Is the Minimum Wage a Pulling Factor for Migrants?

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(Please do not quote)

Abstract

This paper studies the impact of the minimum wage on immigration. A framework is presented where inflows of immigrants are a function of the expected wage growth induced by the minimum wage. The analysis focuses on the USA minimum wage increase of 1996/1997, using data from the Current Population Survey and the Census. The estimation strategy consists of using the fraction of affected workers as instrumental variable for the growth of expected wages. The findings show that States where the growth of expected wages was relatively large (about 20%) exhibited inflow rate increases that are four to five times larger than States where average wages grew 10% less. Placebo tests confirm that the policy did not affect immigration of high wage earners.

Keywords: employment effects, expected wages, immigration, minimum wage, wage effects
JEL Classification Code: J08, J23, J38, J61

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1 Introduction

Does an increase of the minimum wage constitute a pulling factor for low-skilled immigrants? A minimum wage set in the receiving country has ambiguous effects on immigration: on the one hand, average wages will increase, but on the other, employment perspectives might be adversely affected. The objective of this paper is to explore this question in the context of the increase in the USA federal minimum wage that took place between 1996 and 1997.

There is extensive research about the determinants of immigration and, although it is difficult to define a taxonomy of these factors, there is a consensus that immigrants respond to both economic and non-economic incentives in the receiving country. Relatively favourable employment and wage conditions, along with the presence of network effects, distance from the origin country and immigration policies, are indicated as principal causes of immigration (Clark et al., 2002; Mayda, 2005). On the other hand, research on the role played by labour market institutions, such as the minimum wage, is rather exiguous. A minimum wage in the receiving country creates a disequilibrium in the labour market that may encourage or deter immigration. Economic theory predicts a growth in the average wages of low-wage workers; employment effects are, however, uncertain and depend on the labour market structure (Manning, 2003).

A simple model that relates the minimum wage to immigration is developed and used to estimate the impact of the increase in the USA federal minimum wage on the inflows of low-wage workers. The model postulates that migrants take decisions in terms of expected wages, whereby the probability of finding employment is represented by the employment population ratio in the destination country. The change in the minimum wage has effects on the expected wages because it alters both the average wages and the probability of employment. The effects of the policy are analysed using the change in the USA federal minimum wage that took place between 1996 and 1997, a period during which both minimum wage impacts and immigration flows exhibited considerable variation across the 51 States[1]. The instrumental variable approach implemented in the analysis can be efficiently explained by two steps. In the first step, the growth of expected wages is regressed on the fraction of foreign-born individuals who earn between the old and the new minimum wage; in the second, the predicted values are correlated with changes in the inflow rate of immigrants. The main results show that the $0.90 top-up in the minimum wage led to an increase in the inflow rate of low-wage immigrants that varies from less than 0.01% in States with lower growth in expected wages to more than 0.08% in States where expected wages grew most. The robustness of these results is tested by including controls for macroeconomic conditions in each State. Furthermore, placebo tests show that the policy did not affect the inflow rates of immigrants earning above the minimum wage.

The paper begins with a review of the studies on the minimum wage and immigration. The theoretical model and the econometric specification are sketched in Sections 2.3 and 2.4. Section 2.5 provides a description of the data, followed by an illustration of facts about immigration and minimum wage. Section 2.6 presents the results of the estimation along with robustness tests. A brief discussion of the findings and directions for future research conclude the paper.

[1] Including District of Columbia.

2 Minimum wage and immigration

2.1 The effects of the minimum wage

Theories about the effects of the minimum wage are divided into two strands: on the one side are researchers who support the classical view, which builds upon the seminal model of Stigler (1946); on the other is a more recent literature strand known as the "new economics of the minimum wage" - named after the influential work of Card and Krueger (1995) - which contradicts the classical textbook framework. The core difference between the two views is the contrasting prediction in terms of employment effects.

The neoclassical model predicts that, under a binding minimum wage, firms are constrained to pay wages higher than the market clearing level and therefore employment would be reduced to the point where the marginal revenue product of labour equals the minimum wage. At this point, more individuals are willing to offer their work in exchange for the minimum and this will determine unemployment. Both wage and employment effects depend on the elasticity of the demand and supply. Advances to the classic model of the minimum wage date back to the 1970s, when some interesting extensions were built upon the basic framework, such as the introduction of an uncovered sector (Welch, 1974; Mincer, 1976). Recently, theoretical models became more structured with the extension to heterogeneous labour, where the introduction of the minimum wage determines a truncation of the skill distribution (Brown, 1999).

Scholars of the new economics of the minimum wage argue that firms face an upward-sloping labour demand curve because of frictions in the labour markets. Moderate increases in the minimum wage may thus lead to non-negative employment outcomes. Markets may be imperfect because of rigidity in the labour turnover, presence of mobility costs, or asymmetric information (Manning, 2003). The simplest model of imperfect competition is that of a monopsonistic labour market, with employers having some market power in setting wages. Card and Krueger (1995) build upon the classical monopsony framework and present a search model in which firms offer higher wages in order to discourage turnover. Alternative models of equilibrium wage settings have been developed, but the general implications of such models is that employment effects are not unambiguously negative as predicted by the classical framework[2].

The contrast in these theories is embodied in the empirical analyses of the minimum wage, which are far from reaching consensus about the employment effects. Most of these works focus on teenage workers, and, although the target of the studies is always the same - the elasticity of employment with respect to the minimum wage - the methodologies used vary substantially[3]. For example, Card (1992) and Card and Krueger (1995) use the fraction of affected workers to assess wage and employment outcomes of the minimum wage. The fraction of affected workers

[2]A comprehensive study is Manning (2003).

[3]The literature focuses on employment rather than unemployment because the second is thought to be latent, since the minimum wage exerts, in the first instance, an effect on the labour force participation. If individuals are discouraged to enter/stay in the labour force, the unemployment effects would understate the true effect of the policy. On the other hand, the analysis of the employment rate of particular groups is a plausible measure for the labour market effects of the minimum wage, provided adequate control for macroeconomic factors is taken. A comprehensive survey on minimum wage is Neumark and Wascher (2006).

is defined as the proportion of a given population that earns between the old and the new minimum wage. Using cross-state observations from the Current Population Survey (CPS) for the period just before and after the increase of the minimum wage, the authors show that the fraction of affected is a valid instrument to explain the "top-up" effect of the law in the average wages of teenage workers. When used to predict changes in employment, the elasticity is in most of the cases close to zero. Neumark and Wascher (1992) are among the first to introduce a state-year design: using observations from the CPS for the period between 1973 and 1989, they find negative values in the employment elasticity for teenagers (between -0.10 and -0.20) and young adults (between -0.15 and -0.20). The results of their fixed-effects model are robust to several alternative specifications. Using the same data, Card and Krueger (1995) demonstrate that the findings of Neumark and Wascher are sensitive to the inclusion of the proportion of individuals enrolled in school. By claiming that the enrolment ratio should be excluded from the estimation (since it depends on the minimum wage and not the opposite), they obtain non-negative values for the elasticity. The studies just described are the expression of the long debate about the effects of the minimum wage, which still accompanies much of the recent literature.

