Opening the Floodgates: Immigration and Structural Change

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Preliminary and Incomplete

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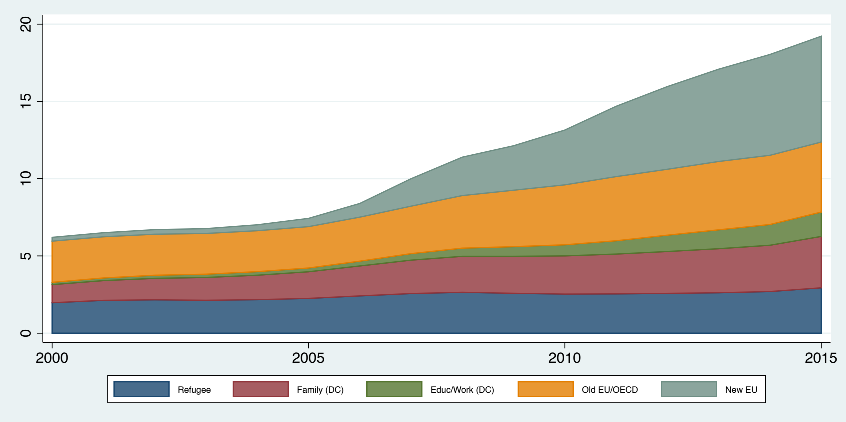
A Pretty Big Labor Supply Shock



2004&2007 EU expansions: Migration restrictions lifted for 100 mill people.

$\longrightarrow$ Immigranrt share **7** to **17%** over sample period 2004-2013.

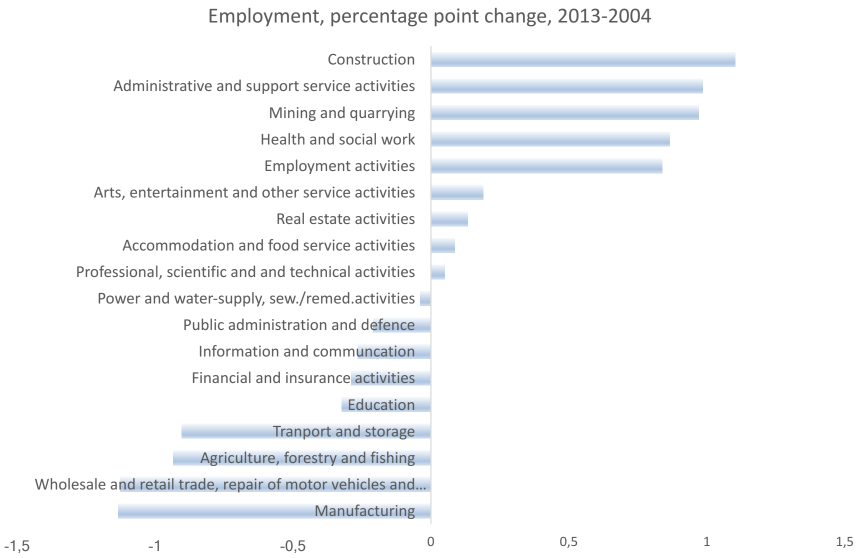
$\longrightarrow$ **60%** of increase due to EU accession countries.

$\longrightarrow$ 11% population growth - almost **70%** was net immigration.

Research Question

- What is the impact of a large labor supply shock?
  - On industry growth & structural change.
- As we will see, supply shock *uneven* across occupations.
- We test the simplest possible factor proportions theory:
  - An industry i is intensive in the use of an occupation o.
  - A labor supply shock to o lowers relative wages.
  - Costs/prices decline $\longrightarrow$ i grow more than other industries.

Employment Growth



Identification

- Fundamental identification challenge: High growth industries attract immigrants.
- Our solution: Occupations are more or less *language intensive*.
  - Norwegian is typically the workplace language.
  - The supply of migrants from source n to occupation o depends on
    - The language intensity of o.
    - The linguistic distance from n to Norwegian.
  - Use this to create instrument for change in immigrant share in o.

Today

- Related literature
- Data.
- A factor-proportions model.
- Econometric model.
- Results and conclude.

