Gender, Selection into Employment, and the Wage Impact of Immigration

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- Immigrant supply shocks are typically expected to reduce the wage of comparable workers

- Natives may respond to the lower wage by moving to markets that were not directly targeted by immigrants and where presumably the wage did not drop

- This paper argues that the wage change observed in the targeted market depends not only on the *size* of the native response, but also on *which* natives choose to respond

1. Introduction

- All other things equal, an immigration-induced increase in the size of the workforce is expected to reduce the wage of comparable workers

- One key insight from this literature is that native workers may respond to the supply shock by moving to labor markets that were not directly affected by immigration and where presumably the wage did not drop

- This paper argues that this approach to understanding how the native response biases the measured wage impact of immigration is incomplete

- We document the empirical relevance of this type of selection bias by examining how immigration differentially affected the employment and wages of men and women in the French labor market

- **Figure 1** illustrates key trends in the size and gender composition of the foreign-born labor force in France

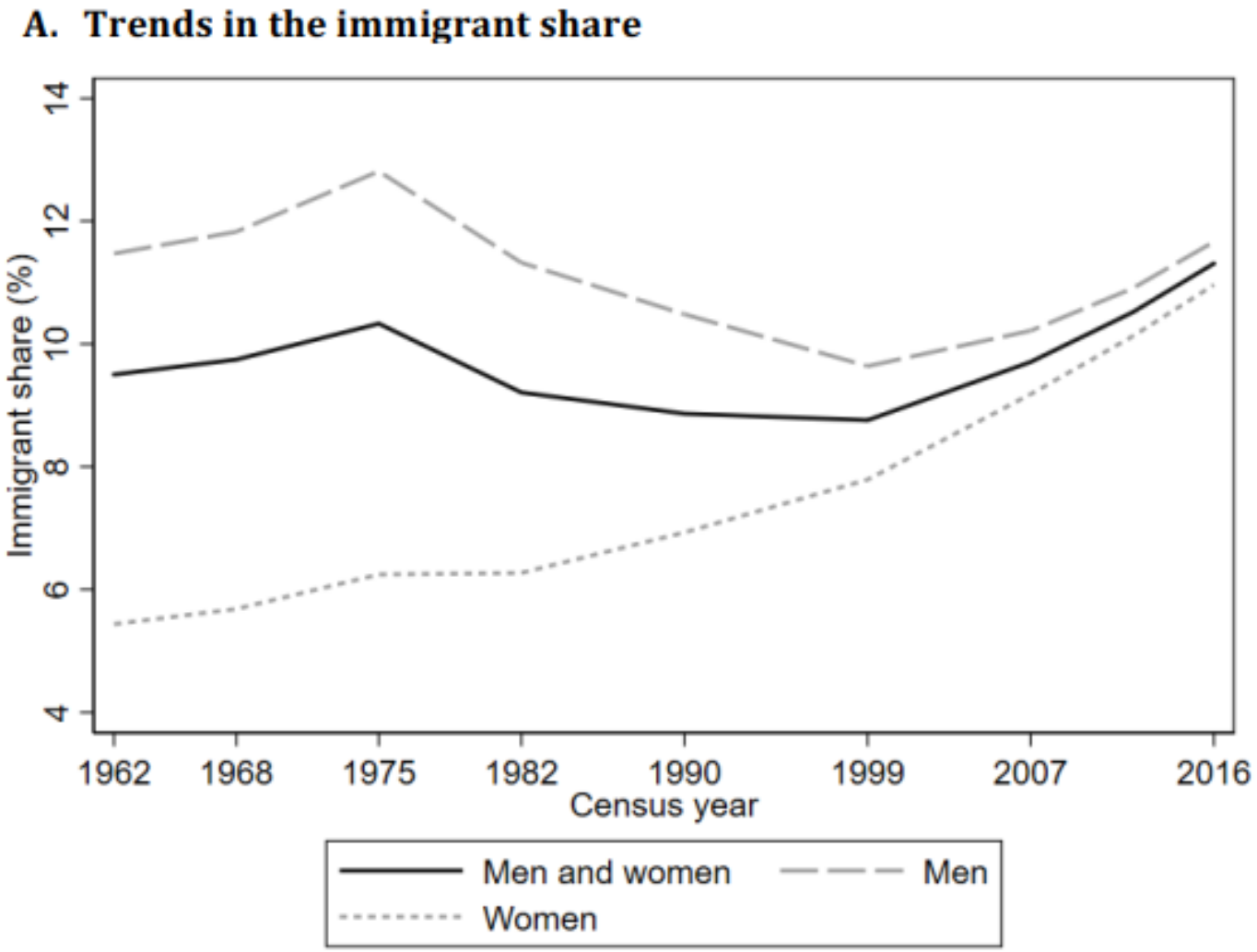
- The *top panel* of the figure shows how the policy shift led to an immediate decline in the immigrant share of the labor force

- The *bottom panel* of **Figure 1** further demonstrates the feminization of French immigration by contrasting the French experience with that of the United States

- It is important to emphasize that family reunification was not the only factor driving the rapid feminization of the immigrant labor force in France

- Our study is guided by a theoretical framework that isolates the three key channels through which an immigrant supply shock changes the observed mean wage in a labor market

