ECON0041: Economics of Migration and Job Search

Revision Notes

Contents

1 Lecture 1: Migration and Return Migration

1.1 Overview and key concepts

Migration is the movement of individuals across regions. The lectures distinguish:

- **Internal migration**: mobility within a country; younger people move more, education is closely tied to mobility, and migration is tightly linked to job search.
- **International migration**: driven by wage differences, persecution/displacement, and country-specific preferences.
- **Temporary migration**: return migration and circulatory/seasonal migration.

The economic consequences are two-sided. Host countries face changes in wages, unemployment, prices, taxes, benefits, and social outcomes. Source countries lose workers immediately, but may gain through remittances and through later return migration.

1.2 Compressed descriptive facts

The lecture's descriptive evidence can be compressed into four messages.

1. The global stock of international migrants is large; in 2019 it was about 270 million, with the United States hosting roughly one-fifth of all migrants.
2. Europe has immigrant shares above 10% in many countries, but source composition differs sharply by geography and policy; the UK, for example, receives more college-educated immigrants than Germany.
3. Immigrants are heterogeneous relative to natives: employment gaps remain even after conditioning on observable characteristics, and new arrivals often experience occupational downgrading and segregation.
4. Second-generation outcomes can exceed first-generation outcomes: the notes emphasise stronger educational returns and higher log wages for the second generation.

1.3 A simple one-shot migration model

The core migration model treats mobility as an individual lifetime maximisation problem.

Setup. There are two skill dimensions, manual skill S_m and cognitive skill S_c. Country $j \in \{0, 1\}$ pays skill prices (b_{jm}, b_{jc}) and has country-time productivity R_{jt}. Individual human capital in efficiency units is

$$b_j S = b_{jm} S_m + b_{jc} S_c,$$

so wages satisfy

$$w_{jit} = R_{jt} \exp(b_j S), \qquad \ln w_{jit} = \ln R_{jt} + b_j S. \tag{1}$$

Hence wage differences across countries can come from either different returns to skill or different aggregate productivity.

Migration rule. Let C be the one-off migration cost and r the discount rate. Define the discounted lifetime gain from moving from country 0 to country 1 as

$$\Delta_i = \sum_{t=0}^{T} \frac{w_{1,it} - w_{0,it}}{(1+r)^t} - C. \tag{2}$$

The worker migrates if and only if $\Delta_i > 0$.

Comparative statics.

- Higher foreign skill prices (b_{1m}, b_{1c}) or higher foreign productivity R_{1t} raise $w_{1,it}$ and therefore increase Δ_i.
- Migration depends on *expected future income streams*, not only on current wages. A worker may stay home even if current foreign wages are higher when home-country productivity is expected to catch up quickly.
- Large migration costs, non-pecuniary amenities, and credit constraints can prevent migration even when the present-value gain is positive.

1.4 Return migration

The return-migration extension makes migration duration endogenous.

Choice problem. The worker chooses the fraction t of life spent abroad together with consumption at home and abroad. Utility in country j is written as $v(\zeta_j, c_j)$, where ζ_j indexes the value of consuming in that country.

Home bias. The source notes assume

$$\zeta_0 > \zeta_1,$$

so the marginal utility of consumption is higher at home than abroad. If goods are also more expensive abroad $(p_1 > p_0)$, migration occurs only when the foreign wage exceeds the home wage by enough to compensate for both home bias and higher prices.

Comparative statics. With equal prices across countries, $p_1 = p_0$:

- An increase in the home wage w_0 reduces time spent abroad.
- An increase in the foreign wage w_1 has an *ambiguous* effect on time abroad:
  - **Substitution effect**: foreign work becomes more attractive, so t rises.
  - **Income effect**: the worker reaches the desired earnings target faster, so t falls.

Intuition and exam takeaways. The exam logic is simple: migration is a present-value decision, not a current-wage decision. Return migration appears naturally once the worker values home consumption more highly and can choose duration abroad. Whenever you see a migration question, first ask: what determines the lifetime gain, what fixes migration costs, and how do non-wage factors enter?

2 Lecture 2: The Roy Model and Selection of Immigrants

The Roy model explains *self-selection*: individuals choose the sector, region, or country that pays most for their skill mix. In migration applications, it explains why migrants can be positively selected, negatively selected, or sorted by comparative advantage.

2.1 Setup: wages in two countries

Let E denote the source country and I the destination country. Individuals have two skills, S_1 and S_2, with

$$(S_1, S_2) \sim \mathcal{N}((0,0), I_2), \qquad \mathrm{Cov}(S_1, S_2) = 0.$$

Country $j \in \{E, I\}$ rewards those skills through

$$u_{ji} = b_{j1}S_{1i} + b_{j2}S_{2i},$$

and log earnings are

$$Y_{ji} = \ln y_{ji} = \mu_j + u_{ji}, \tag{3}$$

where $\mu_j = \ln R_j$ is the country-specific mean component.

Because u_{ji} is normal, (Y_{Ei}, Y_{Ii}) is bivariate normal. The variance-covariance structure is

$$\sigma_I^2 = b_{I1}^2 + b_{I2}^2, \qquad \sigma_E^2 = b_{E1}^2 + b_{E2}^2, \qquad \sigma_{IE} = b_{I1}b_{E1} + b_{I2}b_{E2},$$

with correlation $\rho = \sigma_{IE}/(\sigma_I \sigma_E)$.

2.2 Migration rule

Let k be the log migration cost. The worker migrates when destination earnings net of cost exceed source-country earnings:

$$Y_{Ii} - k > Y_{Ei}.$$

Equivalently,

$$u_i \equiv u_{Ii} - u_{Ei} > z \equiv \mu_E + k - \mu_I. \tag{4}$$

Since u_i is normal with variance

$$\sigma_u^2 = \sigma_I^2 + \sigma_E^2 - 2\sigma_{IE},$$

selection reduces to a truncation problem.

2.3 Truncation formulas and mean earnings of migrants

Define

$$a = \frac{z}{\sigma_u}, \qquad \lambda_U(a) = \frac{\phi(a)}{1 - \Phi(a)}, \qquad \lambda_L(a) = \frac{\phi(a)}{\Phi(a)}.$$

Also define the covariances between country-specific earnings components and the migration index:

$$\sigma_{Iu} = \frac{\sigma_I^2 - \sigma_{IE}}{\sigma_u} = \frac{b_{I1}(b_{I1} - b_{E1}) + b_{I2}(b_{I2} - b_{E2})}{\sigma}, \qquad \sigma_{Eu} = \frac{\sigma_{IE} - \sigma_E^2}{\sigma_u} = \frac{b_{E1}(b_{I1} - b_{E1}) + b_{E2}(b_{I2} - b_{E2})}{\sigma}.$$

Then the mean log earnings of migrants are

$$\mathbb{E}[Y_I \mid u > z] = \mu_I + \sigma_{Iu}\lambda_U(a), \tag{5}$$
$$\mathbb{E}[Y_E \mid u > z] = \mu_E + \sigma_{Eu}\lambda_U(a), \tag{6}$$

and for non-migrants,

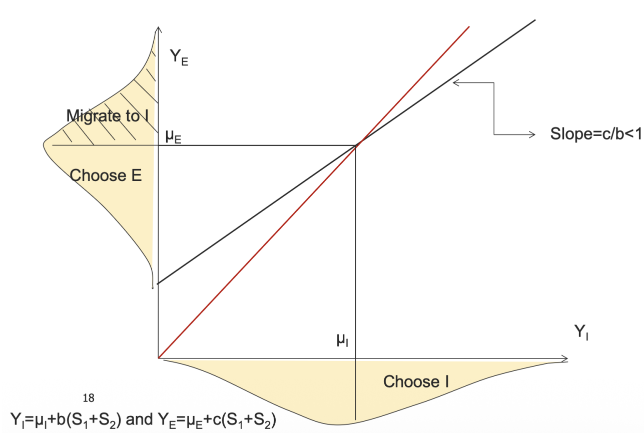
$$\mathbb{E}[Y_I \mid u \le z] = \mu_I - \sigma_{Iu}\lambda_L(a),$$
$$\mathbb{E}[Y_E \mid u \le z] = \mu_E - \sigma_{Eu}\lambda_L(a).$$

The signs of σ_{Iu} and σ_{Eu} determine the direction of selection.