Related Literature

- Industry response to labor supply shocks: Dustmann and Glitz (2015), González and Ortega (2011), Hanson and Slaughter (2002), Lewis (2003), Quispe-Agnoli and Zavodny (2002) .
- Multi-sector Roy models: Burstein et al (2016a,b), Curuk and Vannoorenberghe (2014), Galle, Rodriguez-Clare and Yi (2015), Hsieh et al. (2013), Lagakos and Waugh (2013).
- Language-intensity as instrument: Hoen (2016).

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Data

Four main datasets:

1. Balance sheet data for all private sector firms (joint-stock companies).
   - Total employment, wage costs ++ for industry-municipality pairs ir.
2. All job spells + immigration status (country of birth):
   - Immigrant share $\mu_{ot} \equiv M_{ot}/(N_{ot} + M_{ot})$ for occupation o at time t.
   - Pre-period factor-intensity matrix $\lambda_{io} \equiv L_{io}/\sum_o L_{io}$.
   - Restrict to full-time employees.

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Data

3. O*Net occupation characteristics:
   - Range from 1=not important to 5=extremely important.
   - Take average of oral+written comprehension/expression.
   - Get language intensity LI_o for 341 STYRK occupations, using concordance from Hoen (2016).
     - Carpenters: -1.50, pre-school teachers: 0.36 (standardized).
4. Linguistic distance data
   - Based on how many levels of the linguistic family tree two languages share (Adsera and Pytlikova, 2015).
   - 223 countries, distance from n to NO: $Dist_n$
     - SWE=DK=0.3, UK=USA=0.75, Poland=0.9.

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Note: The figure shows the percentage point change in the share of immigrant relative to total employees on the x-axis, and total 2013 employment on a log scale on the y-axis (in 1000s persons). The unit of observation is 3-digit NACE sector (left figure) and 4-digit STYRK occupation code (right figure). Industries/occupations with 2013 employment $<$ 1000 persons are omitted from the figures.

The Factor Intensity Matrix (2004)

	Professor or similar STYRK 2310			Sum
NACE803 "Higher education"	.52	.	.	1
NACE 751 "Administration of the state (..)	.06	.	.	1
NACE 732 "Research (..) on natural sciences and engineering"	.05	.	.	1

	Carpenter or similar STYRK 7421			Sum
NACE203 "Manufacture of builders' carpentry and joinery"	.21	.	.	1
NACE205 "Manufacture of other products of wood (..)	.19	.	.	1
NACE454 "Building completion"	.15	.	.	1

The Model

- Simple framework to guide empirical part of paper.
  - Show how labor supply of occupation o affects employment & wages in all industries.
  - Taking into account all general equilibrium effects.
- Main ingredients:
  - Industries i produce output with different factor intensities of occupations o.
  - Roy-type model of the allocation of workers with occupation o across sectors i.
  - No occupational switching.

Production and Labor Demand

- Production function
$$y_i = \varphi_i \prod_o E_{io}^{\omega_{io}}$$
where E_{io} is the number of units of effective labor and $\sum_o \omega_{io} = 1$.
- Cobb-Douglas preferences across sectors with expenditure shares β_i.
- Perfectly competitive markets.
- Demand for efficiency units of labor in sector i of occupation o is then
$$E_{io} = \omega_{io} \frac{\beta_i Y}{w_{io}},$$
where Y is total income and w_{io} is the wage.

Labor Supply

- Workers from occupation o get productivity draws z_i for each sector.
  - Nominal income in sector i is $z_i w_{io}$.
  - z_i is Frechet with shape κ and location parameter A_{io}.

- Workers choose industry to maximize $z_i w_{io}$.
  - Upward sloping labor supply curve: Higher w_{io} attracts more workers.
  - But the marginal worker has worse draws.

- Industry-specific wages:
  - If $w_{io} > w_{jo}$, some workers still choose j because they have a bad z in i.

Labor Supply

- Eaton-Kortum mechanics yield the share of o workers in industry i

$$\pi_{io} \equiv \frac{L_{io}}{L_o} = \frac{A_{io} w_{io}^{\kappa}}{\Phi_o^{\kappa}},$$

  where $\Phi_o^{\kappa} \equiv \sum_j A_{jo} w_{jo}^{\kappa}$ is "earnings potential" of occupation o.
- Effective labor supply is

$$E_{io} = \eta \frac{\Phi_o}{w_{io}} \pi_{io} L_o,$$

  where η is a constant.