Figure 1: Immigration and gender in France

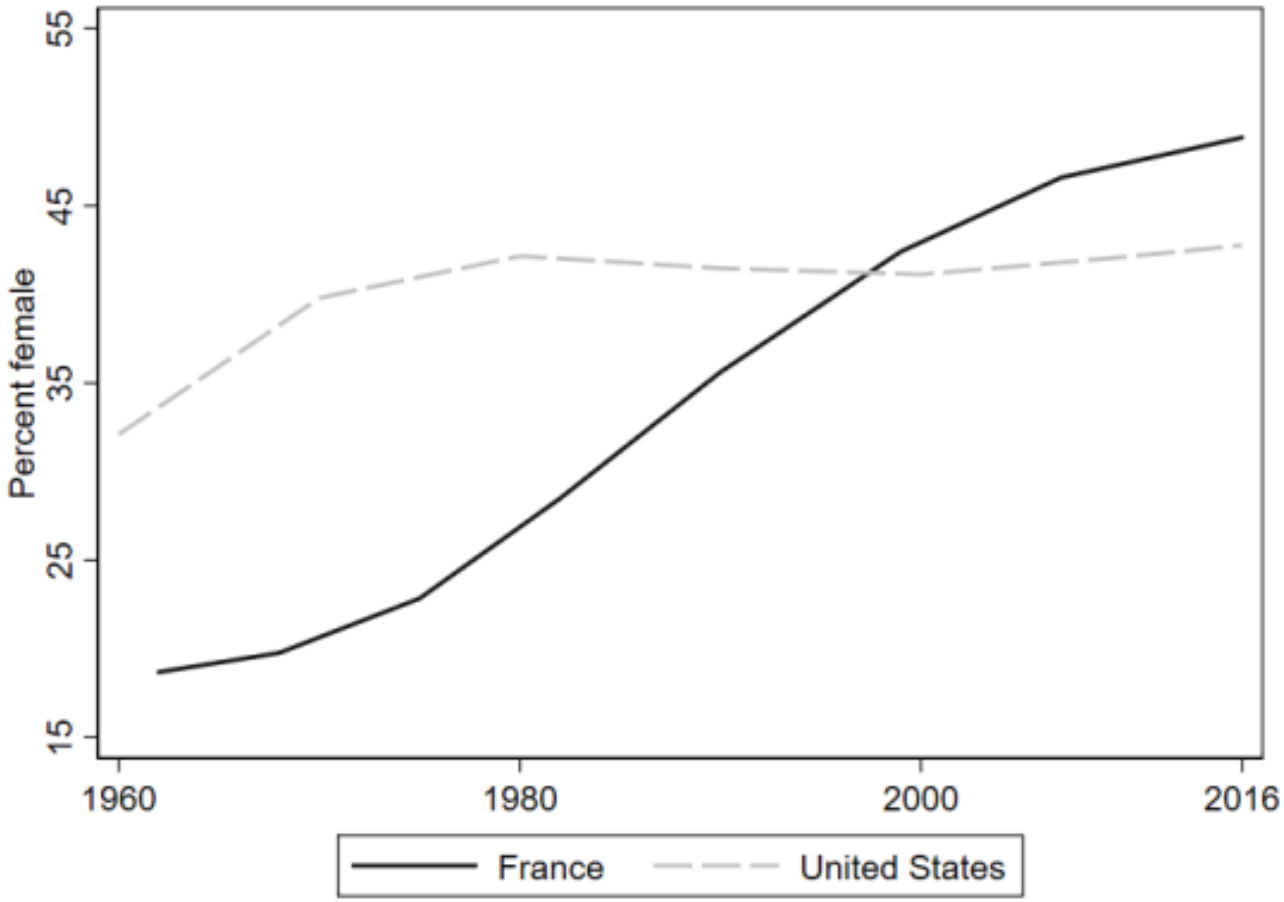


Source: INSEE, French censuses; IPUMS, USA decennial censuses and American Community Surveys

Cont.

Figure 1: Immigration and gender in France

B. The feminization of the immigrant labor force, France v. USA



Source: INSEE, French censuses; IPUMS, USA decennial censuses and American Community Surveys

- Our empirical study uses data from various French population censuses merged with information on labor market outcomes from the Labour Force Surveys (LFS) in the 1982-2016 period

- We show that the *"zero wage elasticity"* implied by the raw data for French women is partly an artifact of selection bias

- It is crucial to note, however, that the approach of measuring the wage impact of immigration by tracking the wage of labor force "survivors" does not solve the selection problem

- Our conceptual framework and empirical analysis have implications that extend beyond the French context

The paper is organized as follows:

- **Section 2** describes the data used in the analysis and documents the striking gender asymmetry in the wage and employment impact of immigration in France

- **Section 3** derives a theoretical framework that combines a model of labor demand with a model of an individual's decision to participate in the labor force, delineating the distinct channels through which immigration affects wages

- **Section 4** introduces the econometric framework, and describes the instruments used to control for the endogeneity of key variables as well as the selection correction

- **Section 5** reports the main empirical results and evaluates the sensitivity of our findings to a number of alternative model specifications

- **Section 6** expands the empirical analysis by documenting the wage impact of immigration across different skill groups

- **Section 7** summarizes the results and draws some conclusions

2. Data and Descriptive Evidence

- Our analysis of the French labor market uses data drawn from population censuses and the Labour Force Surveys (LFS) conducted by the French National Institute for Statistics and Economic Studies (INSEE)

- The annual LFS reports wages at the individual level beginning in 1982. Our empirical analysis of the wage impact of immigration thus covers the 1982-2016 period

- Our empirical analysis mostly focuses on the monthly wage of full-time native workers to have a more precise measure of the "price of labor"

- Our sample is restricted to persons aged 18-64 living in European France

- **Table 1** summarizes some of the key characteristics of our data
- **Figures 2A** and **2B** document the asymmetric relationship between immigration and wages for native men and women in France
- The data, illustrated in **Figure 2**, provide further evidence of the gender asymmetry in the labor market impact of immigration
- **Figures 2C** and **2D** show a strong negative correlation between employment rates and immigration for native women, but essentially a zero correlation between employment and immigration for native men
- The raw data suggest an important interaction between gender and the observed labor market impact of immigration on employment and wages
- In sum, the descriptive evidence reveals a conspicuous gender asymmetry in the labor market impact of immigration on French workers

Table 1: Descriptive statistics

	1962	1968	1975	1982	1990	1999	2007	2016
	A. French census data							
Immigrant share	9.50	9.75	10.33	9.21	8.86	8.76	9.71	11.31
Immigrant share, women	5.44	5.68	6.25	6.27	6.93	7.79	9.18	10.96
Immigrant share, men	11.47	11.83	12.81	11.32	10.48	9.64	10.22	11.66
Employment rate of female natives	37.15	40.08	47.55	51.51	56.40	62.19	67.76	70.06
Employment rate of male natives	89.43	87.36	86.62	81.05	77.34	75.47	75.45	73.64
	B. French labor force survey data							
Average wage of female natives	-	-	-	1626.8	1639.1	1746.2	1846.7	1896.3
Average wage of male natives	-	-	-	2049.8	2014.7	2047.9	2168.8	2213.6
Employment rate of female natives	-	-	-	55.18	56.60	61.73	63.57	65.83
Employment rate of male natives	-	-	-	83.41	78.69	76.28	71.55	70.42
Observations	-	-	-	32,446	78,531	83,311	59,414	75,446

Notes: The table uses data drawn from the French censuses (Panel A) and the French Labour Force Surveys (Panel B). The immigrant shares are computed using the sample of persons in the labor force and are defined as $\log(1 + M/N)$, where M and N give the number of foreign-born and native labor force participants, respectively.