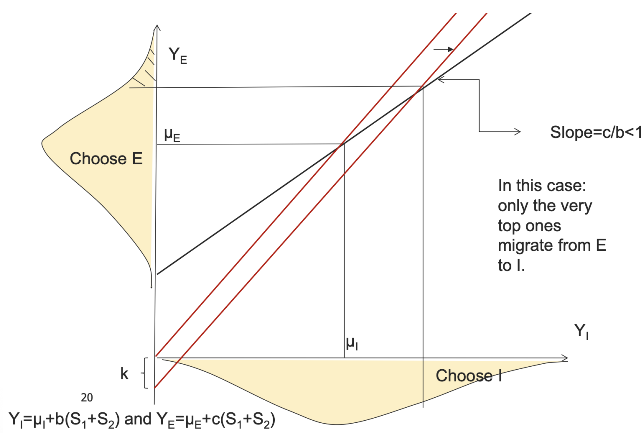
2.4 Case-by-case selection logic

2.4.1 Case I: positive hierarchical selection

If $\sigma_{Iu} > 0$ and $\sigma_{Eu} > 0$, migrants earn above average both at home and abroad. Intuitively, the destination has the more dispersed payoff distribution, so the highest-earning individuals gain most from moving.



(a) Positive hierarchical selection.



(b) Higher migration costs reduce flows and strengthen positive selection.

2.4.2 Case II: negative hierarchical selection

If $\sigma_{Iu} < 0$ and $\sigma_{Eu} < 0$, migrants are below average in both countries. This is the "compressed destination wage distribution" case: the destination insures low earners relatively well, so the lower tail gains most from moving.

2.4.3 Case III: non-hierarchical selection (comparative advantage)

If $\sigma_{Iu} > 0$ but $\sigma_{Eu} < 0$, migrants are above average in the destination but below average in the source. They are not the "best overall"; they are the workers whose skill mix is especially rewarded abroad. This is the central comparative-advantage case.

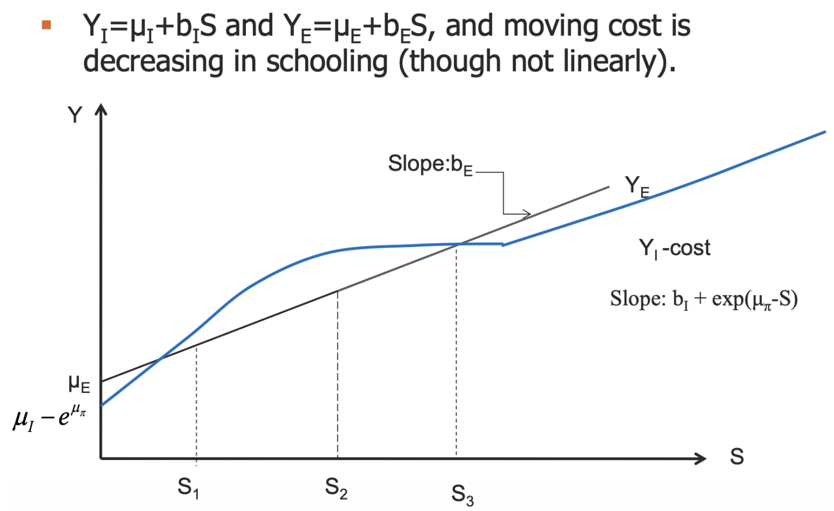
2.4.4 Case IV: impossibility

The notes show that the opposite sign pattern, $\sigma_{Iu} < 0$ and $\sigma_{Eu} > 0$, is impossible except in the degenerate no-selection case $\sigma_u = 0$.

2.5 Migration costs and nonlinear costs

A higher migration cost shifts the migration threshold upward. Fewer people move, and those who still move are more positively selected.

Chiquiar and Hanson (2005) suggests intermediate or positive selection on observed characteristics, which is hard to reconcile with a constant-cost Roy model when the United States has the more compressed wage distribution. The lecture's reconciliation is a *nonlinear migration cost decreasing in schooling*: if highly educated workers face much lower moving costs, migration need not come from the lower tail even when constant-cost Roy predicts negative selection.



Migration Costs=exp(μ_π-S). Workers between S1 and S3 migrate in this case.

3 Lecture 3: Wage Impact of Immigration (Part I)

3.1 The causal question

The object of interest is the causal effect of immigration on wages:

- **Observed outcome**: wages before and after immigration.
- **Counterfactual**: wages after immigration if immigration had not occurred.

The lecture begins with reduced-form strategies and then moves to structural labour-demand estimation.

Main problems.

- **Self-selection**: immigrants choose booming regions or attractive skill cells, so immigration is correlated with local wage shocks.

- **Downgrading/Problematic pre-allocation**: Highly qualified immigrants may be observed in lower-skill occupations upon arrival (due to language barriers, lack of country-specific credentials, etc.), mis-assigning them to the wrong cell and mismeasuring competition.
- **General equilibrium**: native out-migration and other market adjustments attenuate local wage effects, so local estimates understate economy-wide impacts.

3.2 Skill-cell and region-cell regressions

The reduced-form idea is to partition the labour market into "sub-markets" that face different immigration intensity: regions, skills, or skill-region cells.

Baseline panel cell regression.

$$\ln w_{irt} = \alpha + \alpha_r + \alpha_i + \alpha_t + \alpha_{rt} + \alpha_{ri} + \alpha_{it} + \gamma \ln X_{irt} + \varepsilon_{irt}, \tag{7}$$

where

- $\ln w_{irt}$: log average wage of skill group i, in region r, in year t.
- α_r, α_i, α_t: fixed effects for region, skill group, and time respectively.
- α_{rt}, α_{ri}, α_{it}: **two-way fixed effects (TWFE)** — interactions between pairs of dimensions.
  - α_{rt}: absorbs region-specific **shocks/trends over time** (e.g. local business cycles, region-level policy changes, housing/amenity shocks, region-specific demographic shifts).
  - α_{ri}: absorbs time-invariant region–skill composition differences.
  - α_{it}: absorbs skill-group-specific aggregate trends (e.g. economy-wide skill-biased technological change).
- $\ln X_{irt}$: log of the immigrants-to-natives ratio in cell (i, r, t).
- γ: the coefficient of interest — the wage effect of a 1% increase in immigrant labour supply.

First-differencing. Assume two survey waves t and $t-1$. Define $\Delta \ln w_{irt}$ and $\Delta \ln X_{irt}$ as changes in average wage and labour supply of a particular group.

Taking first differences of equation (7):

$$\Delta \ln w_{irt} = \Delta\alpha_t + \underbrace{(\alpha_{rt} - \alpha_{r,t-1})}_{A_r} + \underbrace{(\alpha_{it} - \alpha_{i,t-1})}_{A_i} + \gamma \Delta \ln X_{irt} + \zeta_{irt}, \tag{8}$$

where time-invariant terms (α_r, α_i, α_{ri}) **drop out**. The remaining terms are:

- $\Delta\alpha_t$: common time effect (a year dummy in the differenced regression).
- $A_r = \alpha_{rt} - \alpha_{r,t-1}$: **region FE in differences** — controls for region-specific *linear* time trends.
- $A_i = \alpha_{it} - \alpha_{i,t-1}$: **skill FE in differences** — controls for skill-group-specific *linear* time trends.

The identifying variation is therefore the change in immigrant exposure $\Delta \ln X_{irt}$ *within* region–skill cells, conditional on common trends and group-specific linear trends.

3.3 Shift-share (enclave) IV

To address endogenous inflows (because immigrants self-select into sub-markets and regions that offer higher wages), Card (2009) proposed a historical-settlement instrument:

$$Z_{irt} = \frac{\sum_c \lambda_{irc,\tau} \, \Delta I_{ict}}{X_{ir\tau}}, \tag{9}$$

where $\lambda_{irc,\tau}$ is the base-period share of immigrants from country c in cell (i, r), and ΔI_{ict} is the national change in immigrants from country c entering skill group i.