Equilibrium

Labor supply = labor demand yields equilbrium wages

$$w_{io}^{\kappa} = \frac{\omega_{io}\beta_i}{A_{io}} \left(\frac{Y}{\eta L_o}\right)^{\kappa} \left(\sum_i \omega_{io}\beta_i\right)^{\kappa-1}.$$

Two Propositions

Proposition

In general equilibrium, the share of occupation o workers in industry i is

$$\pi_{io} = \frac{\omega_{io}\beta_i}{\sum_i \omega_{io}\beta_i}$$

Proposition

Consider a change in the labor supply of occupation o, L_o, keeping all other parameters constant. In general equilbirium, the change in industry employment, L_i, is

$$\hat{L}_i = \sum_o \lambda_{io}\hat{L}_o,$$

where $\lambda_{io} = L_{io}/L_i$ and using the notation $\hat{x} = x'/x$, where x and x' denotes the value in the initial and counterfactual equilibrium, respectively.

Comparative Statics : Industry Employment

Proposition 2 is a useful guide for empirical analysis:

- Industry employment can be expressed as a simple function of initial weights λ_{io} and occupation shocks.
- All goods and factor markets interdependent.
  - Those complex GE relationships are all represented by $\sum_o \lambda_{io} \hat{L}_o$.

- Occupational wages.

$$\hat{w}_{io} = \hat{w}_{jo} = \frac{\hat{Y}}{\hat{L}_o} (= \hat{\Phi}_o).$$

- Industry wages. Total wage bill relative to employment in industry i is

$$\hat{W}_i = \frac{\hat{Y}}{\hat{L}_i}$$

Comparative Statics : Welfare

- Change in real income for occupation o is

$$\frac{\hat{\Phi}_o}{\hat{P}},$$

where P is the aggregate price index.

- Sufficient with the following data:
  - β_i
  - ω_{io}
  - Y_o/Y
  - $\hat{L}_o$.

From Model to Empirics

- L_o unobserved, $\mu_o \equiv M_o / L_o$ observed.
- Recall

$$\hat{L}_i = \sum_o \lambda_{io} \hat{L}_o,$$

- If
  - No native flight ($\hat{N}_o = 1$)
  - Natives/immigrants perfect subst. *within* occupation, $L_o \equiv N_o + M_o$,

  then (locally)

$$\hat{L}_o = 1 + \frac{\Delta \mu_o}{1 - \mu_o}.$$

- Hence,

$$\ln L_i \approx \sum_o \tilde{\lambda}_{io} \Delta \mu_o,$$

  where $\tilde{\lambda}_{io} = \lambda_{io} / (1 - \mu_o)$.
- Card & DiNardo (2000) & Card (2001) find no evidence of intercity out-migration by natives.

Instrument

- $\Delta\mu_o$ is endogenous.
- Idea: High LI_o means you have to learn the language really well $\longrightarrow$ high immigration cost.
  - When opening the floodgates, $\Delta\mu_o$ should be greater in low LI_o occupations.
  - Language hurdle even larger for migrants with high $Dist_n$.

Instrument

- Bartik-style instrument: The predicted share of immigrants in o is

$$\mu_o^{IV} = \frac{\sum_n \zeta_{no} M_n}{\sum_n \zeta_{no} M_n + \zeta_{NOo} N},$$

  where M_n is the observed immigrant stock from source n and $\sum_o \zeta_{no} = 1$.
- Overall immigration endogenous but differential sorting into occupations is not.
- Instrument becomes

$$IV_i = \sum_o \lambda_{io} \Delta \mu_o^{IV}$$

The Key

- For immigrants from n, predicted share working in o is

$$\zeta_{no} = \frac{e^{-LI_o Dist_n}}{\sum_p e^{-LI_p Dist_n}}.$$

	Norway	Sweden	Poland
Carpenter	.5	.64	.84
Pre-school teacher	.5	.36	.16
SUM	1	1	1

- Complementarity: If $Dist_n$ high, language intensity *matters more*.

Baseline Specification

- Unit of observation:
  - LHS var: Industry i (5 or 3-digit)-municipality pair.
  - RHS var: Industry i (3-digit).