Figure 2: Immigration, wages, and employment of native men and women

Figure 2A

Figure 2B

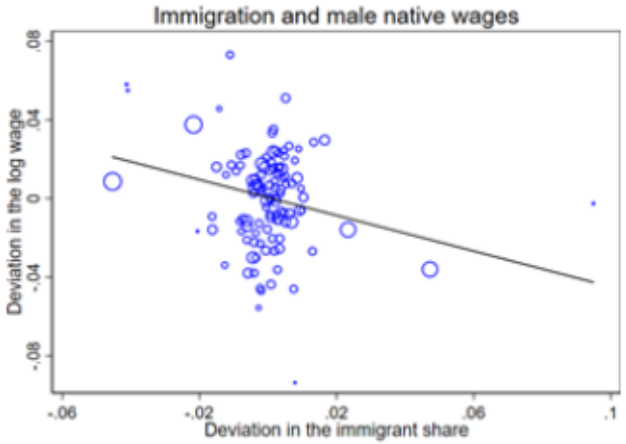


Figure 2C

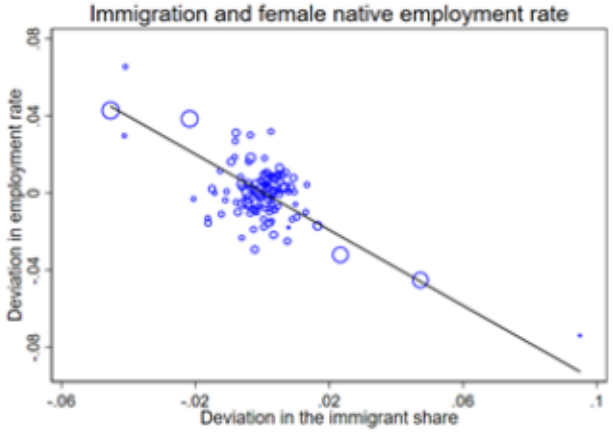
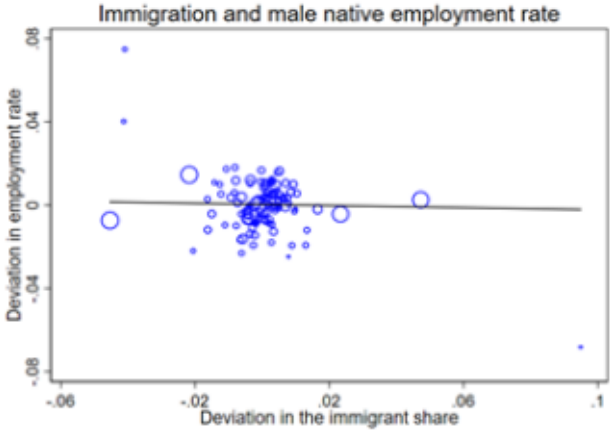


Figure 2D



Source: INSEE, French censuses

3. Theoretical Framework

- We illustrate the conceptual importance of the selection bias that contaminates the wage effect of an immigrant supply shock by focusing on a two-period model where natives choose whether or not to participate in the labor force

- A standard labor demand framework that assumes a Cobb-Douglas aggregate production function with labor and capital as inputs implies that the *market* wage in the pre-migration period is given by:

$$\log w_{k0} = \varphi_{k0} + \eta \log N_{k0}\,, \qquad (1)$$

- The *individual* earnings function giving the wage for person i in the pre-migration period depends not only on market conditions, but also allows for variation in individual wages because of differences in (observable and unobservable) characteristics captured by a variable ϵ_{i0}:

$$\log w_{ik0} = \varphi_{k0} + \eta \log N_{k0} + \epsilon_{i0}\,, \qquad (2)$$

- The individual earnings function for native workers in market *k* in the post-migration period (*after* natives have responded) can then be written as:

$$\log w_{ik1} = \varphi_{k1} + \eta \log(M_k + N_{k1}) + \epsilon_{i1}\,, \qquad (3a)$$

$$\log w_{ik1} = \varphi_{k1} + \eta\, m_k + \eta \log N_{k1} + \epsilon_{i1}\,, \qquad (3b)$$

- The change in the wage of individual i is then given by:

$$\Delta \log w_{ik} = \varphi_k + \eta\, m_k + \eta \log \frac{N_{k1}}{N_{k0}} + \upsilon_i, \qquad (4)$$

- It is instructive to formally represent this attenuation of the wage effect of immigration by assuming that the percent change in the number of native workers depends on the size of the supply shock (Borjas and Monras, 2017):

$$\frac{N_{k1} - N_{k0}}{N_{k1}} \approx \log \frac{N_{k1}}{N_{k0}} = \gamma \log\left(1 + \frac{M_k}{N_{k1}}\right) \approx \gamma \frac{M_k}{N_{k1}}, \qquad (5)$$

- By substituting **equation (5)** into **(4)**, we obtain a type of "reduced-form" equation relating the wage change to the immigrant supply shock, or:

$$\Delta \log w_{ik} = \varphi_k + \eta(1+\gamma)\, m_k + v_i. \qquad (6)$$

- Our theoretical framework assumes that immigration is exogenous to economic conditions in market *k* at time 0

- In practice, however, immigrants are not randomly distributed across labor markets and likely prefer to settle in markets that offer thriving economic opportunities

- It turns out, however, that even if we could account for the native response to immigration along the lines of **equation (4)** or simply attempt to estimate the reduced-form wage impact of immigration in **equation (6)**, these IV regressions would *still* yield inconsistent estimates of the corresponding wage impact of immigration

- To derive **equations (4)** and **(6)**, we simplified the model by assuming that all natives work in the pre-migration period

- We write the distribution of the reservation wage in the native population as:

$$\log \hat{w}_{ik} = \theta + u_{i,} \qquad (7)$$

- More precisely, the wage offered to native worker *i immediately* after the supply shock is given by:

$$\log w'_{ik} = \varphi_{k0} + \eta \log(M_k + N_{k0}) + \epsilon_{i0}\,, \qquad (8a)$$

$$\log w'_{ik} = \varphi_{k0} + \eta\, m'_k + \eta \log N_{k0} + \epsilon_{i0}\,, \qquad (8b)$$