2.2 Linking minimum wage and immigration

One of the first studies to explore the links between minimum wage and mobility is the two-sector model of Harris and Todaro (1970), where the minimum wage is used to explain the persistence of high levels of urban unemployment in some developing countries. This framework assumes that agents take decisions in terms of expected wages. Workers continue to migrate from the rural sector until the urban expected minimum wage equals the agricultural earnings; the excess labour remains hence unemployed.

The only theoretical work that extends the Harris-Todaro framework to the context of international migration is Basu (1995); similarly, the empirical literature that explores this particular link is rather scarce. This is somewhat surprising, in light of the fact that welfare benefits are likely to influence the location choice of immigrants, as discussed by Borjas (1999). Borjas shows that immigrants are particularly responsive to welfare programs and that this can explain in part the clustering of immigrants in few States.

To date, Castillo-Freeman and Freeman (1992) is the only relevant study that investigates the relationship between minimum wage and immigration. The authors explore the changes in the migration out of Puerto Rico as a consequence of the extension of the U.S. minimum wage to the island. They document that the minimum wage impact substantially increased over the years, reaching 60% of the average wage in 1987 (this compares to less than 35% in the USA). By analysing migration and inter-industry employment patterns, the authors conclude that the increase of the minimum wage induced a movement of low-skilled workers towards the USA, preventing high levels of unemployment.

The framework presented in this paper is somewhat opposite to that of Castillo-Freeman and Freeman, in that minimum wage is studied as a pulling rather than a pushing factor. However, as effectively highlighted in their work, "Economic analysis has no clear prediction about how

the volume of migration might respond to higher minimum wages."[4]. This statement embodies the fact that the effects of the policy are ambiguous and hence immigration could increase or decrease as a consequence of the minimum wage. In the next Section, such ambiguous effects are cast into a theoretical framework that links the policy with changes in immigrants' expected wages.

3 Theoretical framework

The key feature of the model is that potential migrants take decisions in terms of expected wages, as in Harris and Todaro (1970). To keep the model as simple as possible, it is assumed that potential migrants belong to two skill groups, high (h) and low (l) skilled. At any time, high-skilled workers earn a wage above the minimum. The immigration flow to each State j at a given time can be represented by the following expression:

$$m^s_{jt} = F(\omega^s_{jt}, z_{jt}), \tag{1}$$

where $\omega^s_{jt} = w^s_{jt} e^s_{jt}$; the term ω^s_{jt} represents the expected wage of skill group s, and w^s_{jt} and e^s_{jt} are the wage and the employment population ratio of skill group $s \in \{l, h\}$ in the receiving country. The term z_{jt} represents characteristics of the State j or conditions in the sending countries. The migration function has the feature that $F_\omega(\omega, z) > 0$. At each time, and assuming that the federal minimum wage affects only the average wages, the effect on immigration can be represented by the following expression:

$$\frac{\partial m^s_j}{\partial \bar{w}} = F_\omega \frac{d\omega^s_j}{d\bar{w}}. \tag{2}$$

It is plausible to assume that $\frac{d\omega^h_j}{d\bar{w}} = 0$, i.e., the minimum wage will not affect the labour market of high-skilled workers[5]. The effect on immigration on low-skilled workers will hence depend on the magnitude and sign of $\frac{d\omega^l_j}{d\bar{w}}$, which can be decomposed into:

$$\frac{d\omega^l_j}{d\bar{w}} = \frac{\partial w^l_j}{\partial \bar{w}} e^l_j + \frac{\partial e^l_j}{\partial \bar{w}} w^l_j, \tag{3}$$

The expression 3 is unambiguously positive only if $\frac{\partial e^l_j}{\partial \bar{w}} > 0$. If this term is negative, the sign and the magnitude depend on the relative impacts of the wage and employment effects. Notice that this condition can be rewritten as: $\frac{d\omega^l_j}{d\bar{w}} > 0 \iff \frac{de^s_j}{dw^s_j} \frac{w^s_j}{e^s_j} < 1$, i.e., the labour demand elasticity is below unity. The economic rationale is that the incentive to migrate induced by higher wages might be offset by potential adverse effects on employment prospects.

[4]Castillo-Freeman and Freeman (1992, p.189) use this statement in the context of emigration. They discuss the fact that, since an increase of the minimum wage implies both a reduction in employment and an increase in wages, less-skilled workers are more likely to emigrate, while relatively more-skilled workers are less willing to move.

[5]For simplicity it is assumed that $F^l_\omega = F^h_\omega$, i.e., low- and high-skilled workers react to changes in expected wages with the same magnitude.

4 Econometric implementation

The model presented in equation 1 explains the relationship between the changes in immigration flows and the growth of expected wages. This relationship can be cast into an econometric specification that uses variations across States:

$$\frac{\Delta m_j^s}{P_j} = \alpha + \beta \Delta \omega_j^s + \Delta Z_j + \varepsilon_j^s, \tag{4}$$

where $\frac{\Delta m_j^s}{P_j}$ is the change in the immigration inflow rate, $\Delta \omega_j^s$ represents the growth in the expected wages, and Z_j is a set of covariates to control for changes in macroeconomic fundamentals of State j; ε_j^s represents a random component. The parameter of interest is β, which captures the sensitivity of the migration inflows to the growth of expected wages.

Some observations about equation 4 are necessary. First, the specification uses differences, which has the advantage of washing out fixed effects that characterize each observational unit (Dustmann et al., 2003). As an example, if immigrants move to States with persistent prosperous conditions, a regression of immigration flows on minimum wage could hide a spurious relationship or lead to an upward bias in the estimates. Using first differences allows to filter out such persistent components.

Second, the term $\Delta \omega_j^s$ is endogenous. This is because the growth of average wages and of employment population ratio are simultaneously determined by a change in the minimum wage (Card, 1992), hence creating measurement error in ω_j^s. In addition, immigration flows will lead to a simultaneity bias because they will affect equilibrium wage and employment in the destination country. To solve this problem, the expected wages are instrumented by the fraction of affected immigrants, i.e., immigrants who earn between the new and old minimum wage. Card (1992) uses the fraction of affected teenagers because this is thought to be correlated with the change in average wages, but exogenous to changes in employment. He obtains two reduced-form equations for changes in wages and changes in employment. The present work builds upon this methodology by combining wage and employment equations into a reduced form for changes in expected wages as a function of the fraction of affected immigrants:

$$\Delta \omega_j^s = a + \theta B_j^s + \upsilon_j^s. \tag{5}$$

The Appendix shows that equation 5 is obtained by exploiting the additive property of OLS. The term B represents the fraction of affected immigrants and θ captures the causal effect of the minimum wage on expected wages or, more precisely, the semi-elasticity of the expected wages with respect to the fraction of affected workers. Equation 5 is the econometric equivalent of equation 3: it is important to note that the parameter θ combines the effect of the minimum wage on both changes in the average wages and in the employment probability in a given period. This can be decomposed into the two effects. The Appendix shows that θ corresponds to the sum of the semi-elasticity of the two reduced-form equations used by Card (1992) and gives mathematical proof of the ambiguity of its sign, as previously discussed.