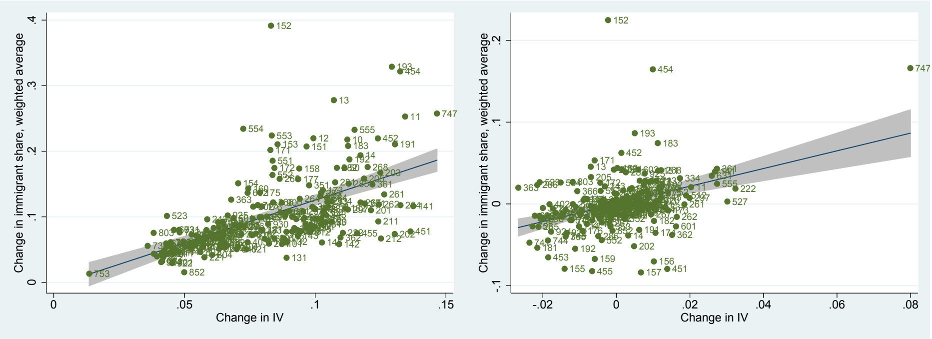
- 2-digit industry-municipality fixed effects:
  - Control for trends in industry and/or regional output.
  - Only *within 2-digit* differences in instrument that matters.

- Weights refer to 2004 and the change is 2004 to 2013.

Threats to Identification

- Identifying variation: Mean language intensity of 5-digit relative to 2-digit industry.
- Exclusion restriction fails if langugage intensity & growth are otherwise related.
    - Demand/supply side factors.
    - Language intensity reflects skill intensity.
- Our solutions:
    1. Control for pre-sample characteristics of the industry:
        - Value added, employment, mean wages, wage share & export intensity.
    2. Control for the skill-intensity of the industry
        - Share of workers with high-school or more.
    3. Falsification tests.

1st stage



Note: The figures show scatterplots between the 2004-2013 change in the instrument on the x-axis and the percentage point change in the weighted immigrant share ($\sum_o \tilde{\lambda}_{io} \Delta\mu_o$) on the y-axis. The unit of observation is a 3-digit NACE sector. The left figure shows the raw scatterplot and the right figure shows the scatterplot after demeaning both variables by 2-digit industry averages. The line represent the linear regression line and the gray area the 95 percent confidence interval.

Table: Immigration and Employment Growth. 2SLS Estimates.

Dependent variable: $\Delta \ln L_i$	(1)	(2)	(3)	(4)
Δ Immigrant share ($\sum_o \tilde{\lambda}_{io} \Delta\mu_o$)	.60[a]	1.19[a]	1.75[a]	2.02[a]
	(.14)	(.36)	(.35)	(.35)
Pre-sample industry controls	No	No	Yes	Yes
Pre-sample worker controls	No	No	No	Yes
Industry (2-digit)-municipality FE	No	Yes	Yes	Yes
	1st Stage Estimates			
$\sum_o \lambda_{io} \Delta\mu_o^{IV}$	1.62[a]	1.81[a]	1.81[a]	1.81[a]
	(.02)	(.04)	(.04)	(.04)
Number of observations	16,763	16,763	16,763	16,763

Note: Robust standard errors clustered by industry-municipality in parentheses. Changes refer to the time period 2004 to 2013. The unit of observation is a 5-digit industry (NACE)-municipality pair. The independent variable and the instrument is constructed at the 3-digit industry level. Industry controls are: Log value added, log employment, log average wages, the share of exports in total sales and the share of wages in total costs (2003 values). The workers control is the share of workers with a completed high school education or higher (2003 values, averaged across firms in a 5-digit industry). [a] $p < 0.01$, [b] $p < 0.05$, [c] $p < 0.1$.

Results: Industry Wage Growth

Table: Immigration and Industry Wage Growth. 2SLS Estimates.

Dependent variable: $\Delta \ln W_i$	(1)	(2)	(3)	(4)
Δ Immigrant share ($\sum_o \tilde{\lambda}_{io} \Delta \mu_o$)	-.56[a]	-.47[b]	-.94[a]	-.74[a]
	(.08)	(.19)	(.19)	(.20)
Pre-sample industry controls	No	No	Yes	Yes
Pre-sample worker controls	No	No	No	Yes
Industry (2-digit)-municipality FE	No	Yes	Yes	Yes
	1st Stage Estimates			
$\sum_o \lambda_{io} \Delta \mu_o^{IV}$	1.62[a]	1.81[a]	1.81[a]	1.81[a]
	(.02)	(.04)	(.04)	(.04)
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Magnitudes

Employment:

- $10th$ and $90th$ percentile of change in immigrant share: 5 and 17 pp.
- Estimates suggest $.12x2.0 \approx .24$ log points higher industry employment.
- Mean $\Delta \ln \text{Employment} = .18$.