- The sample selection rule that determines if a particular native worker stays in the labor force *and* that we can observe the wage in both the pre- and post-migration periods is given by:

$$\Delta \log w_{ik} \text{ is observed if } Z_i^* = \log w'_{ik} - \log \hat{w}_{ik} > 0, \qquad (9)$$

- This latent variable can be rewritten as:

$$Z_i^* = \varphi_{k0} - \theta + \eta\, m_k' + \eta \log N_{k0} + \epsilon_{i0} - u_i\,, \qquad (10a)$$

$$Z_i^* = C_k + \tau_i, \qquad (10b)$$

- Using standard results from the sample selection literature in grouped data (Gronau, 1974), the *observed* wage change in market *k* between the pre- and post-migration period is given by:

$$\mathrm{E}(\Delta \log w_k \mid Z_i = 1) = \varphi_k + \eta\, m_k + \eta \log\left(\frac{N_{k1}}{N_{k0}}\right) + \mathrm{E}(v_i \mid Z_i = 1), \qquad (11a)$$

$$\mathrm{E}(\Delta \log w_k \mid Z_i = 1) = \varphi_k + \eta\, m_k + \eta \log\left(\frac{N_{k1}}{N_{k0}}\right) + \rho_{v\tau}\, \sigma_v\, \lambda(\pi_k), \qquad (11b)$$

- **Equation (11*b*)** easily illustrates the insight that both the *size* of the native response and the *skill composition* of the response help determine the observed wage impact of immigration

- The **second** term captures the possibility that immigrants crowd out the supply of natives

- Finally, the **third** term gives the selection bias resulting from the fact that the natives who drop out of the labor market are not randomly selected from the initial sample of native workers

- In particular, substitute **equation (6)** into **(11*b*)** to obtain the reduced form of the regression model:

$$\mathrm{E}(\Delta \log w_k \mid Z_i = 1) = \varphi_k + \eta(1+\gamma)\, m_k + \rho_{v\tau}\, \sigma_v\, \lambda(\pi_k). \qquad (12)$$

- The omitted variable formula implies that:

$$\operatorname{plim} \eta\widehat{(1+\gamma)} = \eta(1+\gamma) + \rho_{v\tau}\, \sigma_v\, \delta_{\lambda m}, \qquad (13)$$

- **Equation (13)** clearly shows that the failure to take account of the selection bias produced by the supply response of native workers systematically biases the estimate of the wage impact of immigration as long as $\rho_{v\tau} \neq 0$

- **Equation (8b)** delineates how immigration changed the wage of the native population at risk, measured *after* immigrants have entered the labor market but *before* any native labor supply response

- **Equation (12)** describes the evolution of wages in the subsample of survivors

- The application in **equation (13)** shows the bias created by estimating the wage impact of immigration using only the wage trends observed in the self-selected subsample of survivors

- In sum, the discussion in this section implies that correctly estimating the wage impact of immigration requires that we take account of the selection bias generated by the native response to immigrant supply shocks

4. Econometric Framework

4.1. The Wage Equation

- We estimate the selection-adjusted wage impact of immigration by turning to individual-level data and applying the Heckman selection correction

- Based on the theoretical discussion, the general form of the individual earnings function that forms the basis for our empirical analysis is:

$$\log w_{irt} = \theta_r + \theta_t + \beta_1 m_{rt} + \beta_2 \log N_{rt} + \beta_3 \lambda_{it} + \mu_{it}, \qquad (14)$$

- The vector of regional fixed effects (θ_r) in **equation (14)** eliminates all time-invariant regional characteristics that may affect the level of wages and the spatial distribution of immigrants, and the vector of time fixed effects (θ_t) adjusts for common factors specific to the survey year

- We estimate **equation (14)** separately in the samples of working men and women

- The immediate wage drop that presumably follows the supply shock might encourage some natives to withdraw from the labor force, and the regression includes the (log) number of native workers N_{rt} to adjust for this reverse movement of the supply curve in labor market (r, t)

- However, it is unlikely that such native flows in and out of the labor market are random

- The three key variables in the expanded regression model in **equation (14)** are either endogenous (m_{rt} and log N_{rt}) or need to be estimated (the inverse Mills ratio λ_{it})

4.2. Endogeneity of the Immigrant Supply Shock

- It is well known that estimating the regression model in (14) using OLS will not provide consistent values of the wage elasticity because of the non-random sorting of immigrants across regions

- To build our instrument, we follow the procedure implemented in the study by Edo, Giesing, Poutvaara and Öztunc (2019) that investigates the political consequences of immigration in France over the 1988-2015 period

- We predict the number of immigrants for each region-time cell at time t ($t > 1968$) by multiplying the 1968 spatial distribution of immigrants in each education-origin group by the total number of immigrants from that group at time t, as follows:

$$\widehat{M}_r(t) = \sum_n \sum_e \frac{M_r^{ne}(1968)}{M^{ne}(1968)} \cdot M^{ne}(t), \qquad (15)$$

- We use a similar approach to predict the number of natives (N) in the region because the actual number of natives is unlikely to be independent from regional conditions:

$$\widehat{N}_r(t) = \sum_e \frac{N_r^e(1968)}{N^e(1968)} \cdot N^{\text{ne}}(t). \qquad (16)$$

- The shift-share instrument is then defined by:

$$\widehat{m}_{rt} = \log\left(1 + \frac{\widehat{M}_r(t)}{\widehat{N}_r(t)}\right). \qquad (17)$$

- It is well-know that the shift-share instrument in **(17)** does not satisfy the exclusion restriction imposed by the IV strategy if:

  (a) the 1968 spatial distributions of immigrants and natives are correlated with persistent local factors that affect labor market outcomes; and/or

  (b) current economic outcomes are still adjusting to past immigration

4.3. Endogeneity of Native Labor Supply

- Although the generic regression model used in the immigration literature simply relates the wage in a particular market to the immigrant share in that market, the labor demand framework implies that a fully specified regression model should also include the size of the native labor force