The third observation is that the model uses inflow rates, i.e., immigration flows divided by the

working population in each State before immigration. The use of a relative measure acknowledges the fact that immigration inflows are a function of the size of each State. As a robustness check, results are presented also for the differences in the level of immigration inflows.
A potential issue with the empirical analysis is the possibility that the policy is not exogenous with respect to the macroeconomic conditions of each State. This would be the case of a State minimum wage, where each government may decide to increase the level of the minimum wage in response to some macroeconomic events (for example, very low wages for certain groups of the population). Such a situation could lead to a spurious (perhaps negative) correlation between immigration and minimum wage, because immigrants will tend to move, *ceteris paribus*, where wages are higher. This is the reason why the analysis is focused on the federal minimum wage, the implementation of which can be thought to be exogenous to single State conditions.

5 Data description

This study focuses on the minimum wage increase that took place in 1996 and in 1997. The first increase from \$4.25 to \$4.75 took place in October 1996, followed by an increase to \$5.15 in September 1997.
The data used come from the monthly CPS for the period 1994 to 1999 and from the 1990 and 2000 Censuses. Information on wages, employment status, unemployment and the fraction of affected immigrants is extracted from the CPS. This sample yields a total of more than $10,000,000$ individual observations; this enormous amount is needed because cases of immigrants are, on average, 10% of the total sample and wage and employment information is collected only for the outgoing rotation groups (one sixth of the total). Since a limited amount of observations would create noise when deriving observations at State level, data have been pooled over the two years before and after the increase of the minimum wage. Each year starts in October and ends in September[6]. Sample weights are applied to make the data nationally representative.
From the CPS it is possible to derive different measures for hourly earnings. In this paper, two measures of hourly wages are used, which will be henceforth referred to as actual and constructed hourly wages. The actual hourly wages are derived using responses of individuals who report an hourly wage and are paid by the hour[7]. The constructed State hourly wages are obtained using information on weekly wages of workers paid at a frequency different from hourly and usual hours worked in a week. This measure is likely to be noisy, since both denominator and numerator are measured with error; however, it produces a larger amount of information. Since the effect of minimum wage is measured with higher precision with the actual hourly wages, these will be used as a benchmark in the estimation. Robustness tests will include the results using constructed hourly wages too. All wages below \$1 are excluded; values beyond \$30

[6]This particular timing allows the capturing of the exact period before the increase of the minimum wage (October 1996). The period after the increase is here computed from October 1997, although the second part of the increase in the minimum wage took place in September; this is done to allow comparability with the period before the increase and to rule out potential seasonal effects.

[7]In unreported results, the analysis has been carried out also including respondents who report an hourly rate but who are paid at a different frequency. Inferences are substantially identical.

and $40 are removed for the actual and constructed wages, respectively. This procedure is such that less than 1% of observations are censored, and it helps in moderating the measurement error. The growth of wages is defined as the difference of the log average wages before and after the increase of the minimum wage. The fraction of affected immigrants corresponds to the portion of immigrants (over the total reporting wages) who earn between the old ($4.25) and the new ($5.15) federal minimum wage in the period before the increase. The employment population ratio is defined as the proportion of employed immigrants over the working age immigrant population in each State. This excludes persons aged over 64 and under 16, but includes individuals that are enrolled in schools. The growth of employment is defined as the difference in the log of employment population ratio. The growth of expected wages is then defined as the product of the growth of wages and the growth of employment. CPS data are also used to compute wage and unemployment changes for the group of prime-age natives in each State, which are used as control variables in some of the specifications.

Data from the 2000 Census are drawn from the 5% Public Use Microdata Samples. These are used to compute immigration flows before and after the increase of the minimum wage. Flows before the increase include individuals who immigrated into the USA between January 1995 and December 1996, while flows after the increase contain immigrants who entered the USA between January 1998 and December 1999[8]. Flows include only persons who report earnings and are classified depending on their hourly wage, which is obtained by dividing the reported earnings by the hours worked in a year[9].

Since flows are likely to be measured with some error, three different "treatment" groups are defined: I) with earnings between $4.25 and $6.50; II) with earnings between $4.25 and $7.15; III) with earnings between $3.75 and $5.65. Group I is considered the benchmark for the analysis since it includes all individuals that earn between the old minimum wage and the highest State minimum wage. The lower bound of $4.25 is justified to account for the presence of sub-minimum wages or imperfect compliance. The upper bound of $6.50 is set to include individuals who migrated because of the federal minimum wage but who, after immigration, earn a State minimum wage which is higher than the federal rate and thus binding at the moment of the Census[10]. Group II consists of all individuals of group I and of immigrants who might be affected by spillover effects. The upper bound of the group is set at $2 above the federal minimum wage and hence captures potential "ripple" effects for individuals who earn a wage that is already 40% higher than the minimum. Group III includes a wage "window" that is $0.50 below the old minimum floor and $0.50 above the new one[11].

Three more groups are created, which include individuals who earn between: IV) $6.51 and

[8]Census data can only be categorized by calendar year. This creates a small mismatch between CPS and Census data. However, three months is a plausible gap if immigrants tend to respond to minimum wage changes with a lag because of, for example, delay in the circulation of information.

[9]The hours worked in a year are calculated using average hours worked in a week and the weeks worked in a year.

[10]At the end of 1999, the State minimum wage in Massachusetts was $5.25; in Alaska, Connecticut, Delaware and Rhode Island $5.65; in California and Vermont $5.75 and in Oregon $6.50. The Appendix reports the value of the State minimum wage and the dates of the introduction of the law.

[11]Robustness checks have also been conducted on the group with earnings between $4.65 and $5.65 (i.e., $0.50 above and below the new threshold). Results are very similar to those for Group III.

$9.00; V) $9.01 and $14.00; VI) $14.01 and $30.00. Each of these groups corresponds to roughly one third of the total flows of immigrants who earn wages higher than individuals above group I and will be used to implement placebo tests.
Finally, data from Census 1990 come from the Tables computed by the USA Census Office and are used to construct variables for the historical immigration, used in some specifications.

5.1 Facts about minimum wage and immigration

Table 1 presents the characteristics of different groups in the period before the minimum wage increase. The first row reports the fraction of affected workers, defined as the proportion of individuals earning between the old and the new minimum wage. About 15% of the total population earns wages between $4.25 and $5.14. When compared to other studies (e.g., Cortes, 2004), this share is relatively high; the reason is that the hourly wages used here are those reported from hourly workers, as this is thought to better capture the impact of the policy.

Table 1: Characteristics of minimum wage earners before the 1996/7 increase

	Immigrants	Total population	Women	Blacks	Hispanics	Teenagers
Fraction of affected workers	19.24	15.40	17.99	18.41	22.48	51.68
Hourly wages	8.41	9.25	8.44	8.61	7.95	5.35
Percentage less than high school	41.16	19.02	15.79	18.53	45.06	58.75
Working experience	17.62	16.04	16.57	16.48	15.20	0.22
Weekly hours worked	35.03	33.28	31.07	34.03	34.93	21.53
N	14,914	141,715	74,215	17,786	12,896	14,675

Source: monthly CPS October 1994 to September 1996. Sample weights are applied. Data refer to individuals aged 16 to 64 who report wages. The group of Blacks also includes mixed groups; Hispanic population corresponds to respondents indicating Hispanic origin, and may be of any race. Potential working experience is calculated according to educational attainment as follows: age minus 17 if less than 10^{th} grade; age minus 18 if between 11^{th} grade and High School Diploma; age minus 19 if some college; age minus 20 if Associate Degree; age minus 22 if Bachelor's Degree; age minus 24 if above Bachelor's degree.