3.3.1 Interpretation.

The instrument predicts current inflows using old enclave patterns and national "push" shocks. It is relevant when settlement patterns are persistent and exogenous when those old settlement decisions are unrelated to current wage shocks.

3.3.2 Identification conditions.

1. Relevance: $\text{Cov}(Z_{irt}, \, \Delta X_{irt}) \neq 0$

Because settlement patterns are **highly persistent**, the 1980 distribution of immigrants across regions and skill cells is a strong predictor of new inflows in 2000. Immigrants from the same origin country tend to cluster in the same cities over time, so historical shares reliably predict where future waves land.

2. Exogeneity: $\text{Cov}(Z_{irt}, \, \zeta_{irt}) = 0$

The base-period shares $\lambda_{irc,\tau}$ reflect where immigrants settled in 1980, which was determined by economic conditions *at that time* — not by the economic conditions of today (year t). The instrument is therefore "blind" to current shocks: it assigns immigrants to a region based on a decades-old map, not based on today's wage spikes.

Threat to exogeneity. Immigrants in 1980 may have disproportionately settled in high-wage cities. If those cities remain high-wage in subsequent decades due to persistent productivity advantages, then $\lambda_{irc,\tau}$ is correlated with current wage levels. This **long-run persistence of high/low wages** is the main threat: the instrument is no longer exogenous if the characteristics that attracted immigrants in the base period continue to drive wage growth today.

3.3.3 2SLS logic.

The first stage regresses the change in immigrant exposure on Z_{irt}; the second stage regresses wage changes on the fitted immigrant exposure.

3.3.4 Empirical result: Dustmann and Glitz (2013)

The notes report an estimate around $\gamma \approx -0.41$ for Germany: a 1% increase in labour supply in a skill group lowers wages in that group by about 0.41%. The effect appears mainly in non-tradables; tradable sectors adjust through output mix or technology rather than wage cuts alone.

3.3.5 Why move to a structural model?

The grouping approach imposes too much homogeneity.

- Workers in the same education-experience cell need not be equally productive.
- Immigrants and natives, or men and women, may be imperfect substitutes even within the same observed cell.
- Local reduced-form estimates are hard to scale to large national shocks because migration and price adjustment feed back into the result. (i.e. Limited OOS interpretation)

3.4 Nested CES labour demand

Manacorda, Manning and Wadsworth (2013) estimate a nested CES production function to allow for imperfect substitution:

$$Y_t = A_t L_t,$$

Aggregate labor (L_t) = High-skill labor (L_{ht}) + low-skill labor ($L_{\ell t}$)

$$L_t = \left[\theta_{ht} L_{ht}^{\rho_E} + L_{\ell t}^{\rho_E}\right]^{1/\rho_E}, \qquad \sigma_E = \frac{1}{1-\rho_E},$$

Each skill group = Native labour (N_{et}) + Immigrants (M_{et})

$$L_{et} = \left[N_{et}^{\delta} + \beta_{et}^{M} M_{et}^{\delta}\right]^{1/\delta}, \qquad \sigma_I = \frac{1}{1-\delta}.$$

Here β_{et}^M is immigrant labour efficiency relative to natives in cell (e, t).

Under perfect competition, wages equal MPL via the chain rule:

$$W_{et}^s = \frac{\partial Y_t}{\partial S_{et}} = \frac{\partial Y_t}{\partial L_t} \times \frac{\partial L_t}{\partial L_{et}} \times \frac{\partial L_{et}}{\partial S_{et}}, \qquad s \in \{N, M\}, \quad e \in \{h, \ell\}.$$

Evaluating each partial derivative from the CES production functions:

$$W_{et}^s = A_t \cdot \theta_{et} \left(\frac{L_t}{L_{et}}\right)^{1-\rho_E} \cdot \beta_{et}^s \left(\frac{L_{et}}{S_{et}}\right)^{1-\delta}.$$

Defining $\sigma_I = 1/(1-\delta)$ and $\sigma_E = 1/(1-\rho_E)$, the powers simplify:

$$W_{et}^s = A_t \cdot \left(\theta_{et}\, L_t^{\frac{1}{\sigma_E}}\, L_{et}^{-\frac{1}{\sigma_E}}\right) \cdot \left(\beta_{et}^s\, L_{et}^{\frac{1}{\sigma_I}}\, S_{et}^{-\frac{1}{\sigma_I}}\right) = A_t\, \theta_{et}\, \beta_{et}^s \cdot L_t^{\frac{1}{\sigma_E}} \cdot L_{et}^{\left(\frac{1}{\sigma_I} - \frac{1}{\sigma_E}\right)} \cdot S_{et}^{-\frac{1}{\sigma_I}}.$$

Taking logs linearises the formula:

$$\ln W_{et}^s = \underbrace{\ln A_t}_{\text{TFP}} + \underbrace{\ln \theta_{et} + \ln \beta_{et}^s}_{\text{Efficiency}} + \underbrace{\frac{1}{\sigma_E} \ln L_t}_{\text{Agg Labour}} + \underbrace{\left(\frac{1}{\sigma_I} - \frac{1}{\sigma_E}\right) \ln L_{et}}_{\text{Skill Grp Supply}} - \underbrace{\frac{1}{\sigma_I} \ln S_{et}}_{\text{Own Supply}}, \tag{10}$$

where $s \in \{N, M\}$ and S_{et} denotes the supply of group s in skill cell e.

3.5 Bottom-up estimation

Step 1: immigrant-native substitutability within a cell. Apply (10) separately for $s = N$ (where normalized $\beta^N_{et} = 1$, so $\ln \beta^N_{et} = 0$) and $s = M$ ($\beta^M_{et} \neq 1$):

$$\ln W^N_{et} = \underbrace{\ln A_t + \ln \theta_{et} + \tfrac{1}{\sigma_E} \ln L_t + \Big(\tfrac{1}{\sigma_I} - \tfrac{1}{\sigma_E}\Big) \ln L_{et}}_{\text{common terms, independent of } s} - \frac{1}{\sigma_I} \ln N_{et},$$

$$\ln W^M_{et} = \underbrace{\ln A_t + \ln \theta_{et} + \tfrac{1}{\sigma_E} \ln L_t + \Big(\tfrac{1}{\sigma_I} - \tfrac{1}{\sigma_E}\Big) \ln L_{et}}_{\text{common terms, independent of } s} - \frac{1}{\sigma_I} \ln M_{et} + \ln \beta^M_{et}.$$

Subtracting and cancelling common terms:

$$\ln \frac{W^M_{et}}{W^N_{et}} = \ln \beta^M_{et} - \frac{1}{\sigma_I} \ln \frac{M_{et}}{N_{et}}. \tag{11}$$

W^s_{et} is the average wage of (e, s)-type workers in year t; M_{et} and N_{et} can be headcounts or hours worked.

Efficiency parameter. β^M_{et} is unobserved and must be parameterised. Model it via additive dummies:

$$\ln \beta^M_{et} = d_e + d_t \quad \Longleftrightarrow \quad \beta^M_{et} = \exp(d_e + d_t),$$

where $d_e = \mathbf{1}\{e = h\}$ is a skill-group dummy and d_t is a time dummy. An interaction term can be added if needed; further layers (e.g. an age group) simply require an additional dummy.

Estimation. Substituting gives the regression estimated by both Ottaviano–Peri (2013) and Manacorda–Manning–Wadsworth (2013) via OLS, treating immigrant labour supply as exogenous:

$$\ln \frac{W^M_{et}}{W^N_{et}} = d_e + d_t - \frac{1}{\sigma_I} \ln \frac{M_{et}}{N_{et}}.$$

Step 2: substitutability across skill groups. Use Step 1 estimates of σ_I and β^M_{et} to construct the skill-group labour aggregates L_{et}, then compare the fitted wage ratio of high- to low-skilled workers for a given type s (with $\theta_{\ell t} = 1$ by normalization):

$$\ln \frac{\widehat{W}^s_{ht}}{\widehat{W}^s_{\ell t}} = \ln \theta_{ht} - \frac{1}{\sigma_E} \ln \frac{L_{ht}}{L_{\ell t}}.$$

Since θ_{ht} is unobserved, approximate it with a linear time trend (Card & Lemieux, 2001):

$$\ln \theta_{ht} \approx \kappa_0 + \kappa_1 t.$$

This assumption is standard but may be restrictive; results should ideally be robust to replacing the trend with a time dummy. Substituting gives the estimation regression:

$$\ln \frac{\widehat{W}^s_{ht}}{\widehat{W}^s_{\ell t}} = \kappa_0 + \kappa_1 t - \frac{1}{\sigma_E} \ln \frac{L_{ht}}{L_{\ell t}}.$$

OLS delivers $\hat{\sigma}_E = 1/(1-\hat{\rho}_E)$ and $\hat{\theta}_{ht} = \exp(\hat{\kappa}_0 + \hat{\kappa}_1 t)$, which are then used to construct the full effective labour supply aggregate L_t.