- Our instrument for the (log) size of the native workforce is given by:

$$\log \hat{E}_r(t) = \log\ [\theta_r(t) \cdot \bar{N}_r(t)]\,, \tag{18}$$

- The adjusted shift-share projection is then given by:

$$\bar{N}_r(t) = \hat{N}_r(t)(1 + \Delta g_r)^{t-1968}. \tag{19}$$

- Our extension of the shift-share approach to create the adjusted projection in **equation (19)** relies on the same types of assumptions typically made to justify the validity of shift-share instruments in other contexts

4.4. First-Stage IV Estimates

- **Table 2** presents the first stage of our baseline IV individual-level wage regressions for both samples of native women and native men

- **Panel A** of the table presents the first-stage regression associated with this model, where we regress m_{rt} (i.e., the single endogenous regressor) on $\widehat{m}_{rt}$ (i.e., the shift-share instrument defined in **equation (17)**) and a set of region and time fixed effects

- **Panel B** reports the first-stage estimates for the expanded specification that has two endogenous variables, the immigrant share m_{rt} and native labor supply (log N_{rt})

- The first-stage F-tests of excluded instruments are between 21 and 29, indicating that our instruments are reasonably strong

Table 2: Instrumental variables, first-stage regressions

	Sample of native women		Sample of native men	
	(1)	(2)	(3)	(4)
	A. Single endogenous variable model			
Dependent variable: Immigrant share in workforce				
Predicted immigrant share in population	1.77***	-	1.71***	-
	(0.27)		(0.32)	
Kleibergen-Paap F-test of excluded instrument	42.08	-	27.57	-
Observations	71,326	-	103,704	-
	B. Two-endogenous variables model			
Dependent variable: Immigrant share in workforce				
Log predicted immigrant population	-	0.12***	-	0.11***
		(0.02)		(0.02)
Log predicted native labor force	-	-0.15***	-	-0.14***
		(0.04)		(0.04)
SW multivariate F-test of excluded instruments	-	21.45	-	25.68
Dependent variable: Log of native labor force				
Log predicted immigrant population	-	-0.09	-	-0.09
		(0.06)		(0.06)
Log predicted native labor force	-	0.65***	-	0.65***
		(0.09)		(0.09)
SW multivariate F-test of excluded instruments	-	26.03	-	28.70
Observations	-	71,326	-	103,704

4.5. The Inverse Mills Ratio

- Finally, the regression model in **equation (14)** includes the inverse Mills ratio to adjust for the selection bias produced by the non-random exit of some natives from the labor force after the immigrant supply shock

- We construct the inverse Mills ratio by first estimating a probit model that relates a native person's decision to work to the various regressors in the model, including a vector of "family" characteristics Z that, by assumption, do not enter the labor demand function:

$$\mathrm{P}(EMP_{irt} = 1) = \Phi(\theta_a + \theta_s + \theta_r + \theta_t + \alpha Z_{it} + \gamma_1 m'_{rt} + \gamma_2 \log N_{rt-1} + v_{it}), \qquad (20)$$

- The OLS regressions that relate a worker's wage to the immigrant share will use an inverse Mills ratio computed directly from the probit model in (**20**)

5. Empirical Results

5.1. The Probability of Employment

- **Table 3** reports the estimates of the probit regression on whether native person i in region r at time t is employed in the reference week

- For illustrative purposes, **columns 2** and **4** of **Table 3** estimate the direct impact of the immigrant share m'_{rt}- on the native employment probability using an IV strategy

- The probit regressions reveal a strong and negative relationship between the immigration variables and the probability of employment for native women, while the same correlations are close to zero for native men

- The other coefficients reported in **Table 3** show that the lagged size of the predicted native population is negatively correlated with the employment probability of natives

Table 3: Probit regressions on the employment probability of natives

	Native women		Native men	
	Reduced form probit	Instrumental variable probit	Reduced form probit	Instrumental variable probit
	(1)	(2)	(3)	(4)
Predicted immigrant share in population	-4.60***	-	-0.22	-
	(1.19)		(1.24)	
Marginal effect	*-1.45*		*-0.06*	
Immigrant share	-	-3.81***	-	0.13
		(1.14)		(0.94)
Marginal effect		*-1.21*		*0.03*
Log predicted native population in t-1	-0.42**	-0.10	-0.59***	-0.65***
	(0.20)	(0.28)	(0.18)	(0.22)
Marginal effect	*-0.13*	*-0.03*	*-0.15*	*-0.16*
Married	-0.05***	-0.05***	0.42***	0.42***
	(0.02)	(0.02)	(0.02)	(0.02)
Marginal effect	*-0.02*	*-0.02*	*0.11*	*0.11*
Number of children below 6	-0.27***	-0.27***	0.25***	0.25***
	(0.03)	(0.03)	(0.04)	(0.04)
Marginal effect	*-0.09*	*-0.09*	*0.07*	*0.06*
Married*Number of children below 6	-0.02	-0.02	-0.18***	-0.18***
	(0.04)	(0.04)	(0.04)	(0.04)
Marginal effect	*-0.01*	*-0.01*	*-0.05*	*-0.05*
Observations	173,432	173,432	155,716	155,716

5.2. The Wage of Native Workers

- **Table 4** reports the OLS and IV estimated impact of the immigrant supply shock on the age- and education-adjusted log wage of native women (**Panel A**) and men (**Panel B**) between 1982 and 2016

- **Column 1** presents the simplest model, where the log wage is related only to the immigrant share (and region and year fixed effects)

- **Column 2** adds the inverse Mills ratio to adjust for the selection bias resulting from the change in the sample composition of female workers following the supply shock

- **Columns 5** and **6** of **Panel A** present the analogous IV regression results where the immigrant share is instrumented using the corresponding shift-share prediction

- The remaining columns of **Table 4** expand the basic model relating wages to immigration

