perspective of the sending country.

As a first step, I derive counts of emigrants to and return migrants from the United States, using the sample weights provided by the survey. I approximate emigration from Mexico with the number of Mexican individuals who express the intention to migrate to a certain US state. Return migration to Mexico is defined as the number of migrants who report coming back from a certain US state. I restrict the definition of return migrants to those who declare coming back with the purpose to find a job in Mexico. As a second step, I define the net migration rate as the difference between emigration and return migration, divided by the US state civilian adult population in the year before the minimum wage change. This measure is similar to the one that I use throughout the analysis, except that it is based on the sending country's flow estimates. As a third step, I separate the immigration flows into those related to "undocumented" and "legal" migrants. Legal migrants are defined as those who report possessing a travel document at the time of emigration to the United States. Undocumented migrants are those who report to not possess such document. This procedure yields a total of 35 observations for FMW1 and 36 observations for FMW2. Indeed, these measures are at best approximations of the true net flows of legal and undocumented migrants from Mexico. However, the main aim in this exercise is to obtain a reliable measure of the cross-state distribution of the flows of legal vis-á-vis undocumented migrants. To mitigate potential concerns about the reliability of the measure of undocumented immigration, I have compared it with two alternative data sources and ascertained the similarity across different estimates.[23] The final steps consist of estimating

[22]Emif Norte data are available for the year 1995 and then from 1999 to 2010. Hence, for FMW1, I use information from the 1999 survey and for FMW2 I accessed the 2010 survey. Data are obtained from El Colegio de la Frontera Norte website (www.colef.net/emif/bases.php). The survey has been used before in the context of studies on remittances (see, e.g., Amuedo-Dorantes and Pozo 2005, 2006).

[23]I have compared the emigration and return flows of undocumented migrants from the Emif Norte with the estimates of stocks of unauthorized immigrants calculated by the Pew Hispanic Center (PHC) and presented in Passel and Cohn (2011), and those calculated by the Department of Homeland Security (DHS) and presented in Hoefer et al. (2010). I found rather high correlation between the Emif Norte

regression models in line with those of the benchmark model using the flows of all immigrants and, separately, of legal and undocumented immigrants. The results are reported in Table 8.

Table 8: Net immigration rate – migration from Mexico

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | FMW1 | | | FMW2 | | |
| | All | Legal | Undoc. | All | Legal | Undoc. |
| Change in expected wages | 0.045 | 0.046 | –0.001 | 0.026 | 0.019 | 0.007 |
| | (0.017) | (0.017) | (0.002) | (0.019) | (0.014) | (0.006) |
| Change in state employment population ratio | –0.170 | –0.184 | 0.014 | –0.114 | –0.085 | –0.029 |
| | (0.136) | (0.142) | (0.011) | (0.066) | (0.052) | (0.015) |
| Immigration growth 1960-1970 | –0.001 | –0.002 | 0.000 | –0.001 | –0.001 | 0.000 |
| | (0.002) | (0.002) | (0.000) | (0.004) | (0.003) | (0.001) |
| Constant | –0.003 | –0.003 | 0.000 | –0.002 | –0.002 | –0.000 |
| | (0.001) | (0.001) | (0.000) | (0.002) | (0.002) | (0.000) |
| N | 35 | 35 | 35 | 36 | 36 | 36 |

Source: CPS, Emif Norte 1999 (FMW1) and Emif norte 2010 (FMW2). Notes: Robust standard errors in parentheses. The dependent variable is the net immigration rate of Mexican migrants to the United States, defined as the difference between the flows of emigrants to and the flows of return migrants from a certain US state divided by the US state civilian adult population of the year before the minimum wage change. Flows are obtained applying the Emif Norte sample weights. Emigrants are defined as individuals who express the intention to migrate to a certain US state; return migrants are defined as individuals who report coming back from a certain US state with the purposes to find a job in Mexico. Legal (undocumented) migrants are defined as those who report to (not) possess a travel document at the time of crossing the border. Expected wages are defined as the product of log hourly wage and log employment population ratio of immigrants; state employment population ratio is derived from the Bureau of Labor Statistics Geographic Profile of Employment and Unemployment (GPS). Changes are calculated between the year after and the year before the minimum wage change. The immigration growth refers to the growth in the share of foreign-born in the state between 1960 and 1970. The change in expected wages is instrumented by the fraction of affected immigrants in the year before the minimum wage change. All models are weighted by the stock of immigrant population in each state before the minimum wage change.