Immigrants have a relatively high share of affected individuals (above 19%), which is slightly larger than that of the groups of women and Blacks, but slightly smaller than that of Hispanics (above 22%). Teenagers have the largest share of affected workers (above 50%); this is not surprising, given the fact that most young workers under 19 years are employed in industries where the minimum wage bites. Differences in the fraction of affected workers are reflected in the hourly wages of these groups. On average, immigrants earn slightly less than women and Blacks, but roughly $0.50 more than Hispanics. The hourly rate for teenagers is the lowest, and corresponds to roughly 60% of the population average.
Part of the gaps in the fraction of affected workers and in the hourly wages is attributed to different levels of education of the groups. If one excludes teenagers - since only a small part

of them have completed secondary education - the groups of immigrants and Hispanics have the largest share of individuals with attainments lower than high school level. This proportion is much larger than those of other groups, such as women and Blacks. In terms of working experience and hours worked, however, immigrants report a value slightly larger than other groups (except teenagers, who have basically zero working experience).
In the period under consideration, the share of affected workers differed substantially across the 51 States. This can be effectively seen from the inspection of Figure 1, which represents the proportion of immigrants who earn between $4.25 and $5.15 in each State.

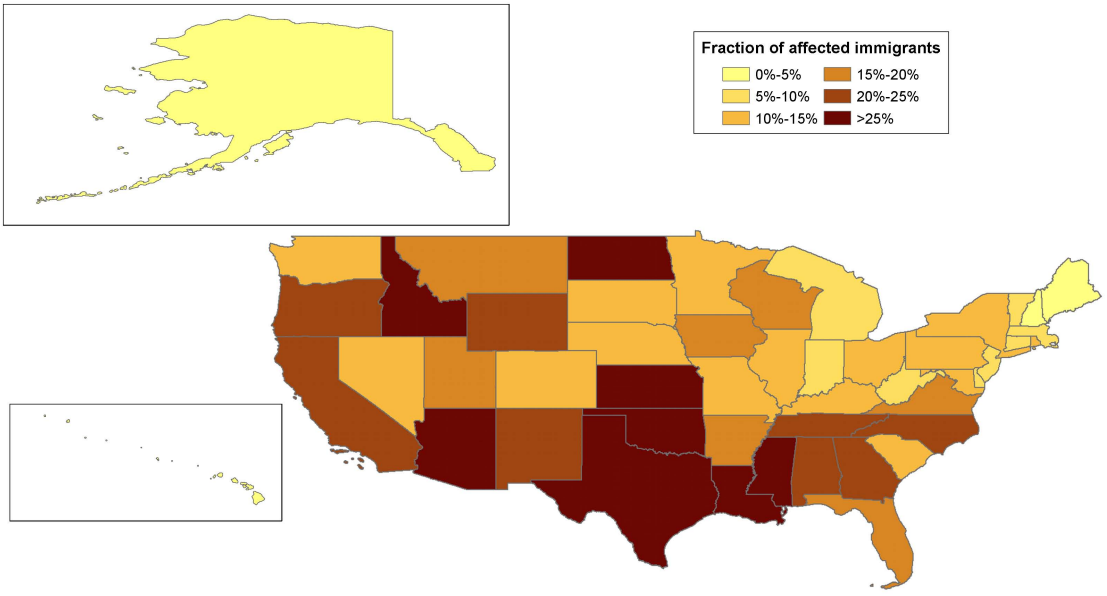

Figure 1: Fraction of affected immigrants in the 51 States
Source: CPS. Digital boundaries from http://www.Census.gov/geo/www/tiger/index.html

In all States of the Northeast region and in the Pacific (Alaska and Hawaii), the fraction of affected workers is under 10%. The Midwest region is quite heterogeneous, but shares do not exceed 20% except in two states (North Dakota and Kansas). Likewise, there are differences in the West region, with values that are, in general, higher than in the Northeast and Midwest. The region with the highest percentage is the South, where the majority of States have a fraction of affected immigrants above 20%. There are several elements that determine these differences. For example, States in the South have, in general, lower wages than the remaining areas in the USA; States in the West have higher immigration of low-wage workers than in the Northeast and the Midwest. The fraction of affected immigrants represents a functional predictor for the impact of the change in the minimum wage. To have a preliminary understanding of the magnitude of the policy, it is useful to compare wages of immigrants before and after the increase. This is done in Figure 2, which represents the kernel wage densities for immigrants in the two periods; the vertical lines indicate the minimum wage before October 1996 and after September 1997. The portion of the density in blue colour that is contained between the vertical lines represents the nationwide proportion of affected immigrants.

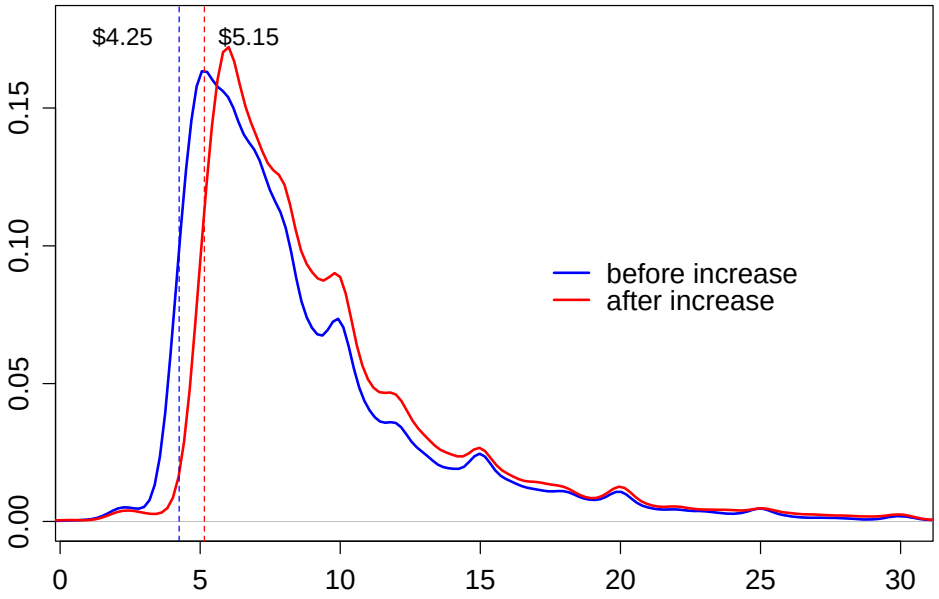

Figure 2: Kernel density of wages before and after the minimum wage increase
Source: CPS October 1994-September 1996 (before) and CPS October 1997-September 1999 (after)

Although the wage distribution does not exhibit the classic "spike" at the minimum wage level, the effect of the policy is quite substantial. This is evident from the erosion of the lower part of the wage distribution and the consequent ripple effect that shifts the density to the right. The average wage of immigrants increased from \$8.41 before the change to \$9.42 after the new minimum wage was set. Assuming that, in the period under scrutiny, the minimum wage was the only determinant of wage growth, the policy determined an increase of about 12%. For comparison, wages of teenagers grew by about 16% in the same period. This is due to the fact that a wider fraction of teenagers gain from the minimum wage increase and this leads to a larger increase in the average hourly wage.