Table 4: Impact of immigration on native individual wages

	OLS estimates				IV estimates			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Impact on the wage of native women								
Immigrant share	-0.10	-0.46***	-0.05	-0.34**	-0.12	-0.47***	-0.64**	-0.94***
	(0.07)	(0.08)	(0.11)	(0.13)	(0.11)	(0.11)	(0.27)	(0.27)
Inverse Mills ratio	-	0.22***	-	0.22***	-	0.22***	-	0.22***
		(0.02)		(0.02)		(0.02)		(0.02)
Log of native labor force	-	-	0.03	0.07	-	-	-0.20***	-0.16**
			(0.06)	(0.06)			(0.08)	(0.08)
Kleibergen-Paap F-test	-	-	-	-	42.08	42.21	-	-
SW multivariate F-test (imm. share)	-	-	-	-	-	-	21.47	21.45
SW multivariate F-test (log nat.)	-	-	-	-	-	-	26.02	26.03
B. Impact on the wage of native men								
Immigrant share	-0.68***	-0.69***	-0.53***	-0.50***	-0.81***	-0.83***	-0.65***	-0.56***
	(0.11)	(0.11)	(0.15)	(0.16)	(0.09)	(0.09)	(0.17)	(0.18)
Inverse Mills ratio	-	0.10***	-	0.11***	-	0.10***	-	0.10***
		(0.01)		(0.01)		(0.01)		(0.01)
Log of native labor force	-	-	0.09	0.11*	-	-	0.07	0.11*
			(0.05)	(0.05)			(0.06)	(0.06)
Kleibergen-Paap F-test	-	-	-	-	27.57	27.58	-	-
SW multivariate F-test (imm. share)	-	-	-	-	-	-	22.64	22.64
SW multivariate F-test (log nat.)	-	-	-	-	-	-	28.71	28.70

- Our theoretical framework implies that we can recover the crowd-out parameter γ from the coefficients of the immigrant share variable in **columns 6** and **8**

- **Panel B** replicates the entire set of regressions using the sample of working native men

- **First**, although men are also positively selected into employment, the intensity of selection is much weaker

- **Second**, the coefficient of the native labor supply variable is positive, though only significant at a 10% level in **column 8**

- **Finally**, regardless of the specification of the regression model, the estimated coefficient of the immigrant share variable for men is negative, significant, and hovers between -0.6 and -0.8

- As our descriptive analysis in **Figure 2** showed, there is a strong negative correlation between immigration and the wage of French native men

- The results in **Table 4** indicate that working men are positively selected from the population (although the extent of selection is not strong)

- It is also worth emphasizing that the simplest (generic) model in **column 5** linking immigration and wages suggest a zero correlation between the two variables for women and a negative correlation for men

- In addition, we examined the precision of the estimated coefficients reported in **Table 4** by implementing the wild cluster bootstrap method of Cameron, Gelbach and Miller (2008, p. 427) using 1,000 replications

5.3. Robustness Tests

- This section implements several robustness tests to assess the sensitivity of the "baseline" results reported in **Table 4**
- **Table 5** estimates the model using alternative sample periods
- In columns 1-4 of **Table 5**, we restrict the regressions to the 1990-2016 sample period for two reasons
- The results from columns 1-4 of **Panel A** again illustrate the importance of accounting for sample selection and the size of the native employment response when estimating the wage elasticity for native women
- The baseline analysis reported in **Table 4** used data from five different crosssections: 1982, 1990, 1999, 2007, and 2016

Table 5: Immigration and wages using alternative periods

	Sample period: 1990-2016				Baseline period, adds 2012			
	OLS	IV estimates			OLS	IV estimates		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Impact on the wage of native women								
Immigrant share	-0.20**	-0.17	-0.52***	-1.09***	-0.10	-0.11	-0.46***	-0.91***
	(0.07)	(0.12)	(0.11)	(0.28)	(0.07)	(0.11)	(0.10)	(0.25)
Inverse Mills ratio	-	-	0.23***	0.23***			0.23***	0.23***
			(0.02)	(0.02)			(0.01)	(0.01)
Log of native labor force	-	-	-	-0.16*				-0.15**
				(0.09)				(0.08)
Kleibergen-Paap F-test	-	38.04	38.11	-	-	42.01	42.15	-
SW multivariate F-test (imm. share)	-	-	-	18.84	-	-	-	21.87
SW multivariate F-test (log nat.)	-	-	-	20.96	-	-	-	26.59
B. Impact on the wage of native men								
Immigrant share	-0.80***	-0.92***	-0.95***	-0.72***	-0.67***	-0.79***	-0.81***	-0.54***
	(0.13)	(0.12)	(0.11)	(0.23)	(0.11)	(0.10)	(0.09)	(0.18)
Inverse Mills ratio	-	-	0.11***	0.11***	-	-	0.11***	0.11***
			(0.01)	(0.01)			(0.01)	(0.01)
Log of native labor force	-	-	-	0.14*	-	-	-	0.12*
				(0.08)				(0.06)
Kleibergen-Paap F-test	-	24.03	24.03	-	-	27.09	27.10	-
SW multivariate F-test (imm. share)	-	-	-	19.73	-	-	-	23.09
SW multivariate F-test (log nat.)	-	-	-	23.27	-	-	-	29.44

- All the regression coefficients reported in **Table 6** are similar to the baseline results in **Table 4**
- Following Mulligan and Rubinstein (2008), columns 1-4 of **Table 7** use an alternative probit model to compute the inverse Mills ratio
- Columns 5-8 of **Table 7** extend the analysis by calculating the hourly wage rate for each worker in the sample
- **Table 8** performs a final robustness check by using an alternative definition of a geographic region
- Our instrument for the immigrant share differs slightly from that used at the region level
- The regression coefficients reported in **Table 8** then use the five available crosssections (1982, 1990, 1999, 2012/2013 and 2016)

Table 6: Immigration and wages using alternative measures of the supply shock

	Immigrants to pre-existing natives				Gender-specific supply shock			
	OLS	IV estimates			OLS	IV estimates		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Impact on the wage of native women								
Immigrant share	-0.12	-0.14	-0.51***	-0.91***	-0.04	-0.10	-0.39***	-0.95**
	(0.08)	(0.13)	(0.12)	(0.22)	(0.05)	(0.10)	(0.11)	(0.39)
Inverse Mills ratio	-	-	0.22***	0.22***	-	-	0.22***	0.22***
			(0.02)	(0.02)			(0.02)	(0.02)
Log of native labor force	-	-	-	-0.14**	-	-	-	-0.24*
				(0.06)				(0.14)
Kleibergen-Paap F-test	-	17.87	17.94	-	-	27.58	27.62	-
SW multivariate F-test (imm. share)	-	-	-	27.81	-	-	-	9.37
SW multivariate F-test (log nat.)	-	-	-	25.47	-	-	-	14.26
B. Impact on the wage of native men								
Immigrant share	-0.62***	-0.77***	-0.79***	-0.56***	-0.70***	-1.04***	-1.07***	-0.58***
	(0.13)	(0.14)	(0.14)	(0.16)	(0.24)	(0.17)	(0.17)	(0.20)
Inverse Mills ratio	-	-	0.10***	0.11***	-	-	0.10***	0.11***
			(0.01)	(0.01)			(0.01)	(0.01)
Log of native labor force	-	-	-	0.10**	-	-	-	0.15***
				(0.05)				(0.05)
Kleibergen-Paap F-test	-	13.75	13.76	-	-	46.13	46.15	-
SW multivariate F-test (imm. share)	-	-	-	30.33	-	-	-	48.34
SW multivariate F-test (log nat.)	-	-	-	27.26	-	-	-	28.59