Step 3: simulate wage effects of immigration. Plug all estimated parameters back into the wage equation:

$$\ln \widehat{W}^s_{et} = \ln A_t + \ln \hat{\theta}_{et} + \ln \hat{\beta}^s_{et} + \frac{1}{\hat{\sigma}_E} \ln L_t + \left(\frac{1}{\hat{\sigma}_I} - \frac{1}{\hat{\sigma}_E}\right) \ln L_{et} - \frac{1}{\hat{\sigma}_I} \ln S_{et}.$$

Two notes on A_t:

- A_t drops out when computing *changes* in wages, since it is independent of the labour supply vector.
- If immigration generates TFP spillovers (e.g. high-skilled immigrants raise A_t), then A_t depends on immigration and the simulation understates the true wage effect.

3.6 Main findings and limitations

- Ottaviano–Peri and Manacorda–Manning–Wadsworth both find that immigrants and natives are **imperfect substitutes** within education-age cells.
- As a result, immigration depresses immigrant wages more than native wages: much of the competition is immigrant-on-immigrant.
- The main limitation is assignment by observed skills. If highly educated immigrants work in low-skill jobs, cell-based competition is mismeasured.

4 Lecture 4: Wage Impact of Immigration (Part II)

4.1 Natural experiments: the Mariel Boatlift

The lecture next studies identification from exogenous regional shocks.

Event. In 1980, roughly 125,000 Cubans arrived in Miami during the Mariel Boatlift, increasing Miami's labour force by about 7%. The key claim is that the timing and magnitude of this shock were independent of Miami's local labour-market conditions.

Difference-in-differences. Card's design compares Miami with four control cities before and after the Boatlift. In potential-outcome language,

$$\text{Treatment effect} = (Y_{\tau 1} - Y_{\tau 0}) - (Y_{c1} - Y_{c0}).$$

In regression form,

$$Y_{it} = \beta_0 + \alpha(\text{Miami}_i \times \text{Post}_t) + \delta\,\text{Post}_t + \gamma\,\text{Miami}_i + u_{it}, \tag{12}$$

where α is the DiD estimate.

Main result. Card (1990) finds little effect on wages or unemployment of less-skilled non-Cubans in Miami.

4.2 Critiques of the Mariel design

The lecture emphasises four reasons why a zero local effect need not mean zero total effect.

1. Miami had a special industrial structure (apparel, textiles, and an established Hispanic enclave), so absorption may have been unusually easy.
2. Domestic workers may have avoided moving into Miami, attenuating the observed local supply increase.
3. Angrist and Krueger (1999)'s "non-event" boatlift test suggests that the control cities may not satisfy parallel trends.
4. Miami is not an autarkic labour market: technology, trade, and output mix can adjust, and control cities may be indirectly connected through factor-price equalisation.

4.3 Borjas (2003): national skill-cell approach

Borjas argues that regional studies understate the effect of immigration because natives can move away. He therefore uses national variation across education-experience cells (*Similar to MMW*).

Production structure. A nested CES production function with 32 skill-cells per period:

- **Level 1**: Capital and aggregate labour.
- **Level 2**: 4 education groups — high-school dropouts, high-school graduates, some college, college graduates.
- **Level 3**: 8 experience groups, each a 5-year bin covering 1–40 years of potential experience.

Assumptions.

- Immigrants and natives are perfect substitutes within a cell.
- There is no immigrant downgrading.
- Education groups are arranged in a nested CES structure with age/experience cells.

The immigrant supply shock in cell (e, a) is measured by the immigrant share

$$p_{ea} = \frac{M_{ea}}{M_{ea} + N_{ea}}.$$

Reported results. A 10% increase in immigrant share lowers wages of competing native workers by roughly 3–4%. Between 1980 and 2000, immigration is reported to have lowered the wage of the average native by 3.2%, with much larger effects for high-school dropouts (8.9%).

4.4 Borjas (2006): geography matters

Using the same basic model at different geographic levels, Borjas finds more negative estimated wage effects at broader geographic aggregation levels:

$$\text{nation} > \text{division} > \text{state} > \text{metro}$$

in absolute magnitude. The interpretation is that local effects are attenuated when natives and capital can respond more easily across nearby areas. Measurement error at fine geographic levels may also contribute to attenuation.

4.5 Card (2009): why are local effects often small?

Card revisits local labour markets and estimates substitution patterns using MSA-level data with network IVs. The lecture highlights two results.

- Low-skill groups such as high-school dropouts and high-school graduates behave as close substitutes, so low-skill immigration is spread over a broad "high-school-equivalent" market rather than concentrated on dropouts alone.
- Immigrants and natives are imperfect substitutes within broad education groups, so much of the competitive pressure falls on earlier immigrants.

Study	Identification design	Core assumption / threat	Main message
Card (1990)	Miami vs control cities, DiD	Parallel trends and valid controls	Local effect of Mariel appears small
Borjas (2003)	National education-experience cells	No downgrading; strong within-cell substitutability	Larger national wage effects, especially for close competitors
Borjas (2006)	Same idea at wider geographic levels	Internal mobility attenuates local estimates	Broader markets show larger negative effects
Card (2009)	Regional approach with network IV	Historical enclaves identify inflows	Small native wage effects are consistent with imperfect substitution

5 Lecture 5: Local Labour Market (Part I)

5.1 The Roback framework

The Roback model studies how wages and rents capitalise location-specific attributes.

Assumptions.

- Workers are perfectly mobile across areas and sectors.

- Firms and workers are homogeneous.
- There is one nationally traded good, whose price is normalised to one.
- Cities differ in an exogenous amenity s, which affects worker utility and firm costs.

Worker problem. A representative worker chooses consumption of the traded good x, residential land ℓ^c, and location c:

$$\max_{x,\ell^c,c} U(x, \ell^c, s) \qquad \text{s.t.} \qquad w = x + r\ell^c.$$

Let $V(w, r, s) = U(x^*, \ell^{c*}, s)$ be the indirect utility (optimal utility for a given s). Whether s raises or lowers welfare depends on its type:

$$\frac{dV}{ds} > 0 \text{ (amenity)}, \qquad \frac{dV}{ds} < 0 \text{ (dis-amenity)}.$$

Since x^* and ℓ^{c*} are conditional on s, the problem reduces to choosing the location that maximises indirect utility:

$$\max_c \ V(w, r, s).$$

In equilibrium, perfect mobility implies indirect utilities are constant across locations (no incentive to move):

$$V(w, r, s) = V_0. \tag{13}$$

Firm problem. Firms use labour N, production land ℓ^p, and the city amenity s:

$$x = f(\ell^p, N, s).$$

With constant returns to scale and perfect competition, the unit cost function satisfies

$$C(w, r, s) = 1. \tag{14}$$

Sign restrictions

$$C_w > 0, \qquad C_r > 0, \qquad C_s > 0 \text{ if } s \text{ is unproductive}, \qquad C_s < 0 \text{ if } s \text{ is productive}.$$

Land constraint. Suppose there are N workers and M firms

$$M\ell^p + N\ell^c = L. \tag{15}$$

5.2 Equilibrium logic with an unproductive amenity

Suppose $s_1 < s_2$, then firm and worker have opposite preference:

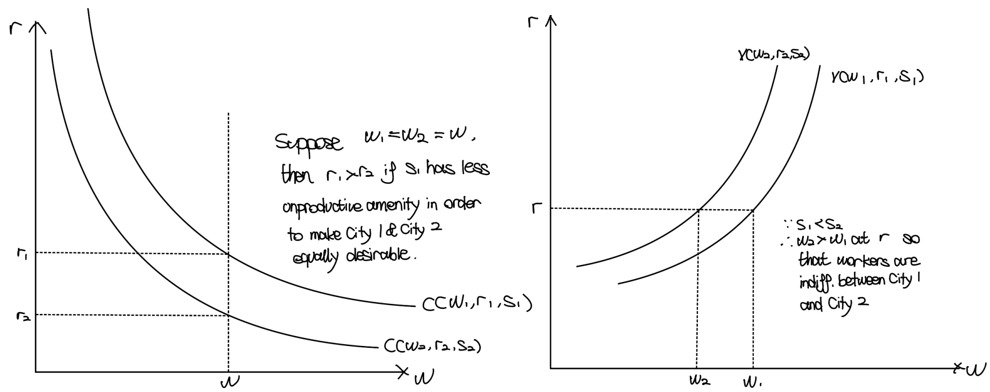
Worker side. Holding rents fixed, a more attractive city needs a *lower wage* to keep workers indifferent:

$$\left.\frac{\partial w}{\partial s}\right|_{V=V_0} < 0.$$

Firm side. Holding wages fixed, firms require *lower rents* in the high-amenity city to offset the higher production cost:

$$\left.\frac{\partial r}{\partial s}\right|_{C=1} < 0.$$

Implication. The equilibrium wage effect is unambiguous but the rent effect is not. Wages are lower in the more amenable city; the relative rent can be high or low depending on how the worker-indifference and firm-zero-profit loci intersect.



5.3 Empirical implication

Roback's empirical idea is to regress local wages (and, in fuller versions, rents) on location characteristics after controlling for worker observables. Compensating differentials and amenity capitalisation are then read off from the coefficients.

5.4 Limitations

The key limitation is the homogeneous-worker assumption. In reality, people have idiosyncratic preferences over cities, strong birthplace attachment, and network effects. That motivates the next lecture.

6 Lecture 6: Local Labour Market (Part II)

6.1 From Roback to heterogeneous preferences

Kline and Moretti (2013) extend Roback by allowing workers of a given type to value cities differently. For worker i in city c,

$$u_{ic} = \underbrace{\beta_w(w_c - t) - \beta_r r_c + \beta_A A_c}_{\text{Don't vary across people}\,(\delta_c)} + e_{ic}, \tag{16}$$

where e_{ic} is an idiosyncratic taste shock, t is a common lump-sum tax, and A_c is a city amenity index. The lecture assumes e_{ic} is **i.i.d. Type-I extreme value**. This yields a logit choice structure.

6.2 Choice probabilities

Define mean utility

$$\delta_c = \beta_w(w_c - t) - \beta_r r_c + \beta_A A_c.$$

Then utility is $u_{ic} = \delta_c + e_{ic}$ and the probability that worker i chooses city c is

$$P(d_{ic} = 1) = \frac{\exp(\delta_c)}{\sum_{k=1}^{J} \exp(\delta_k)}. \tag{17}$$

Hence the expected population in city c is the sum of the choice probabilities over all workers:

$$\sum_{i}^{I} \left(\frac{\exp(\delta_c)}{\sum_{k=1}^{J} \exp(\delta_k)} \right)$$

Interpretation. Perfect equalization of utility no longer holds. High-utility cities can have larger populations because some workers value them more than others.

6.3 Discrete-choice taxonomy

The lecture distinguishes:

- **Conditional logit**: alternative-specific covariates vary across cities.
- **Multinomial logit**: individual-specific covariates vary across people.
- **Mixed logit**: combines both; let β be a parameter vector common to all choices.

Mixed logit specification. For choice $j = 2, \ldots, J$:

$$\Pr(Y_i = j \mid x_{i1}, \ldots, x_{iJ}) = \frac{\exp(x'_{ij}\beta)}{\exp(0) + \sum_{k=2}^{J} \exp(x'_{ik}\beta)} = \frac{\exp(x'_{ij}\beta)}{1 + \sum_{k=2}^{J} \exp(x'_{ik}\beta)},$$

where X_{ij} incorporates both individual-specific attributes and choice-specific covariates. For choice $j = 1$ we **normalise utility to zero**: $\exp(0) = 1$. This is necessary because only utility *differences* are identified.

6.4 Berry inversion and IV estimation

The lecture adapts Berry's (1994) inversion. Let city 1 be the normalised outside option with $\delta_1 = 0$.

Let $\hat{s}_c$ denote the **predicted population share of a given worker type in city** c. Given $e_{ic} \overset{i.i.d.}{\sim}$ Type-I Extreme Value, each individual chooses city c with the logit probability, so the predicted share is

$$\hat{s}_c = \frac{1}{N} \sum_{i=1}^{N} \frac{\exp(\delta_c)}{1 + \sum_{k=2}^{J} \exp(\delta_k)}.$$

Since the choice probability is independent of i, the sum over N individuals collapses:

$$\hat{s}_c = \frac{1}{N} \cdot N \cdot \frac{\exp(\delta_c)}{1 + \sum_{k=2}^{J} \exp(\delta_k)} \implies \hat{s}_c = \frac{\exp(\delta_c)}{1 + \sum_{k=2}^{J} \exp(\delta_k)}.$$

Setting $\hat{s}_c = s_c$ (observed share) and noting $s_1 = \left(1 + \sum_{k=2}^{J} \exp(\delta_k)\right)^{-1}$, taking logs and subtracting yields

$$\delta_c = \ln s_c - \ln s_1, \qquad c = 2, \ldots, J. \tag{18}$$

In a second step, estimate

$$\delta_c = \beta_w(w_c - t) - \beta_r r_c + \zeta_c, \tag{19}$$

where ζ_c captures unobserved amenities ($\beta_A A_c$).

IV logic. In (19), $\zeta_c = \beta_A A_c$ is unobserved and correlated with both w_c and r_c through the Roback mechanism, so OLS is inconsistent. The estimated $\hat{\beta}_w$ and $\hat{\beta}_r$ represent workers' demand elasticities for cities with respect to wages and rents; identifying them requires exogenously shifting the labour supply curve.

A standard instrument is a **Bartik (shift-share) labour-demand shock**: national industry employment growth interacted with the city's industrial composition in a base year. With K industries, the instrument for city c at time t is

$$Z_c = \sum_{k=1}^{K} z_{k,c}^{t-10} \times \Delta \ln H_t^k,$$

where $z_{k,c}^{t-10}$ is the local employment share in industry k ten years ago, and $\Delta \ln H_t^k$ is the change in national employment hours in industry k over the period. A city with a larger historical share in a booming industry experiences a larger labour-demand shock.

- *Relevance*: decent — national shocks are amplified in cities historically specialised in the affected industry.
- *Exogeneity*: debatable — the base-year shares may persist and correlate with today's ζ_c (the persistence problem).

Because both w_c and r_c are endogenous, **at least two valid instruments are needed** to separately identify $\hat{\beta}_w$ and $\hat{\beta}_r$. Once estimated, the amenity index is recovered as the residual:

$$\hat{\beta}_A A_c = \delta_c - \hat{\beta}_w(w_c - t) - \hat{\beta}_r r_c.$$

6.5 Recovering amenities and closing the model

Once β_w and β_r are estimated, the amenity component is backed out as a residual from (19). The final step is to embed the location-choice block inside equilibrium:

- local labour demand comes from a production side (nested CES in later lectures),
- local labour supply comes from the logit shares,
- housing supply adds congestion so that not all workers pile into the highest-wage city.

7 Lecture 7: Local Labour Market (Part III)

7.1 Overview of the full spatial equilibrium model

This lecture integrates local labour demand, location choice, and housing supply in one static spatial equilibrium model. Workers differ by skill, gender, nativity, and birthplace; immigrants value enclave networks, natives value birthplace proximity, and cities differ in productivity, amenities, and housing-supply elasticity.