The estimates for the net immigration rate of all Mexican migrants are positive and statistically significant for FMW1. The magnitude of the coefficient is somewhat smaller than the benchmark results, but is qualitatively similar considering the differences in the sample, data source and number of observations. When I analyse separately flows of legal and undocumented migrants, I find only a positive effect for the group of legal migrants; the estimate of the expected wages for the group of undocumented migrants is negligible both in terms of magnitude and statistical significance. I obtained qualitatively similar results for FMW2. In this case, the effect on immigration is smaller than FMW1 and at the borderline of statistical significance, very much in keeping with the results throughout the analysis. Consistent with the results for FMW1, when decomposing the flows into legal and undocumented migrants, the effect is entirely attributable to legal migrants – albeit yet again the estimate is statistically weak.

and the PHC and DHS estimates, although it is important to emphasize that these two alternative data sources refer to stocks of immigrants and not to flows.

There are several possible explanations behind the finding that only legal migrants are affected by the minimum wage. One possibility is that the rise in expected wages is not large enough to cover the cost of migration which, for undocumented migrants, could be relatively large in terms of both monetary costs and risk of apprehensions at the border. Another – potentially antithetical – explanation is that illegal immigrants are insensitive to minimum wages since they might be paid sub-minimum wages. When hiring undocumented immigrants, employers have more bargaining power and can pay a wage below the minimum making leverage on the illegal status of immigrants (Epstein and Heizler, 2003).

# 6 Conclusions

This paper studies an under-explored aspect of the minimum wage: its effect on immigration. The relationship between migration and the minimum wage is of particular relevance in the context of recent socio-economic events that have occurred in the United States. The immigrant population rose significantly during the 1990s and 2000s, reaching 13 percent of the United States population in 2010.[24] Parallel to these events, the history of minimum wage legislation has also experienced remarkable changes: after a steady decline in the 1980s, the increases that took place in 1990s and 2000s contributed to a recovery of the real value of the minimum wage.

There are two main findings in my study: first, the minimum wage has contributed significantly to the increase of the average wages of immigrants. In addition, there were non-negative effects on employment. These results support the hypothesis that there are frictions in the labor market which can be alleviated through the minimum wage policy. The net positive effects on the labor market outcomes have increased the gains – as captured by the expected wage – that potential immigrants can attain.

The second result is that low-skilled immigrants are responsive to changes in expected wages. This variable, as instrumented by the fraction of affected immigrants, robustly predicts changes in the flows of immigrants without high school diploma. On the other hand, immigrants who are relatively more skilled and earn more than the minimum wage are insensitive to the expected gains produced by the policy. These results are robust to several specifications, and hold also

[24]Source: ACS 2010.

in the case of interstate mobility of immigrants. Remarkably, I found that changes in the federal minimum wage attract only legal immigrants, while they do not increase the flows of undocumented immigrants.

These findings suggest important implications for both minimum wage and immigration policy. First, that the minimum wage, besides its known direct impact on the wage distribution and possibly on employment, influences also immigration. This suggests that policy makers, when designing minimum wage policies, must take into account the potential impact on immigration. Second, among the many factors affecting immigration to the United States, an exogenous increase in wages implied by the minimum wage is proved to be a strong magnet for low-skilled immigrants. Indeed, this effect should be carefully evaluated in the context of the immigration policies in force during the 1990s and 2000s, and could have been different under alternative policies. Bearing this cautious interpretation in mind, my findings suggest that policy makers should take into account the nexus between immigration and minimum wage when designing and implementing immigration policies.

# References


Amuedo-Dorantes, Catalina and Susan Pozo, "On the Use of Differing Money Transmission Methods by Mexican Immigrants", *International Migration Review 39*:3 (2005), 554–576.