Table 7: Immigration and wages using alternative samples of native workers

	Probit on full-time employment				Full- and part-time workers			
	OLS	IV estimates			OLS	IV estimates		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Impact on the wage of native women								
Immigrant share	-0.10	-0.12	-0.38***	-0.75***	-0.36***	-0.42***	-0.54***	-0.93***
	(0.07)	(0.11)	(0.10)	(0.24)	(0.05)	(0.11)	(0.12)	(0.26)
Inverse Mills ratio	-	-	0.21***	0.21***	-	-	0.07***	0.07***
			(0.01)	(0.01)			(0.01)	(0.01)
Log of native labor force	-	-	-	-0.13*	-	-	-	-0.15*
				(0.07)				(0.08)
Kleibergen-Paap F-test	-	42.08	42.15	-	-	34.05	34.14	-
SW multivariate F-test (imm. share)	-	-	-	21.47	-	-	-	20.66
SW multivariate F-test (log nat.)	-	-	-	26.04	-	-	-	25.57
B. Impact on the wage of native men								
Immigrant share	-0.68***	-0.81***	-0.82***	-0.58***	-0.59***	-0.64***	-0.64***	-0.59***
	(0.11)	(0.09)	(0.09)	(0.17)	(0.07)	(0.08)	(0.08)	(0.14)
Inverse Mills ratio	-	-	0.09***	0.09***	-	-	-0.01	-0.01
			(0.01)	(0.01)			(0.01)	(0.01)
Log of native labor force	-	-	-	0.11*	-	-	-	0.04
				(0.06)				(0.05)
Kleibergen-Paap F-test	-	27.57	27.57	-	-	27.65	27.66	-
SW multivariate F-test (imm. share)	-	-	-	22.65	-	-	-	22.36
SW multivariate F-test (log nat.)	-	-	-	28.71	-	-	-	28.22

Table 8: Immigration and wages using geographic variation across departments

	OLS estimates				IV estimates			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Impact on the wage of native women								
Immigrant share	-0.17**	-0.44***	-0.18*	-0.42***	-0.21	-0.54***	-0.61***	-0.88***
	(0.07)	(0.07)	(0.09)	(0.10)	(0.15)	(0.17)	(0.17)	(0.18)
Inverse Mills ratio	-	0.24***	-	0.24***	-	0.24***	-	0.24***
		(0.01)		(0.01)		(0.01)		(0.01)
Log of native labor force	-	-	-0.01	0.02	-	-	-0.17**	-0.14*
			(0.04)	(0.04)			(0.08)	(0.08)
Kleibergen-Paap F-test	-	-	-	-	12.53	12.51	-	-
SW multivariate F-test (imm. share)	-	-	-	-	-	-	28.21	28.18
SW multivariate F-test (log nat.)	-	-	-	-			12.32	12.32
B. Impact on the wage of native men								
Immigrant share	-0.51***	-0.53***	-0.43***	-0.43***	-0.68***	-0.72***	-0.75***	-0.71***
	(0.11)	(0.10)	(0.13)	(0.13)	(0.19)	(0.20)	(0.22)	(0.23)
Inverse Mills ratio	-	0.12***	-	0.12***	-	0.12***	-	0.12***
		(0.01)		(0.01)		(0.01)		(0.01)
Log of native labor force	-	-	0.06	0.07*	-	-	-0.10	-0.10
			(0.04)	(0.04)			(0.08)	(0.09)
Kleibergen-Paap F-test	-	-	-	-	13.25	13.25	-	-
SW multivariate F-test (imm. share)	-	-	-	-	-	-	27.94	27.94
SW multivariate F-test (log nat.)	-	-	-	-	-	-	14.09	14.10

6. The Wage Impact of Immigration by Skill Group

- This section extends the analysis by providing a closer look at how the wage impact of immigration differs across skill groups (defined by either age or education)

- **Table 9** presents the regression coefficients when the regression models are estimated separately in the two age groups

- **Columns 1-4** present the results for primeage workers

- **Columns 5-8** reproduce the analysis using the sample of younger workers

- **Table 10** reports the coefficients from a parallel analysis where the sample is now divided into two education groups, workers who have completed their high school and those who have not

Table 9: Immigration and wages, by age group

	Age restriction: 30-55				Age restriction: 18-29			
	OLS	IV estimates			OLS	IV estimates		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Impact on the wage of native women								
Immigrant share	0.08	0.18	-0.24**	-0.86**	-0.75***	-1.11***	-1.50***	-1.40***
	(0.09)	(0.14)	(0.11)	(0.40)	(0.11)	(0.30)	(0.26)	(0.28)
Inverse Mills ratio	-	-	0.24***	0.25***	-	-	0.36***	0.36***
			(0.02)	(0.02)			(0.03)	(0.03)
Log of native labor force	-	-	-	-0.17	-	-	-	-0.01
				(0.13)				(0.10)
Kleibergen-Paap F-test	-	39.87	39.96	-	-	41.22	41.45	-
SW multivariate F-test (imm. share)	-	-	-	20.19	-	-	-	25.59
SW multivariate F-test (log nat.)	-	-	-	24.20	-	-	-	33.34
B. Impact on the wage of native men								
Immigrant share	-0.62***	-0.66***	-0.66***	-0.61***	-1.18***	-1.58***	-1.62***	-0.99**
	(0.13)	(0.13)	(0.12)	(0.21)	(0.14)	(0.19)	(0.18)	(0.47)
Inverse Mills ratio	-	-	-0.00	-0.00	-	-	0.28***	0.28***
			(0.05)	(0.05)			(0.01)	(0.01)
Log of native labor force	-	-	-	0.04	-	-	-	0.19
				(0.06)				(0.18)
Kleibergen-Paap F-test	-	26.26	26.27	-	-	28.39	28.39	-
SW multivariate F-test (imm. share)	-	-	-	22.04	-	-	-	25.69
SW multivariate F-test (log nat.)	-	-	-	28.10	-	-	-	33.51