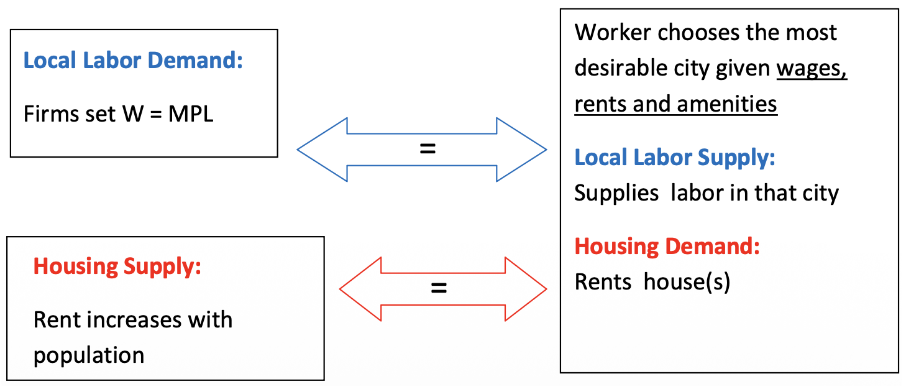


Figure 2: Structure of the full spatial equilibrium model (Lecture 7).

The model is designed to answer a question that reduced-form local regressions cannot answer cleanly: *if immigration rises, where do migrants go, how do wages and rents respond, and how much of the adjustment occurs through internal migration?*

7.2 Local labour demand

Output in city c and year t is Cobb–Douglas in capital and aggregate labour:

$$Y_{ct} = A_{ct} L_{ct}^{\alpha} K_{ct}^{1-\alpha}, \qquad \alpha \in (0,1). \tag{20}$$

Capital is perfectly elastically supplied at a common price.

Three-layer CES labour aggregator. The lecture stacks labour types as follows:

1. **Skill layer**: high-skill and low-skill labour are imperfect substitutes.
2. **Gender layer**: within a skill group, men and women are imperfect substitutes.
3. **Nativity layer**: within a skill-gender cell, immigrants and natives are imperfect substitutes, and the immigrant-native elasticity may differ by skill level.

A compact representation is

$$L_{ct} = \Big(\sum_{e\in\{H,L\}} \theta_{ect} L_{ect}^{\rho_E}\Big)^{1/\rho_E},$$
$$L_{ect} = \Big(\sum_{g\in\{F,M\}} \phi_{egct} L_{egct}^{\rho_G}\Big)^{1/\rho_G},$$
$$L_{egct} = \Big(\sum_{s\in\{M,N\}} \beta_{egct}^{s} S_{egct}^{\rho_{ME,e}}\Big)^{1/\rho_{ME,e}}.$$

where relative importance are normalized (additive to 1): $\theta_{Lct} = 1 - \theta_{Hct}$, $\phi_{eFct} = 1 - \phi_{eMct}$, and $\beta_{egct}^{N} = 1$. The corresponding elasticities are

$$\sigma_E = \frac{1}{1-\rho_E}, \qquad \sigma_G = \frac{1}{1-\rho_G}, \qquad \sigma_{ME,e} = \frac{1}{1-\rho_{ME,e}}.$$

Real wage equation. Using $w/P = MPL$ and the chain rule through the three nests, the lecture derives a wage equation of the form

$$\ln\frac{w_{egct}^{s}}{P_t} = \frac{1}{\alpha}\ln A_{ct} + \eta_t + \ln\theta_{ect} + \frac{1}{\sigma_E}(\ln L_{ct} - \ln L_{ect}) + \ln\phi_{egct} + \frac{1}{\sigma_G}(\ln L_{ect} - \ln L_{egct}) + \ln\beta_{egct}^{s} + \frac{1}{\sigma_{ME,e}}(\ln L_{egct} - \ln S_{egct}). \tag{21}$$

Each term has a clear interpretation: city productivity, aggregate labour-supply pressure, relative scarcity inside each nest, and the efficiency weight of the specific labour type.

7.3 Location choice and labour supply

Utility specification. Worker i of type $z = (e,g,s)$ maximises utility over the national consumption good G_{it} and housing Q_{it} subject to $P_tG_{it} + R_{ct}Q_{it} \le w_{ct}^{z}$. Maximisation yields the closed-form indirect utility

$$V_{ict} = \underbrace{\ln\Big(\frac{W_{ct}^{z}}{P_t}\Big) - \beta_z^{r}\ln\Big(\frac{R_{ct}}{P_t}\Big)}_{w_{ct}^{z}\ \text{(Local Real Wage)}} + \underbrace{\beta_z^{A}x_{ct}^{A} + \beta_z^{rb}x_{ic,t-\tau}^{rb} + \beta_z^{st}x_{ic}^{st} + \beta_z^{d}x_{ic}^{d}}_{u_i(N_{ct})} + \sigma^{z}\varepsilon_{ict}, \quad 0 \le \beta_z^{r} \le 1. \tag{22}$$

The non-wage components, with underbraces matching the structure of u_i, are:

$$u_i(N_{ct}) = \underbrace{\beta_z^{A}x_{ct}^{A}}_{\text{City Amenities}} + \underbrace{\big(\beta_z^{rb}x_{ic,t-\tau}^{rb}\big)}_{\substack{\text{Network}\\ \text{Immigrant relevant}}} + \underbrace{\underbrace{\beta_z^{st}x_{ic}^{st}}_{\text{Birth State}} + \underbrace{\beta_z^{d}x_{ic}^{d}}_{\text{Distance to birth state}}}_{\text{Native Relevant}} + \sigma^{z}\varepsilon_{ict}.$$

Variable definitions:

- x_{ct}^{A}: city amenities (climate, services) — common to all residents.
- $x_{ic,t-\tau}^{rb}$: immigrant network strength (past immigrant stock from the same origin, lagged τ periods); immigrant relevant.
- x_{ic}^{st}, x_{ic}^{d}: "home bias" captured via birth-state proximity and distance to birth state; native relevant.

- $\varepsilon_{ict} \overset{i.i.d.}{\sim}$ **Type I Extreme Value (Gumbel)** with variance σ^z: idiosyncratic taste shocks generating probabilistic sorting.

Normalisation. Since argmax is invariant to positive affine transformations, divide throughout by σ^z and define $\lambda_z^j = \beta_z^j/\sigma^z$. Let $\Gamma_{ct}^z = w_{ct}^z/\sigma^z + \frac{\beta_z^A}{\sigma^z} x_{ct}^A$ be the **mean utility** for type z in city c (wage-price component, net of home-bias and network terms). The full deterministic utility is then

$$U_{ict} = \Gamma_{ct}^z + \lambda_z^{rb} x_{ic,t-\tau}^{rb} + \lambda_z^{st} x_{ic}^{st} + \lambda_z^d x_{ic}^d,$$

so $V_{ict}/\sigma^z = U_{ict} + \varepsilon_{ict}$. The outside option (base city) is normalized to $U_{ct} = 0 \Rightarrow \exp(U_{ct}) = 1$.

Choice probabilities. Given the T1EV shock, the probability that worker i of type z chooses city c is

$$\underset{ct}{\overset{z}{\Pr}} = \frac{\exp(U_{ict})}{1 + \sum_{c'=1}^{J} \exp(U_{ic't})}. \tag{23}$$

Since U_{ict} does not vary across individuals, by the Law of Large Numbers the predicted share equals the individual choice probability.

$$\hat{s}_c = \frac{\exp\Big(\Gamma_{ct}^z + \Big(\lambda_z^{st} x_{ic}^{st} + \lambda_z^d x_{ic}^d + \lambda_z^{rb} x_{ic,t-\tau}^{rb}\Big)\Big)}{1 + \sum_{k \in C}^{J-1} \Big[\lambda_z^{st} x_{ic}^{st} + \lambda_z^d x_{ic}^d + \lambda_z^{rb} x_{ic,t-\tau}^{rb}\Big]} \tag{24}$$

Labour supply. The labour supply of type z to city c in year t is

$$Z_{ct} = Z_t \cdot \underset{ct}{\overset{z}{\Pr}}, \tag{25}$$

where Z_t is the total number of type-z workers in the economy.