It is insightful to describe what has happened to immigration patterns before and after the change of the minimum wage. In the 1990s, as in the previous two decades, immigration to the USA increased substantially (Clark et al., 2002). The fact that recent immigrants have tended to concentrate in a few locations, where previous immigrants settled, is well documented (Bartel, 1989). However, in the 1990s, immigration became less focused and immigrants began to diffuse in a wider range of locations, as is shown in the case of Mexican immigration studied by Card and Lewis (2005). This process of diffusion can be observed through the dynamics of the flows across States.

Table 2 reports the immigration flows before and after the change of the minimum wage both nationwide and for the top twelve destinations[12]. Entries in the left-hand panel refer to immigrants of group I (i.e., low-wage workers), while the right-hand panel reports figures for the total of groups IV, V and VI (i.e., higher wage workers). For each skill group, the change in

[12]These States represent more than 70% of total flows in both periods and roughly 53% of the total working-age population before the minimum wage increased.

the inflow rate (i.e.,$\frac{\Delta m_j^s}{P_j}$) is reported. Although the inflows of both groups increased by about the same amount (90,000 individuals), the dynamics were substantially different. The inflow rate of low-wage workers in the top five States (which are also the major immigration ports of entry) increased at a rate similar to the national average, except for New York, where there was a decline of 0.01%. Flows of higher-wage individuals in the top five States, on the other hand, increased by less than the national rate, with the exception of Illinois. In particular, there was a substantial decrease in the flows to New York. The small increase of the inflow rate in the top destinations was balanced by the relatively large growth in other destinations. The growth of the inflows in four States (Georgia, Massachusetts, North Carolina and Virginia) accounted for roughly one third of the nationwide increase.

Table 2: Immigration in the twelve top destination States, by selected groups

State	Working age pop in 1995	Group I			Group IV, V and VI		
		Flows in 1995/96	Flows in 1998/99	Δ inflow rate (%)	Flows in 1995/96	Flows in 1998/99	Δ inflow rate (%)
USA	166,126,915	273,055	360,879	0.053	905,724	996,417	0.055
California	19,966,667	63,895	75,999	0.061	169,467	173,519	0.020
Texas	11,940,420	35,373	41,814	0.054	84,650	88,466	0.032
New York	11,569,819	28,915	27,730	-0.010	101,368	87,926	-0.116
Florida	8,631,746	28,118	33,227	0.059	84,895	83,187	-0.020
Illinois	7,477,960	14,599	18,308	0.050	50,528	55,811	0.071
New Jersey	5,070,594	11,800	14,575	0.055	45,696	47,163	0.029
Georgia	4,667,591	8,050	14,142	0.131	30,356	41,184	0.232
North Carolina	4,567,214	6,797	13,971	0.157	23,401	31,786	0.184
Virginia	4,243,680	4,505	6,831	0.055	21,637	27,675	0.142
Massachusetts	3,887,229	4,470	6,590	0.055	27,080	34,080	0.180
Washington	3,462,704	4,794	7,474	0.077	20,886	22,912	0.059
Arizona	2,587,427	8,252	11,585	0.129	20,349	21,793	0.056

Source: flows from Census 2000; population derived from CPS October 1994 to September 1996. Sample weights are applied. Flows before the minimum wage change refer to years 1995 and 1996; flows after the change refer to years 1998 and 1999. All flows consist of immigrants aged 16 to 64 who report earnings in the Census.

6 Analysis

This Section presents the results of the estimation; the Subsections report the estimates for the first stage regression (Subsection 2.6.1), for the second stage (Subsection 2.6.2) and for the robustness checks (Subsection 2.6.3).

6.1 Estimation of the growth of expected wages

The results from the first stage regression are represented in Figure 3, which plots the growth of expected wages against the fraction of affected workers, along with the regression line and its 95% confidence interval. The graph also reports the labels of largest immigration States and potential outliers.

The slope of the line - which represents the estimate for θ - is 0.445 (s.e. 0.110). The explanatory power of the fraction of affected is substantial, given the fact that the R^2 is about 0.25. The graph effectively represents the fact that the larger the fraction of affected immigrants, the larger, *ceteris paribus*, the growth of the expected wages. Using the additive property of OLS, it is possible to isolate the contributions of the fraction of affected on the wage and employment growth. These are represented in Figure 4. The results of the estimation of equation 5 are presented in this Subsection. This corresponds to a first stage where the growth of expected wages is regressed on the fraction of affected immigrants. Throughout the analysis, regressions will be weighted by the stock of immigrants in each State; this is done with the aim of controlling for the precision with which observations are measured. Un-weighted results will also be presented.

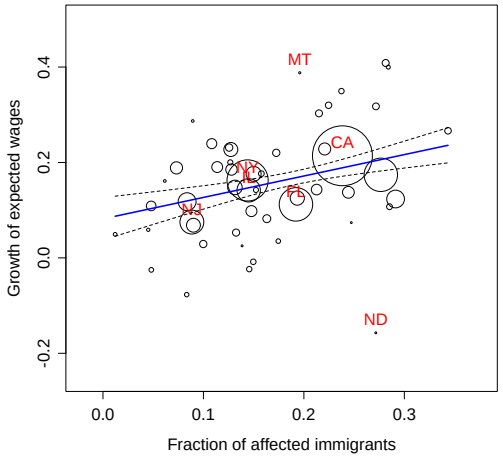

Figure 3: Weighted regression plot of equation 5

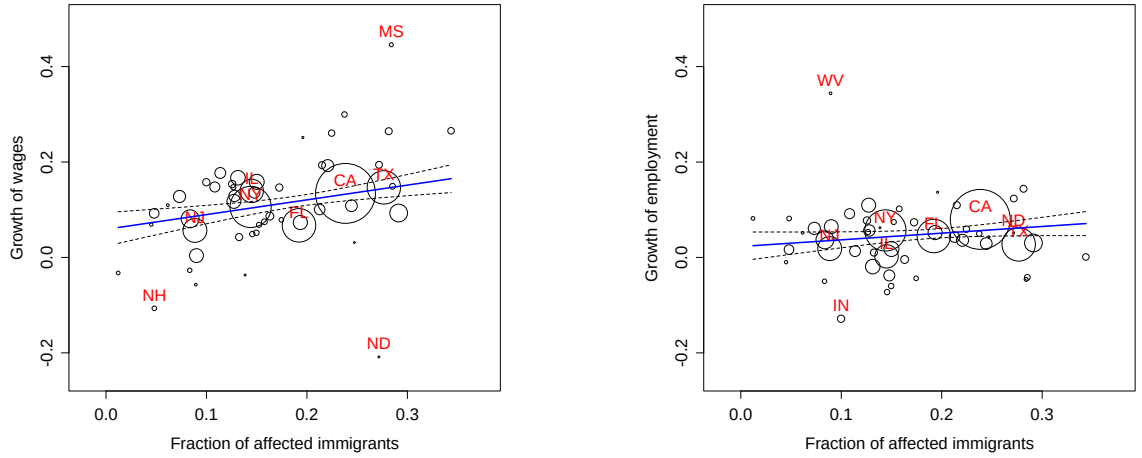

Figure 4: Wage and employment growth and fraction of affected immigrants

The slopes for wage and employment growth are 0.309 (s.e. 0.087) and 0.140 (s.e. 0.076) respectively, which means that an increase in the fraction of affected immigrants of 0.1 implies a growth of 0.031 for wages and of 0.014 for employment. The wage growth overstates the growth