Table 10: Immigration and wages, by education group

	Less than a baccalaureate degree				Baccalaureate degree			
	OLS	IV estimates			OLS	IV estimates		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	A. Impact on the wage of native women							
Immigrant share	-0.58***	-0.74***	-1.23***	-1.41***	0.03	0.05	-0.29*	-0.70*
	(0.10)	(0.22)	(0.23)	(0.28)	(0.10)	(0.17)	(0.15)	(0.42)
Inverse Mills ratio	-	-	0.21***	0.20***	-	-	0.25***	0.25***
			(0.01)	(0.01)			(0.02)	(0.02)
Log of native labor force	-	-	-	-0.11	-	-	-	-0.21*
				(0.09)				(0.13)
Kleibergen-Paap F-test	-	27.60	27.76	-	-	59.50	59.65	-
SW multivariate F-test (imm. share)	-	-	-	23.52	-	-	-	19.21
SW multivariate F-test (log nat.)	-	-	-	26.75	-	-	-	24.54
	B. Impact on the wage of native men							
Immigrant share	-1.03***	-1.25***	-1.32***	-0.82***	-0.68***	-0.73***	-0.75***	-0.54**
	(0.19)	(0.14)	(0.15)	(0.27)	(0.11)	(0.13)	(0.12)	(0.23)
Inverse Mills ratio	-	-	0.10***	0.10***	-	-	0.09***	0.09***
			(0.01)	(0.01)			(0.02)	(0.02)
Log of native labor force	-	-	-	0.10	-	-	-	0.18*
				(0.11)				(0.09)
Kleibergen-Paap F-test	-	17.50	17.52	-	-	52.09	52.08	-
SW multivariate F-test (imm. share)	-	-	-	24.40	-	-	-	19.66
SW multivariate F-test (log nat.)	-	-	-	29.47	-	-	-	26.20

- **Panel A of Table 10** reveals that the negative wage elasticity for women tends to be driven by the adverse impact of immigration on the low-education group

- The wage elasticities for men also tend to suggest a stronger negative response for the low-education group

- The general specification of the regression model is now given by:

$$\log w_{irst} = \theta_r + \theta_s + \theta_t + (\theta_r \times \theta_s) + (\theta_s \times \theta_t) + \beta_1 m_{rst} + \beta_2 \log N_{rst} + \beta_3 \lambda_{it} + \mu_{it}, (21)$$

- We address the endogeneity of the immigrant share at the region-education level by adapting the strategy introduced in our analysis of the department-level data in **Table 8**

- In particular, we instrument the immigrant share m_{rst} by using the shift-share prediction of the regional immigrant share (i.e., the $\widehat{m}_{rt}$ defined in equation (17)) *and* the predicted distribution of immigrants across education groups in each region. We define the latter variable as:

$$\widehat{m}_{rs}(t) = \frac{\widehat{M}_{rs}(t)}{\widehat{M}_{r}(t)}, \qquad (22)$$

- To construct this variable, we multiply the 1968 distribution of immigrants across region-education cells for each country group n by the total number of immigrants from that group in the subsequent years:

$$\widehat{M}_{rs}(t) = \sum_{n} \frac{M_{rs}^{n}(1968)}{M^{n}(1968)} \cdot M^{n}(t), \qquad (23)$$

- This IV strategy allows for the possibility that networks can impact the locational choice of immigrants regardless of their education level

- **Table 11** report the regression coefficients
- It is worth noting that the wage elasticities reported in **Table 11** are roughly of the same magnitude as those reported in our baseline estimates
- However, the wage effects reported in **Table 11** are likely to be underestimated for several reasons
- In sum, the lessons provided by exploiting information on supply shocks within specific skill cells confirm the key hypothesis explored in this paper: A more complete evaluation of the wage impact of immigration requires the explicit modeling of the self-selected labor force produced by the native response

Table 11: Immigration and wages at the region-education-year level

	OLS estimates				IV estimates			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Impact on the wage of native women								
Immigrant share	-0.23***	-0.42***	-0.42***	-0.65***	-0.24**	-0.45***	-0.87***	-1.03***
	(0.08)	(0.09)	(0.14)	(0.14)	(0.10)	(0.09)	(0.28)	(0.24)
Inverse Mills ratio	-	0.24***	-	0.24***	-	0.24***	-	0.24***
		(0.01)		(0.01)		(0.01)		(0.01)
Log of native labor force	-	-	-0.08	-0.10	-	-	-0.24***	-0.22***
			(0.06)	(0.06)			(0.09)	(0.08)
Kleibergen-Paap F-test	-	-	-	-	12.53	12.51	-	-
SW multivariate F-test (imm. share)	-	-	-	-	-	-	12.63	11.14
SW multivariate F-test (log nat.)	-	-	-	-	-	-	14.51	12.16
B. Impact on the wage of native men								
Immigrant share	-0.57***	-0.59***	-0.50***	-0.51***	-0.60***	-0.62***	-0.42*	-0.37*
	(0.05)	(0.06)	(0.15)	(0.15)	(0.06)	(0.06)	(0.22)	(0.22)
Inverse Mills ratio	-	0.10***	-	0.10***	-	0.10***	-	0.10***
		(0.01)		(0.01)		(0.01)		(0.01)
Log of native labor force	-	-	0.03	0.03	-	-	0.06	0.09
			(0.05)	(0.05)			(0.07)	(0.08)
Kleibergen-Paap F-test	-	-	-	-	7.27	7.27	-	-
SW multivariate F-test (imm. share)	-	-	-	-	-	-	11.11	10.16
SW multivariate F-test (log nat.)	-	-	-	-	-	-	11.92	10.51

7. Conclusion

- The surge in international labor flows in the past few decades has inspired an equally large increase in the amount of economic research devoted to understanding and documenting the economic consequences of such flows

- This paper proposes and empirically explores a new hypothesis that provides a deeper understanding into how the diffusion effect might bias estimates of the wage impact of immigration

- It is important to emphasize that the selection bias problem we identify and explore in this paper contaminates existing estimates of the labor market impact of immigration