Average wages:

- Estimates suggest $.12x(-0.7) \approx -.08$ log points lower industry wages.
- Mean $\Delta \ln \text{Avg. Wage} = 0.39$.

Sensitivity

1. Placebo : Regress 1999-2003 growth on 2004-2013 immigration.
2. Alternative IV.
3. OLS.
4. Substitutability between immigrants and natives.
5. Native worker occupational mobility.
6. Occupation wages.

1. Placebo

Table: Immigration and Industry Employment. Falsification Test.

Dependent variable: $\Delta \ln L_i$ (1999-2003)	(1)	(2)
Δ Immigrant share ($\sum_o \tilde{\lambda}_{io} \Delta \mu_o$) (2004-2013)	-.09	-.33
	(.12)	(.34)
Pre-sample industry controls	No	No
Pre-sample worker controls	No	No
Industry (2-digit)-municipality FE	No	Yes
	1st Stage Estimates	
$\sum_o \lambda_{io} \Delta \mu_o^{IV}$	1.62^a	1.81^a
	(.02)	(.04)
Number of observations	14,315	14,315

Note: Robust standard errors clustered by industry-municipality in parentheses. Changes refer to the time period 2004 to 2013 for the instrument and 1999 to 2003 for the dependent variable. The unit of observation is a 5-digit industry (NACE)-municipality pair. The independent variable and the instrument is constructed at the 3-digit industry level. ^{a} p< 0.01, ^{b} p< 0.05, ^{c} p< 0.1.

1. Placebo

Table: Immigration and Industry Employment. Falsification Test.

Dependent variable: $\Delta \ln L_i$ (1999-2003)	(1)	(2)
Δ Immigrant share ($\sum_o \tilde{\lambda}_{io} \Delta \mu_o$) (2004-2013)	-.14[c]	-.03
	(.07)	(.20)
Pre-sample industry controls	No	No
Pre-sample worker controls	No	No
Industry (2-digit)-municipality FE	No	Yes
	1st Stage Estimates	
$\sum_o \lambda_{io} \Delta \mu_o^{IV}$	1.62[a]	1.81[a]
	(.02)	(.04)
Number of observations	14,315	14,315

Note: Robust standard errors clustered by industry-municipality in parentheses. Changes refer to the time period 2004 to 2013 for the instrument and 1999 to 2003 for the dependent variable. The unit of observation is a 5-digit industry (NACE)-municipality pair. The independent variable and the instrument is constructed at the 3-digit industry level. [a] $p < 0.01$, [b] $p < 0.05$, [c] $p < 0.1$.

2. Alternative IV

- Recall endogenous variable $\sum_o \tilde{\lambda}_{io} \Delta \mu_o$.
- Average language intensity of industry i,

$$IV_i = \sum_o \lambda_{io} LI_o.$$

2. Alternative IV

Table: Immigration and Employment Growth. 2SLS Estimates.

Dependent variable: $\Delta \ln L_i$	(1)	(2)	(3)	(4)
Δ Immigrant share ($\sum_o \tilde{\lambda}_{io} \Delta\mu_o$)	$.64^a$	1.24^a	1.88^a	2.14^a
	(.14)	(.37)	(.36)	(.36)
Pre-sample industry controls	No	No	Yes	Yes
Pre-sample worker controls	No	No	No	Yes
Industry (2-digit)-municipality FE	No	Yes	Yes	Yes
	1st Stage Estimates			
$\sum_o \lambda_{io} LI_o$	$-.08^a$	$-.08^a$	$-.08^a$	$-.08^a$
	(.00)	(.00)	(.00)	(.00)
Number of observations	16,763	16,763	16,763	16,763

Note: Robust standard errors clustered by industry-municipality in parentheses. Changes refer to the time period 2004 to 2013. The unit of observation is a 5-digit industry (NACE)-municipality pair. The independent variable and the instrument is constructed at the 3-digit industry level. Industry controls are: Log value added, log employment, log average wages, the share of exports in total sales and the share of wages in total costs (2003 values). The workers control is the share of workers with a completed high school education or higher (2003 values, averaged across firms in a 5-digit industry). ^{a} $p< 0.01$, ^{b} $p< 0.05$, ^{c} $p< 0.1$.