7.4 Housing supply

Housing is produced competitively using land (ℓ_{ct}) and materials (m_{ct}) with a Cobb–Douglas technology:

$$Q_{ct} = a_{ct} \ell_{ct}^{\phi} m_{ct}^{1-\phi}.$$

The per-period rent is proportional to the housing price. The lecture rewrites the housing equilibrium as

$$\ln(R_t) = \ln(CC_{ct}) + [\gamma^{geo} x_c^{geo} + \gamma^{regu}(\ln x_c^{regu})] \ln\left(\sum_z Z_{ct} \lambda_z^r W_{ct}^z\right), \tag{26}$$

where $\ln(CC_{ct})$ is construction cost, Q_{ct} is the housing-demand shifter and γ_c is the inverse elasticity of housing supply.

Key comparative static. γ_c is larger in cities with tighter geography and stricter land-use regulation. Therefore the same demand shock generates a larger rent increase in supply-constrained cities.

7.5 Equilibrium

An equilibrium consists of wages, rents, and populations such that

1. workers choose cities optimally,
2. firms satisfy zero profit,
3. local labour demand equals local labour supply for each worker type,
4. housing demand is consistent with the rent equation.

Walras' law then closes the national traded-good market.

7.6 Data and estimation strategy

The lecture uses 1980, 1990, 2000 Census data and 2005–07 ACS for 114 MSAs plus an outside option.

Block	What is estimated	Main identifying idea
Labour demand, Step 1	Immigrant-native elasticity within nativity nests $\sigma_{ME,e}$ and efficiency terms β^s_{egct}	Relative wage equation within the same (e, g, c, t) cell, instrumented with predicted inflows from 1980 enclaves
Labour demand, Step 2	Gender elasticity σ_G and gender weights ϕ_{egct}	Adjusted male-female wage ratios after purging nativity effects
Labour demand, Step 3	Skill elasticity σ_E and skill weights θ_{ect}	Adjusted high-low wage ratios after purging lower-nest effects
Worker preferences	Mean utilities Γ^z_{ct} and network parameters	Two-step BLP: first invert choice probabilities, then IV-regress mean utility on wages/rents
Housing supply	Rent elasticity parameters γ_c	Exogenous housing-demand shifts from labour-demand instruments interacted with regulation/geography

Table 1: Estimation logic in Lecture 7.

The lecture uses a Katz–Murphy/Bartik-style labour-demand shifter to instrument wages in the preference block: old local industry shares interacted with national industry demand growth. The same logic, combined with land-use regulation, identifies housing-supply responsiveness.

7.7 Baseline estimates and economic interpretation

The reported qualitative findings are:

- low-skill immigrants are closer substitutes for low-skill natives than high-skill immigrants are for high-skill natives;
- migration elasticities with respect to wages are positive;
- low-skill workers are more tied to birthplace and ethnic networks than high-skill workers;
- housing-supply constraints are central because they turn immigration into a real-wage shock, not just a nominal-wage shock.

7.8 Counterfactual experiments

The lecture compares two counterfactual regimes after a high-skill immigration shock:

- **Fixed migration**: incumbents do not relocate internally.
- **Free migration**: all workers re-optimise location.

The headline predictions are:

1. Internal migration equalises local real-wage effects across space.
2. Existing immigrants typically lose more than natives because they are closer substitutes for new immigrants.
3. Housing rents rise most in cities with inelastic housing supply.
4. Welfare losses are largest for workers who are direct substitutes for the inflow; allowing internal migration attenuates those losses.

8 Lecture 8: Wage Assimilation

8.1 Definition and motivation

Wage assimilation is the process by which immigrant earnings catch up to native earnings. It matters for tax contributions, intergenerational mobility, and the long-run fiscal and social consequences of immigration.

8.2 Chiswick (1978): cross-sectional assimilation

Chiswick estimates separate earnings equations for immigrants and natives:

$$\ln w_i^I = b_1^I x_i + b_2^I \text{Exp}_i + b_3^I YSM_i + e_i^I, \tag{27}$$
$$\ln w_i^N = b_1^N x_i + b_2^N \text{Exp}_i + e_i^N. \tag{28}$$

Here YSM_i is years since migration, and Exp_i is potential labour-market experience.

Interpretation.

- b_2^I measures returns to experience accumulated anywhere.
- b_3^I captures extra returns to time spent in the host country.
- $b_2^I + b_3^I$ is the overall immigrant return to experience.

Reported result. Immigrants start with an earnings disadvantage of roughly 17%, but their earnings overtake natives after about 10–15 years in the host country.

8.3 Why the cross-section can be misleading

The core problem is that immigrants with different years-since-migration arrived at different dates. If cohort quality changes over time, the YSM coefficient mixes assimilation with cohort effects.

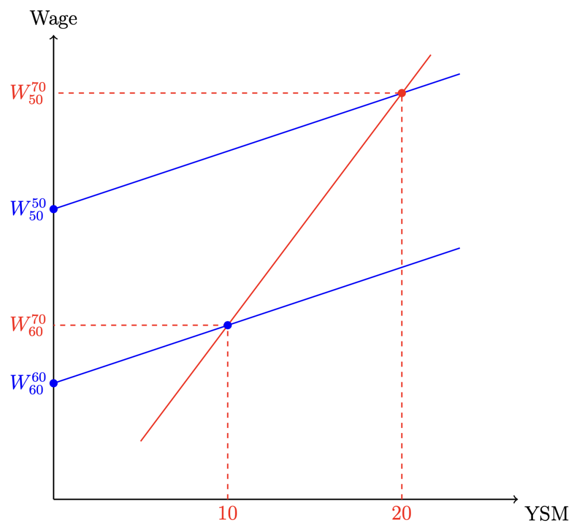


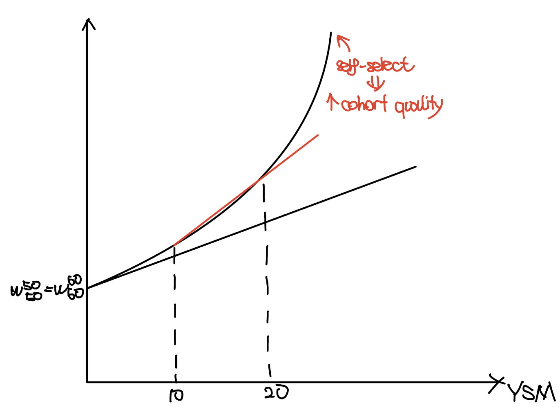
Figure 3: Cohort-effect: when later cohorts start with lower entry wages, a single cross section overstates assimilation.

Borjas (1985): cohort effect. Suppose the 1950s cohort is more capable than the 1960s cohort, but each cohort follows the same within-cohort wage-growth path. Observing only one later cross section mechanically makes the estimated wage profile steeper than the true within-cohort assimilation profile.

Direction of bias.

- Deteriorating cohort quality over time ⇒ cross sections *overstate* assimilation.
- Improving cohort quality over time ⇒ cross sections *understate* assimilation.

Attrition problem. Even if cohort quality were constant, selective out-migration creates upward bias: migrants who do poorly may leave, so the observed surviving cohort becomes increasingly positively selected over time.



8.4 Panel data and the identification problem

A richer specification is

$$\ln w_{it}^I = b_1^I x_{it} + b_2^I \text{Exp}_{it} + b_3^I YSM_{it} + b_m^I C_{im} + \gamma_t^I T_{it} + e_{it}^I, \tag{29}$$

$$\ln w_{it}^N = b_1^N x_{it} + b_2^N \text{Exp}_{it} + \gamma_t^N T_{it} + e_{it}^N. \tag{30}$$

Here C_{im} are cohort indicators and T_{it} are time effects.

Why identification fails mechanically. For immigrants, years since migration satisfies

$$YSM_{it} = T_{it}(t - C_{im}), \tag{31}$$

where $t - C_{im}$ measures how long the worker has been in the host country.