of wages in the economy (16.3%) and this can be attributed to spillover effects. The result for employment growth indicates that, in the period under consideration, the minimum wage had positive effects on the employment of immigrants. This result is comparable with the study for consequences on teenage employment by Card and Krueger (1995), although their estimates are somewhat smaller. One explanation is that wages of immigrants are affected by factors omitted in the simple regression. Hence, in Table 3, a series of alternative specifications is presented. Column (a) reports the estimates of the parameter θ for the benchmark case just outlined. Specification (b) is the un-weighted regression of model (a); the estimates are 12 percentage points larger than the benchmark. From Figure 4 it can be seen that, by ignoring weights, the wage contribution would be much larger, yielding a higher slope. A comparison of the measures of fit suggests that the benchmark model is preferred, as it attributes less weight to outlying observations.

Table 3: OLS regression of expected wage growth

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Fraction aff.	0.449***	0.578***	0.488***	0.444***	0.434***	0.415***	0.413***
	(0.110)	(0.206)	(0.127)	(0.111)	(0.110)	(0.104)	(0.106)
Unempl.				–0.032			–0.004
				(0.050)			(0.049)
Wages					–0.292		–0.041
					(0.232)		(0.247)
CPI						0.046***	0.044**
						(0.016)	(0.019)
Constant	0.082***	0.058	0.082***	0.075***	0.105***	–0.206*	–0.194
	(0.022)	(0.037)	(0.019)	(0.025)	(0.029)	(0.103)	(0.126)
R^2	0.25	0.14	0.23	0.26	0.28	0.36	0.36
N	51	51	51	51	51	51	51

Standard errors in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%. The reported coefficient refers to the fraction of affected immigrants. All models except (b) are weighted by the stock of foreign-born population in each State. The macroeconomic controls are all measured in terms of their growth.

Model (c) uses constructed hourly wages; the coefficient is four points larger than in (a). This is explained by the fact that, although the average growth of constructed wages is slightly smaller than that of actual wages (10% vs 12%), the average fraction of affected immigrants is substantially smaller (14% vs 19%); hence the coefficient needs to be larger to explain the wage growth. Models from (d) introduce macroeconomic variables to control for unobserved changes in the economy that could be omitted by the benchmark case. These are the growth of unemployment rate and of native wages in each State and the growth of the regional Consumer Price Index (CPI)[13]. Only the CPI is statistically significant for explaining the wage growth of immigrants, but this does not affect substantially the estimate of θ, even when the control variables are estimated jointly. Interestingly, while the growth of unemployment rate has the expected sign, the wage growth of natives is negative, although it becomes essentially zero when all control variables are included.

[13]Historical CPI data are downloaded from the website http://www.bls.gov/cpi/. The values of this index are only available for the four macro regions: West, Midwest, Northeast and South.

The results presented above robustly support the fact that the increase in the minimum wage, as measured by the fraction of affected immigrants, leads to a substantial growth of expected wages. This large increase is attributable to the fact that, in the period under analysis, the minimum wage did not have negative effects on employment. The estimates imply a labour demand elasticity of 0.30, which is directly comparable with the value of 0.45 derived from the specification in the study by Card and Krueger (1995) that is mostly similar to the one in Table 3. The Appendix reports the derivation of this elasticity[14].

6.2 Estimation of the change in immigration flows

In this Section, the second stage of the model is estimated. This corresponds to estimating the regression equation 4, with the growth of expected wages instrumented by the fraction of affected workers. The aim is to obtain an estimate of the coefficient β, which measures the sensitivity of the change of the migration inflow rate with respect to the growth of expected wages.

Before presenting the results of the regression, it is useful to illustrate the problem of endogeneity and the need for using the instrumental variable approach. In Figure 5, the relationship between the growth of immigration inflow rate and the expected wages is represented. The left-hand panel contains the expected wage growth as calculated from the data (and hence endogenous); the right-hand panel represents the predicted values from the first stage. In both graphs the regression line and its 95% confidence interval along with the 95% prediction bands are represented. The graphs reveal that if the endogenous variable were used, the relationship would be basically non-existent. On the other hand, the relationship becomes positive when the predicted values of the growth of expected wages are used, with an estimate of β of about 0.005 (s.e. 0.002). These estimates are insensitive to the exclusion of the outliers represented by the observations outside the 95% prediction interval.

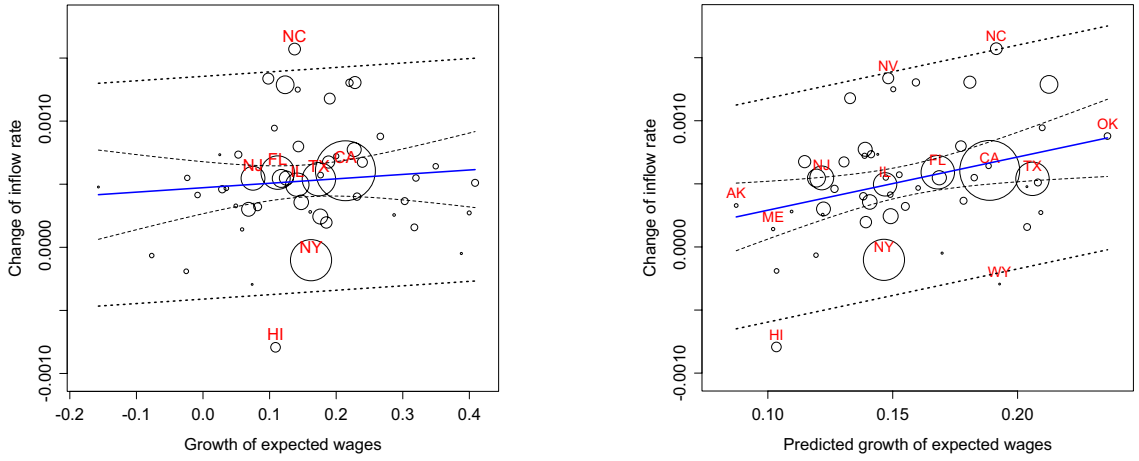

Figure 5: Change in the immigration inflow rate and growth of expected wages

[14]The value of 0.46 can be derived from the estimates contained in columns (1) and (3) of Table 4.4 panel B, page 128 of Card and Krueger (1995).