2. Alternative IV

Table: Immigration and Industry Wage Growth. 2SLS Estimates.

Dependent variable: $\Delta \ln W_i$	(1)	(2)	(3)	(4)
Δ Immigrant share $(\sum_o \tilde{\lambda}_{io} \Delta \mu_o)$	-.54[a]	-.43[b]	-.84[a]	-.64[a]
	(.08)	(.20)	(.19)	(.20)
Pre-sample industry controls	No	No	Yes	Yes
Pre-sample worker controls	No	No	No	Yes
Industry (2-digit)-municipality FE	No	Yes	Yes	Yes
	1st Stage Estimates			
$\sum_o \lambda_{io} LI_o$	-.08[a]	-.08[a]	-.08[a]	-.08[a]
	(.00)	(.00)	(.00)	(.00)
Number of observations	16,763	16,763	16,763	16,763

Note: Robust standard errors clustered by industry-municipality in parentheses. Changes refer to the time period 2004 to 2013. The unit of observation is a 5-digit industry (NACE)-municipality pair. The independent variable and the instrument is constructed at the 3-digit industry level. Industry controls are: Log value added, log employment, log average wages, the share of exports in total sales and the share of wages in total costs (2003 values). The workers control is the share of workers with a completed high school education or higher (2003 values, averaged across firms in a 5-digit industry). [a] $p < 0.01$, [b] $p < 0.05$, [c] $p < 0.1$.

3. OLS

Table: Immigration and Employment Growth. OLS Estimates.

	(1)	(2)	(3)	(4)
Dependent variable: $\Delta \ln L_i$:				
Δ Immigrant share $(\sum_o \tilde{\lambda}_{io} \Delta \mu_o)$	.27[a]	-.09	-.01	.04
	(.10)	(.17)	(.17)	(.17)
Dependent variable: $\Delta \ln W_i$:				
Δ Immigrant share $(\sum_o \tilde{\lambda}_{io} \Delta \mu_o)$	-.20[a]	-.18[b]	-.35[a]	-.29[a]
	(.06)	(.09)	(.08)	(.08)
Pre-sample industry controls	No	No	Yes	Yes
Pre-sample worker controls	No	No	No	Yes
Industry (2-digit)-municipality FE	No	Yes	Yes	Yes
Number of observations	16,763	16,763	16,763	16,763

Note: Robust standard errors clustered by industry-municipality in parentheses. Changes refer to the time period 2004 to 2013. The unit of observation is a 5-digit industry (NACE)-municipality pair. The independent variable is constructed at the 3-digit industry level. Industry controls are: Log value added, log employment, log average wages, the share of exports in total sales and the share of wages in total costs (2003 values). The workers control is the share of workers with a completed high school education or higher (2003 values, averaged across firms in a 5-digit industry). [a] $p< 0.01$, [b] $p< 0.05$, [c] $p< 0.1$.

4. Substitutability between immigrants and natives

Table: Immigrant-Native Wage Differentials

Dep. var: $\ln w_n$	Men (1)	(2)	(3)	Women (4)	(5)	(6)
Immigrant dummy	-0.286 [a]	-0.188 [a]	0.017	-0.216[a]	-0.125[a]	0.014
	(0.027)	(0.025)	(0.014)	(0.039)	(0.029)	(0.014)
Worker controls	No	Yes	Yes	No	Yes	Yes
Occupation FE	No	No	Yes	No	No	Yes
No obs	791,163	791,163	791,163	356,715	356,715	356,715

Note: Robust standard errors clustered by 4-digit occupation. Worker controls are age, experience and tenure. Data set restricted to full time employees in year 2014. [a] $p< 0.01$, [b] $p< 0.05$, [c] $p< 0.1$.