Amuedo-Dorantes, Catalina and Susan Pozo, "Remittances as Insurance: Evidence from Mexican Immigrants", *Journal of Population Economics 19*:2 (2006), 227–254.

Bartel, Ann P., "Where Do the New US Immigrants Live?", *Journal of Labor Economics 7*:4 (1989), 371–391.

Basu, Bharati, "Minimum Wage, International Migration and Their Effects on Welfare", *International Economic Journal 9*:2 (1995), 101–120.

Boffy-Ramirez, Ernest, "Expected Earnings and Migration: The Role of Minimum Wages", *Unpublished Manuscript* (2012).

Borjas, George J., "The Economics of Immigration", *Journal of Economic Literature 32*:4 (1994), 1667–1717.

Borjas, George J., "Immigration and Welfare Magnets", *Journal of Labor Economics 17*:4 (1999), 607–637.

Borjas, George J., "Native Internal Migration and the Labor Market Impact of Immigration", *Journal of Human Resources 41*:2 (2006), 221–258.

Card, David, "Using Regional Variation in Wages to Measure the Effects of the Federal Minimum Wage", *Industrial and Labor Relations Review 46*:1 (1992a), 22–37.

Card, David, "Do Minimum Wages Reduce Employment? A Case Study of California, 1987-89", *Industrial and Labor Relations Review 46*:1 (1992b), 38–84.

Card, David, "Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration", *Journal of Labor Economics 19*:1 (2001), 22–64.

Card, David and Alan B. Krueger, "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania", *The American Economic Review 84*:4 (1994), 772–793.

Card, David and Alan B. Krueger, *Myth and Measurement: The New Economics of the Minimum Wage*, Princeton University Press, 1995.

Card, David and Ethan G. Lewis, "The Diffusion of Mexican Immigrants During the 1990s: Explanations and Impacts", pp. (193–228) In George J. Borjas (Eds.), *Mexican Immigration to the United States*, University Chicago Press, 2007.

Castillo-Freeman, Alida and Richard B. Freeman, "When the Minimum Wage Really Bites: The Effect of the US-Level Minimum on Puerto Rico", pp. (177–212) In George J. Borjas and Richard B. Freeman (Eds.), *Immigration and the Work Force: Economic Consequences for the United States and Source Areas*, University Chicago Press, 1992.

Cadena, Brian, "Newly Arriving Immigrants as Labor Market Arbitrageurs: Evidence from the Minimum Wage", *Unpublished Manuscript* (2012).

Clark, Xiamena, Timothy J. Hatton and Jeffrey G. Williamson, "Explaining US immigration, 1971-1998", *The Review of Economics and Statistics 89*:2 (2007), 359–373.

Cortes, Kalena E., "Wage Effects on Immigrants from an Increase in the Minimum Wage Rate: An Analysis by Immigrant Industry Concentration", *IZA Discussion Paper 1064* (2004).

Dube, Arindrajit, Suresh Naidu and Michael Reich, "The Economic Effects of a Citywide Minimum Wage", *Industrial and Labor Relations Review 60*:4 (2007), 522–543.

Dube, Arindrajit, T. William Lester and Michael Reich, "Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties", *The Review of Economics and Statistics 92*:4 (2010), 945–964.

Epstein, Gil S. and Odelia Heizler, "Illegal Migration, Enforcement and Minimum Wage", *Research in Labor Economics 28* (2008), 197–224.

Giulietti, Corrado, "Is the Minimum Wage a Pull Factor for Immigrants?", *IZA Discussion Paper 5410* (2010).

Hanson, Gordon H., "Illegal Migration from Mexico to the United States", *Journal of Economic Literature 44*:4 (2006), 869–924.

Harris, John R. and Michael P. Todaro, "Migration, Unemployment and Development: A Two-Sector Analysis", *The American Economic Review 60*:1 (1970), 126–142.

Hoefer, Michael, Nancy Rytina and Bryan C. Baker, "Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2010", *Population Estimates, Office of Immigration Statistics, US Department of Homeland Security* (2010), http://www.dhs.gov/xlibrary/assets/statistics/publications/ois_ill_pe_2010.pdf

Kleibergen, Frank and Richard Paap, "Generalized Reduced Rank Tests Using the Singular Value Decomposition", *Journal of Econometrics 133*:1 (2006), 97–126.