To better understand the economic impact of the estimates, some examples are useful. The average increase in the inflow rate for the wage group I is 0.052%. In States such as Maine, where the predicted growth of expected wages is 10%, the immigration inflow as fitted by the regression line is relatively low (the change was 0.017%). In States such as California, where wages grew by about 19%, the regression line predicts an inflow rate change of 0.062%. This means that 9 percentage points growth of expected wages contributed to an inflow rate change that is 0.045% larger. In other words, if the expected wages in California grew by 10% only, there would have been, *ceteris paribus*, an inflow of about 3,000 low-wage immigrants against the actual 12,000.

The results of the second stage regression are reported in Table 4 for all models presented in Table 3 and for additional specifications. For illustration purposes, all estimates and standard errors, except those in column (h), are multiplied by a factor of 100. The comparison of columns (a), (b) and (c) reveals that the un-weighted estimates yield a smaller coefficient than the benchmark case while using the measure for constructed wages produces a larger value. On the other hand, the introduction of macroeconomic controls does not change substantially the value of the estimates, as can be seen from the models (d) to (g). It is interesting to note that, while the wage growth of natives is an important factor in explaining cross-states differences in the change of the inflow rate, the growth of unemployment rate and the CPI are not, although they both have the expected sign. In columns (h) and (i) the specifications for the immigrants in the wage groups II and III are presented. The reported value of β for group II is larger than the benchmark case. Since the upper limit of this group is \$2 larger than the federal minimum wage, it is possible that the presence of spillover effects also attracts immigrants who earn above the minimum wage. Consistently, the coefficient for group III is smaller than that for group I. This can be explained by the fact that the minimum wage window is narrower (the upper limit is \$5.65) and this would exclude all immigrants who were earning the State minimum wage at the moment of the Census[15]. Column (j) includes the concentration of immigrants in 1990, defined as the stock of foreign-born divided by the population in each State at the time of the 1990 Census. The rationale of adding this variable is to control for the presence of fixed effects that are not captured by using first differences. The estimate of β is actually larger than the benchmark case. The coefficient for the historical immigration concentration is negative although not significant. At first sight, the negative sign might appear a strange result, considering the tendency of new immigrants to move to where previous foreign-born populations had settled. However, it is important to recall the fact that the dependent variable in question is the change in the inflow rates. Hence, this means that flows grow relatively more in locations where immigration was historically lower[16]. This fact is also documented by Card and Lewis (2005) who found that Mexican immigrants (who represent the largest share of low-wage immigrants) progressively settle away from traditional immigration gateways. Finally, in column (k) inflows

[15]For example, California has had a minimum wage of \$5.75 since March 1998.

[16]On the other hand, flows are highly correlated with historical stocks. As an example, a regression of the inflow rate after the minimum wage change (i.e., $\frac{m^s_{j1}}{P_{j1}}$) on the 1990 immigration concentration would yield an R^2 over 0.40.

Table 4: IV regression of change in the inflow rate of immigrants (coefficients × 100)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Expected wages growth	0.525**	0.327*	0.695**	0.507**	0.590***	0.550**	0.576**	0.668***	0.420**	0.694**	1.960*
	(0.220)	(0.178)	(0.290)	(0.216)	(0.224)	(0.242)	(0.229)	(0.256)	(0.166)	(0.273)	(1.080)
Unempl.				–0.057			–0.058	–0.045	–0.033	–0.068	0.000
				(0.044)			(0.044)	(0.049)	(0.032)	(0.048)	(0.210)
Wages					0.568**		0.546**	0.673***	0.212	0.184	–1.388
					(0.221)		(0.220)	(0.246)	(0.160)	(0.395)	(1.456)
CPI						–0.015	–0.004	–0.006	–0.017	–0.004	–0.036
						(0.020)	(0.020)	(0.022)	(0.014)	(0.022)	(0.104)
1990 immig. conc.										–0.222	
										(0.194)	
Constant	–0.037	0.003	–0.053	–0.048	–0.087*	0.055	–0.074	–0.076	0.064	–0.043	0.002
	(0.037)	(0.028)	(0.044)	(0.036)	(0.046)	(0.108)	(0.116)	(0.130)	(0.084)	(0.130)	(0.007)
DWH test	9.73	5.07	15.07	10.59	10.83	10.68	14.35	13.40	15.69	16.63	5.36
p-value	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
N	51	51	51	51	51	51	51	51	51	51	51

Standard errors in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%. The reported coefficient refers to the growth of expected wages. The dependent variable is the change in immigration inflow rate except (k), where the difference in inflows is measured in levels. All models except (b) and (k) are weighted by the stock of foreign-born population in each State. The macroeconomic controls are all measured in terms of their growth. The DWH test statistics reports the values of the augmented regression test and its p-value.

rather than inflow rates are used in a regression without weights[17]. Obviously the estimates are not comparable with those of the previous models, but they constitute a robustness test which demonstrates that, even without controlling for population size, the results are similar. The table also reports the values of the Durbin-Wu-Hausman (DWH) test for endogeneity. The null hypothesis is that the OLS estimator is consistent (under the assumption that the instrument is valid). The test is carried out by augmenting the second stage regression with the residuals of an ancillary regression in which the endogenous variable is regressed on all exogenous covariates (including the instrument). If the parameter accruing to the residuals is significantly different from zero, then the null is rejected. As can be seen, the hypothesis that OLS is consistent is strongly rejected in all specifications.

6.3 Placebo tests

A counterfactual analysis of the previous results can be obtained by testing the effect of the policy on groups that are thought to be excluded by the treatment. This Section presents placebo tests using the wage groups IV, V and VI. These are groups formed by immigrants who earn a wage higher than the minimum and hence other factors, such as the change in macroeconomic characteristics, are expected to explain cross-state differences in their inflow rates. The regressions below present the results for models with and without control variables. The results consistently demonstrate that the growth of expected wages - as instrumented by the fraction of affected immigrants - is not significant in explaining the change in the inflow rate of immigrants with earnings higher than the minimum wage. On the other side, the growth of prime-age native wages is very important in explaining the change in the inflow rate for group IV and V, while unemployment is very important for VI; the CPI has the expected sign only for group IV, but none of the estimates is significant.

Table 5: Placebo tests (coefficients × 100)

	Group III)		Group IV)		Group V)	
Expected wages growth	–0.058	0.011	0.073	0.106	0.092	0.064
	(0.156)	(0.141)	(0.160)	(0.169)	(0.146)	(0.145)
Unempl.		–0.013		–0.025		–0.087***
		(0.027)		(0.032)		(0.028)
Wages		0.620***		0.379**		0.128
		(0.135)		(0.163)		(0.140)
CPI		–0.001		0.002		0.010
		(0.012)		(0.015)		(0.013)
Constant	0.000	–0.000	–0.000	–0.001	0.000	–0.001
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
N	51	51	51	51	51	51

Standard errors in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%. The reported coefficient refers to the growth of expected wages. All models are weighted by the stock of foreign-born population in each State. The macroeconomic controls are all measured in terms of their growth. See text for a definition of the wage groups.

[17]When the dependent variable is in level, weights would tend to overestimate the value of the parameter.