Table: Occupation Transitions by Decile of Language Importance. Natives.

t-1/t	1	2	3	4	5	6	7	8	9	10	Sum
1	**90.4**	2.4	1.7	0.9	1.6	0.6	0.4	1.0	0.6	0.5	100.0
2	2.2	**91.3**	1.6	0.9	1.0	1.0	0.3	0.8	0.6	0.4	100.0
3	1.1	1.2	**91.4**	1.1	1.2	1.2	0.7	0.8	0.9	0.4	100.0
4	0.7	0.7	1.5	**90.1**	1.3	0.4	0.8	2.0	1.2	1.3	100.0
5	0.9	0.6	1.1	0.8	**89.5**	1.4	1.2	1.3	1.9	1.2	100.0
6	0.2	0.4	0.9	0.2	0.9	**89.9**	2.4	2.2	2.0	1.0	100.0
7	0.2	0.2	0.4	0.4	0.8	1.8	**90.4**	1.7	2.8	1.4	100.0
8	0.3	0.2	0.3	0.9	0.8	1.6	1.1	**88.8**	3.3	2.7	100.0
9	0.2	0.2	0.3	0.6	1.2	1.2	2.0	2.9	**88.5**	3.1	100.0
10	0.1	0.1	0.2	0.5	0.7	0.6	1.0	2.5	3.1	**91.2**	100.0

Note: The deciles refer to the language intensity of the occupation. The population is all full-time workers over the period 2010 to 2015.

5. Immigrant worker occupational mobility

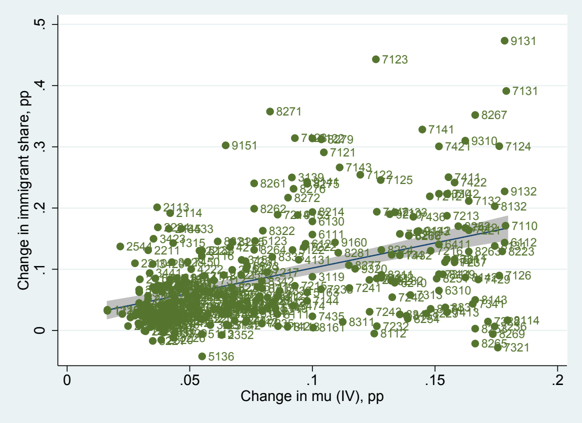
Table: Occupation Transitions by Decile of Language Importance. Immigrants.

t-1/t	1	2	3	4	5	6	7	8	9	10	Sum
1	**90.7**	4.4	1.8	0.8	0.9	0.2	0.4	0.3	0.3	0.2	100.0
2	4.5	**90.6**	1.5	1.2	0.9	0.4	0.2	0.3	0.3	0.2	100.0
3	2.0	1.6	**92.4**	0.9	0.9	0.5	0.8	0.4	0.4	0.2	100.0
4	1.0	1.9	1.8	**89.8**	1.8	0.3	0.5	1.5	0.6	0.9	100.0
5	1.3	1.6	1.3	1.7	**88.4**	0.9	1.3	1.1	1.6	1.1	100.0
6	0.4	0.4	0.5	0.2	0.7	**89.6**	2.8	2.9	2.0	0.6	100.0
7	0.4	0.2	0.5	0.4	0.9	2.2	**90.8**	1.5	2.2	1.0	100.0
8	0.4	0.2	0.4	1.2	0.9	3.0	1.4	**87.6**	2.8	2.1	100.0
9	0.4	0.3	0.5	0.6	1.6	2.5	2.6	2.9	**85.7**	2.7	100.0
10	0.2	0.2	0.3	0.7	1.1	0.7	1.4	2.6	2.8	**90.2**	100.0

Note: The deciles refer to the language intensity of the occupation. The population is all full-time workers over the period 2010 to 2015.

Occupation Wages

- Recall $\hat{w}_{io} = \hat{w}_{jo} = \frac{\hat{Y}}{\hat{L}_o}$.
- We regress $\Delta \ln w_o$ on $\Delta \mu_o$, using the same instruments, where w_o is the mean wage in occupation o. First stage:



- 2SLS coefficient is -.58 (s.e. .19).

Conclusions

- Uneven supply of labor $\longrightarrow$ uneven growth of industries.
  - Immigration has quantitatively large impact on the output mix.
- Empirical support for the simplest possible factor proportions story.
  - Relative wages adjust - immigrant intensive industries benefit more.
  - Caveat: GE wage effects not identified.