Manning, Alan, *Monopsony in Motion: Imperfect Competition in Labor Markets*. Princeton University Press, 2003.

Mayda, AnnaMaria, "International Migration: A Panel Data Analysis of the Determinants of Bilateral Flows", *Journal of Population Economics 23*:4 (2010), 1249–1274.

Moreira, Marcelo J., "A Conditional Likelihood Ratio Test for Structural Models", *Econometrica 71*:4 (2003), 1027–1048.

Moreira, Marcelo J. and Brian P. Poi, "Implementing Tests with Correct Size in the Simultaneous Equations Model", *Stata Journal 3*:1 (2003), 57–70.

Neumark, David and William Wascher, "Employment Effects of Minimum and Subminimum Wages: Panel Data on State Minimum Wage Laws", *Industrial and Labor Relations Review 46*:1 (1992), 55–81.

Neumark, David and William Wascher, "Minimum Wages and Employment: A Review of Evidence from the New Minimum Wage Research", *NBER Working Paper 12663* (2006).

Neumark, David and William Wascher, "Minimum Wages, the Earned Income Tax Credit, and Employment: Evidence from the Post-Welfare Reform Era", *IZA Discussion Paper 2610* (2007).

Neumark, David and William Wascher, "Revisiting the Minimum Wage-Employment Debate: Throwing Out the Baby with the Bathwater?", *IZA Discussion Paper 7166* (2013).

Orrenius, Pia M. and Madeline Zadovny, "The Effect of Minimum Wages on Immigrants' Employment and Earning". *Industrial and Labor Relations Review 61*:4 (2008), 544–563.

Passel, Jeffrey S. and D´Vera Cohn, "Unauthorized Immigrant Population: National and State Trends", *Pew Hispanic Center Report* (2011), http://pewhispanic.org/files/reports/133.pdf.

Shea, John, "Instrument Relevance in Multivariate Linear Models: A Simple Measure", *Review of Economics and Statistics 79*:2 (1997), 348–352.

Sjaastad, Larry A., "The Costs and Returns of Human Migration", *Journal of Political Economy 70*(suppl.) (1962), 80–93.

Stigler, George J., "The Economics of Minimum Wage Legislation", *The American Economic Review 36*:3 (1946), 358–365.

## Appendix

Table A1: Variable description and data sources

| Variable | Description | FMW1 Source | FMW2 Source |
|---|---|---|---|
| a) Net immigration rate | Difference between the stock of immigrants before and after the FMW change | Census | ACS |
| b) Fraction of affected immigrants | Share of immigrants earning between the old and the new FMW | CPS | CPS |
| c) Immigrants' hourly wage | Log of immigrants' hourly wages | CPS | CPS |
| d) Immigrants' employment population ratio | Log of immigrants' employment population ratio | CPS | CPS |
| e) Expected wages | Constructed as c) × d) | CPS | CPS |
| f) State-wide employment population ratio | Aggregate employment population ratio | GPS | GPS |
| g) Immigration growth 1960-1970 | Growth in the share of immigrants between 1960 and 1970 | Census | Census |
| h) Net migration rate of immigrants | Number of immigrants who moved across states between 1995 and 2000 | Census | |
| i) Immigration inflow rate from Mexico | Difference between emigration from and return migration to Mexico | Emif Norte | Emif Norte |
| Dates of minimum wage change | | August 1996<br>September 1997 | July 2007<br>July 2008<br>July 2009 |
| Period before/after increase | | 1996-1998 | 2006-2010 |

CPS = Current Population Survey. Emif Norte = Encuesta sobre Migración en la Frontera Norte de México. Each period before and after refer to the calendar year before and after the minimum wage change, except for CPS data, where the periods are defined as follows. FMW1: from September 1995 to August 1996 (before) and from September 1997 to August 1998 (after). FMW2: from July 2006 to June 2007 (before) and from July 2009 to June 2010 (after).