7 Discussion and final remarks

The present paper studies an unexplored aspect of the minimum wage: its pulling effect for immigrants. The investigation of the linkages between migration and the minimum wage is of particular relevance in the context of recent socio/economic events that occurred in the US. The immigrant population rose systematically during the 1990s and as of 2000 the share of immigrants exceeded 11% of the total population[18]. In parallel to these events, the history of minimum wage legislations also experienced remarkable changes: after a steady decline in the 1980s, the two increases in 1991/1992 and 1996/1997 contributed to bring back the real value of the minimum wage to the level of 1980.

There are two main findings in this study: first, in the period under consideration, the minimum wage contributed significantly to the increase of the average wages of immigrants. In addition, there seems to be a positive effect on employment, and this result supports the hypothesis that there are frictions in the labour market which can be alleviated through the policy. These positive effects on the labour market outcomes have increased the gains that potential immigrants could attain by an average of 15% (as measured by the increase in the expected wages). The second result is that low-wage immigrants are responsive to the growth of expected wages. This quantity, as instrumented by the fraction of affected workers, robustly predicts cross-section differences in the change of inflow rates. Groups of immigrants who earn more than the minimum wage are instead insensitive to the expected gains produced by the policy.

There is much more to learn about immigration and minimum wages. The empirical analysis in this paper exploits a quasi-natural experiment consisting of an exogenous change in the policy, and hence is focused on the federal minimum wage. However, changes in the federal law are quite rare and hence future studies that want to look at this relationship should concentrate in a panel data design which contains both data across States and over time, as done in previous studies that investigate unemployment effects on teenagers (Burkhauser et al. 2000; Neumark and Wascher 1992). This approach would have two advantages: first, the cross-State data in the recent decades have been enriched by the presence of many States which set their own minimum wage and which have different immigration dynamics. The panel data design will be useful to accurately control for State fixed effects. Second, minimum wages effects are interesting also when the nominal wage does not change; the model in the present paper predicts that the erosion of the nominal value will lead to a decrease in the expected wages of immigrants. Analysing the consequences on immigration of a decline in the real minimum wage is an interesting question to be explored in light of the fact that the federal minimum stood at the same level for nearly 10 years[19]. Hopefully this study will provide useful prescriptions for a better planning of policies related with immigration and with the minimum wage. The present paper demonstrates the

[18] Data from Census 2000. In terms of civilian population, the CPS reveals that this figure is just above 10%, due to their different definitions.

[19] The federal rate was recently increased by a new minimum wage bill which established a three-stage increase: \$5.85 after July 2007; \$6.55 after July 2008; \$7.25 by August 2009. This corresponds to an increase in the nominal wage of more than 40%. On the other hand, during the past decade, several States passed laws that introduced a rate higher than the federal: in 1997 only 7 States adopted their own minimum wage; by 2006 this number was 18.

existence of an important relationship, and policies intended to cope with the growing concentration of foreign-born, such as the monitoring of migration levels and the provision of social services, should take into consideration the fact that the minimum wage is an important asset for low-wage earners, capable of inducing them to move to another country.

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Appendix

a) *Derivation of equation 5*

The growth of expected wages can be decomposed into wage and employment growth as follows:

$$\Delta\omega_j^s = \Delta w_j^s + \Delta e_j^s, \tag{A1}$$

where Δw_j^s and Δe_j^s are the log difference of average wages and employment population ratio, respectively. Following Card (1992), the equations for labour demand and the reduced form for wage growth can be defined as:

$$\Delta e_j^s = a + \eta\Delta w_j^s + \nu_j^s, \tag{A2}$$

$$\Delta w_j^s = \alpha + \lambda B_j^s + \zeta_j^s. \tag{A3}$$

The term B_j^s is exogenous and hence can be used to estimate Δw_j^s; the predicted value is then inserted in the equation for the change in employment to obtain:

$$\Delta e_j^s = a + \eta\alpha + \eta\lambda B_j^s + \eta\zeta_j^s + \nu_j^s. \tag{A4}$$

To obtain equation 5, substitute A3 and A4 into A1 and use the OLS additive property:

$$\Delta\omega_j^s = c + \theta B_j^s + \upsilon_j^s, \tag{A5}$$

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

b) *Derivation of elasticity*

The parameter η corresponds to the elasticity of the labour demand, $\eta \approx \frac{d(\Delta e_j^s)}{d(\Delta w_j^s)}$. This is because:

$$\Delta w^s = \log\left(\frac{w_1^s}{w_0^s}\right) \approx \frac{w_1^s - w_0^s}{w_0^s} = \frac{\Delta w}{w_0^s}$$

$$\Delta e^s = \log\left(\frac{e_1^s}{e_0^s}\right) \approx \frac{e_1^s - e_0^s}{e_0^s} = \frac{\Delta e}{e_0^s}$$

c) *Sign of θ*

Appendix a) has shown that θ depends on λ and η; the sign is however ambiguous. This is because, although the minimum wage has unambiguous positive effect on the average wages (i.e., $\lambda > 0$), its sign depends on η.

If $\eta < -1$, i.e., 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 wages, but the increase of λ will be slowed down, i.e., $\theta < \lambda$.

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, i.e., are measured along the supply curve, as in the case of monopsonistic labour markets.

d) *Mechanism of the fraction of affected immigrants*

For illustration, and following what Card (1992) did for the teenagers, consider how much of the wage increase to comply with the new minimum wage is predicted by the fraction of affected immigrants. The average wage in the economy after the minimum wage change is \$5.23. This value is larger than the federal minimum wage because during the period under consideration some States passed a law that increased the minimum wage to a value higher than \$5.15 and thus this weighted average takes into account the different times of the introduction of state and federal laws. The average wage of minimum wage immigrant workers in the period 1994/1996 was \$4.71; in order to comply with the new average minimum wage, average wages have to increase by 11%. Since the average fraction of affected immigrants was about 19%, one would expect wages to grow by $0.11 \times 0.19 = 2.09\%$. Instead, the growth of average wages was 11.75% (from \$8.41 to \$9.42); average wages grew for other reasons, but at least in the short run, one can assume that these causes are not State-specific. If so, they will be absorbed by the constant of the reduced form regression of wage growth on the fraction of affected workers. As shown in the text, the regression of equation A3 for wage growth yields a coefficient of the fraction of affected of about 0.31; by multiplying this result by the fraction of affected immigrants, one obtains a prediction of wage growth equal to 5.89%. This overestimates the "expected" increase by a factor of 5.89/2.09 = 0.31/0.11. = 2.82. This is somewhat higher than the value found by Card (1992), i.e., 0.15/0.088 = 1.70. This over-prediction can be ascribed to several factors: inspection of the data reveals that this overestimate is partially attributable to spillover effects.

e) *States with different levels of the minimum wage*

State	**Minimum wage**	**Date of introduction**
Alaska	5.65	Sep 1997
California	5.75	Mar 1998
Connecticut	5.65	Jan 1999
Delaware	5.65	May 1999
Hawaii	5.25	Jan 1994
Maine	5.25	Jan 1997
Oregon	5.50	Jan 1997
	6.00	Jan 1998
	6.50	Jan 1999
Rhode Island	5.65	Jul 1999
Vermont	5.25	Jan 1998
Washington DC	6.15	Jan 1998