Substituting YSM_{it} into the immigrant wage equation gives

$$\ln w_{it}^I = b_1^I x_{it} + b_2^I \text{Exp}_{it} + b_3^I T_{it}(t - C_{im}) + b_m^I C_{im} + \gamma_t^I T_{it} + e_{it}^I.$$

In any given year t, $T_{it} = 1$, so this simplifies to

$$\ln w_{it}^I = b_1^I x_{it} + b_2^I \text{Exp}_{it} + b_3^I t - b_3^I C_{im} + b_m^I C_{im} + \gamma_t^I + e_{it}^I.$$

Collecting terms on C_{im}:

$$\ln w_{it}^I = b_1^I x_{it} + b_2^I \text{Exp}_{it} + (b_m^I - b_3^I) C_{im} + b_3^I t + \gamma_t^I + e_{it}^I. \tag{32}$$

The cohort coefficient $(b_m^I - b_3^I)$ and the time trend $b_3^I t$ enter only through their combination with γ_t^I: the data can identify their sum but not each component separately. Therefore b_3^I and γ_t^I are not separately identified, and consequently neither are b_m^I and b_3^I.

A way out. If the time effects $\{\gamma_t^I\}_{t=2}^{T-1}$ can be pinned down from an external source, b_3^I is then identified, and in turn b_m^I is identified. (The normalization runs to $T - 1$ because one category of the time dummy must be omitted.)

8.5 Ways to break the collinearity

The lecture discusses three responses.

1. **Impose common macro effects over long periods**: possible but very strong.
2. **Borjas (1988)**: assume immigrants and natives share the same time effects ($\gamma_t^I = \gamma_t^N$), so immigrant time effects are imputed from the native equation. Strong and empirically questionable.
3. **Bratsberg et al. / Barth et al.**: parameterize time effects through local unemployment u_{rt},

$$\gamma_{rt}^I = \gamma_t^0 + \eta^I \ln u_{rt}, \qquad \gamma_{rt}^N = \gamma_t^0 + \eta^N \ln u_{rt}.$$

   Immigrants are estimated to be much more cyclical than natives ($\eta^I \approx -0.14$ versus $\eta^N \approx -0.02$ in the notes).

8.6 What drives wage assimilation?

Lessem and Sanders (2014) decompose wage growth into two channels:

1. **Returns to host-country experience**: immigrants accumulate country-specific language, institutional knowledge, and other human capital.
2. **Job-search and occupational upgrading**: immigrants initially work below their preferred occupation and move up the job ladder over time.

Their counterfactual assigns each immigrant the best occupation already in the first year. The remaining growth then isolates the experience channel. The lecture's conclusion is that job-search frictions are especially important early after arrival, while later wage growth mostly reflects returns to experience.

8.7 Spatial assimilation

The final point is that wage assimilation is not only occupational. Immigrants also move across cities over time and improve earnings through internal migration, even without changing occupation.

9 Lecture 9: Unemployment, Search, and Matching (Part I)

9.1 Why search frictions matter

In a frictionless Walrasian labour market, a single wage should clear the market. With search and matching frictions, unemployment and vacancies coexist: there is excess supply of workers and excess demand for filled jobs at the same time. This is why wage-setting alone cannot explain observed labour-market allocations.

9.2 McCall's sequential search model

An unemployed worker receives offers one at a time and chooses whether to accept or continue searching.

Assumptions.

- Infinite horizon, stationary environment.
- Continuous time and constant discount rate r.
- Wage offers are drawn from a known & stationary distribution with CDF $F(w) : w \in [\underline{w}, \bar{w}]$ on a bounded support. The functional form of $F(w)$ is exogenous.
- Offers arrive at exogenous Poisson rate α.
- Flow payoff is b while unemployed and w while employed.
- No on-the-job search in the baseline model.

9.3 Value functions

Let U be the value of unemployment and $N(w)$ the value of employment at wage w.

Bellman Equation #1: Value of working at wage w

$$N(w) = \frac{w\,dt + N(w)}{1 + r\,dt} = \frac{w}{r}. \tag{33}$$

Bellman Equation #2: Value of unemployment

$$U = \frac{b\,dt + (1 - \alpha\,dt)U + \alpha\,dt\,\mathbb{E}[\max\{N(w), U\}]}{1 + r\,dt}. \tag{34}$$

- $\alpha\,dt\,\mathbb{E}[\max\{N(w), U\}] =$ The expected utility when you receive an offer
- $(1 - \alpha\,dt)U =$ Unemployment utility when not receiving an offer in that period

$$rU = b + \alpha\Big(\mathbb{E}[\max\{N(w), U\}] - U\Big). \tag{35}$$

Using (33), this becomes

$$rU = b + \alpha\Big(\mathbb{E}\big[\max\{w/r, U\}\big] - U\Big).$$

9.4 Reservation wage

Define the reservation wage $w = R$ by the indifference condition $N(w) = U$. Using (33),

$$R = rU. \tag{36}$$

Hence the optimal policy is

$$\text{accept } w \iff w \geq R.$$

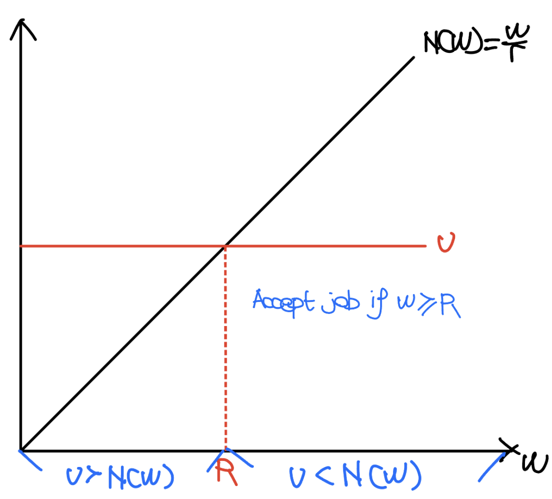


Figure 4: Original reservation-wage graph from Lecture 9.

Substituting (36) into (35) yields the reservation-wage recursion

$$R = b + \frac{\alpha}{r}\,\mathbb{E}[\max\{w - R, 0\}]. \tag{37}$$

Using integration by parts,

$$R = \int_R^{\bar{w}} (w - R) f(w)\, dw = b + \frac{\alpha}{r} \int_R^{\bar{w}} [1 - F(w)]\, \mathrm{d}w. \tag{38}$$

9.5 Comparative statics in the baseline model

Benefits b. Differentiating (38) gives

$$\frac{\mathrm{d}R}{\mathrm{d}b} = \frac{r}{r + \alpha(1 - F(R))} > 0.$$

Higher unemployment benefits raise the reservation wage and therefore tend to lengthen unemployment spells.

Offer-arrival rate α. The lecture derives

$$\frac{\mathrm{d}R}{\mathrm{d}\alpha} = \frac{\int_{R(\alpha)}^{\bar{w}} [1 - F(w)]\, \mathrm{d}w}{r + \alpha\,(1 - F(R(\alpha)))} > 0.$$

If offers arrive more frequently, workers can afford to be pickier. However, the total effect on unemployment duration is ambiguous:

- **Direct effect**: offers arrive more often, so unemployment falls.
- **Indirect effect**: the reservation wage rises, so workers reject more offers, raising unemployment duration.

The exit hazard from unemployment is

$$h = \alpha[1 - F(R)],$$

so expected unemployment duration is $1/h$.

9.6 Extension: exogenous job destruction

Suppose jobs are destroyed at exogenous rate λ.

Employment value. The Bellman equation becomes

$$rN(w) = w + \lambda\big(U - N(w)\big). \tag{39}$$

This preserves the reservation-wage condition $N(R) = U$.

Reservation wage. The notes derive

$$R = b + \frac{\alpha}{r + \lambda}\, \mathbb{E}[\max\{w - R, 0\}]. \tag{40}$$

Since job matches are now shorter-lived, the value of waiting declines and

$$\frac{\mathrm{d}R}{\mathrm{d}\lambda} < 0.$$

Workers become less selective when jobs are fragile.

9.7 Steady-state unemployment

At the steady state, inflows into unemployment equal outflows:

$$\alpha[1 - F(R)]u = \lambda(1 - u).$$

Therefore,

$$u = \frac{\lambda}{\alpha[1 - F(R)] + \lambda}. \tag{41}$$

The lecture treats the comparative static $\mathrm{d}u/\,\mathrm{d}\lambda$ as ambiguous because a higher destruction rate directly raises unemployment inflows but indirectly reduces the reservation wage and raises job acceptance.