Trade and Migration: A Quantitative Assessment

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Introduction

- Considerable advances on the quantification and understanding of the gains from economic integration
- Most of the focus has been on goods market
  - Direct consequence of observing reductions in trade costs (tariffs)
- Yet, most free trade agreements have an explicit commitment to liberalize factor markets, in particular labor markets
  - What are the economic effects of migration?
- In this study we use the EU 2003 accession, to study the gains from trade and migration
  - Exploit the variation in migration policy across countries and time
  - Use a structural model of trade and migration to measure the gains from trade and migration
EU 2003 Accession

- Agreement between member states of the European Union (EU) and New Member States (NMS)
- Integration in the goods market: zero tariffs starting in 2004
  - NMS countries resigned to previous FTA and joined EU FTA’s
- Integration in the factor markets: Migration restrictions varied across countries (use LABour market REForm database)
  - Some EU countries granted access to citizens from NMS in 2004
    - For example, United Kingdom (UK)
  - Other countries followed a 2-3-2 years phase in period
    - For instance, Germany (DE)
  - Non discriminatory policy, except for Cyprus (CY)
    - All EU granted access starting 2004
A Model of Trade and Migration

- We consider a similar environment and solution method as in Caliendo, Dvorkin and Parro (2016), but we have to deal with three different issues:

1. Stock versus flow of migrants
   - A NMS citizen residing in the UK has a different cost to migrate to DE relative to a EU citizen

2. Need to estimate the changes in Trade and Migration policies
   - Use tariffs and exploit the timing variation in Migration policy

3. Want to understand how trade and international migration policy interact
   - Model with tariffs
   - Model where migration has home market effects
Households’ problem

- Time is discrete, there is perfect foresight, and $N$ locations
  - We index a location by $\ell$ and $\ell'$
  - We index nationality by $n$, for example $NMS, EU$

- The value of a $n$ national in country $\ell$ at time $t$ given by

$$v^\ell_{n,t} = \log(c^\ell_t) + \max_{\ell' \in \{\ell'\}} \left\{ \beta \mathbb{E}[v^\ell'_{n,t+1}] - \tau^\ell_{n,t} + \nu \epsilon^{\ell\ell'}_{n,t} \right\},$$

- $\beta \in (0, 1)$ discount factor
- $\tau^\ell_{n,t}$ additive, migration costs to $\ell'$ from $\ell$ conditional on $n$
- $\epsilon^{\ell\ell'}_{n,t}$ are stochastic i.i.d idiosyncratic taste shocks
  - $\epsilon \sim$ Type-I Extreme Value distribution with zero mean
  - $\nu > 0$ is the dispersion of taste shocks

- Households supply a unit of labor inelastically
  - Receive the competitive market wage $w^\ell_t$
  - Consume $c^\ell_t = w^\ell_t / P^\ell_t$, where $P^\ell_t$ is the local price index
Households’ problem - Dynamic migration decision

- The expected (expectation over $\epsilon$) lifetime utility of a worker at $\ell$

$$V_{n,t}^{\ell} = \log\left(\frac{w_t^{\ell}}{P_t^{\ell}}\right) + \nu \log\left[ \sum_{\ell'=1}^{N} \exp\left(\beta V_{n,t+1}^{\ell'} - \tau_{n,t}^{\ell\ell'}\right)^{1/\nu} \right]$$

- Migration shares from country $\ell$ to $\ell'$

$$\mu_{n,t}^{\ell\ell'} = \frac{\exp\left(\beta V_{n,t+1}^{\ell'} - \tau_{n,t}^{\ell\ell'}\right)^{1/\nu}}{\sum_{\ell''=1}^{N} \exp\left(\beta V_{n,t+1}^{\ell''} - \tau_{n,t}^{\ell\ell''}\right)^{1/\nu}}.$$

- Evolution of the distribution of labor across markets

$$L_{n,t+1}^{\ell} = \sum_{\ell'=1}^{N} \mu_{n,t}^{\ell'\ell} L_{n,t}^{\ell'} : \text{all } n$$
Notice that at each $t$, labor supply across markets is fully determined

- We can then solve for wages such that labor markets clear
- We use an heterogenous firm trade policy model

CES preferences with elasticity $\sigma$

Monopolistic producers

- Free entry, fix entry cost $f^{E\ell}$
  - Upon entry, $\varphi$ is drawn from Pareto distribution $G(\varphi) = 1 - \varphi^{-\theta}$
  - All fixed costs $f^{\ell\ell'}$ paid in domestic labor

Costly trade

- Ad-valorem tariffs $\tilde{t}^{\ell\ell'}$, with $\tilde{t}^{\ell\ell} = 1$
- Iceberg trade costs $\kappa^{\ell\ell'} \geq 1$
Production - Static sub-problem - Equilibrium conditions

- Equilibrium defined by ZCP ($\phi^{\ell \ell'*}$) and free entry conditions, goods market clearing, trade balance
- Price index,

$$P_t^\ell = \gamma \left( \sum_{\ell' = 1}^{N} \left( \phi_t^{\ell \ell'*} \right)^{\sigma-\theta-1} M_t^{\ell'} \left( \kappa^{\ell \ell'*} \tilde{\ell}^{\ell'} \omega_t^{\ell'} \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}},$$

- Trade shares,

$$\pi_t^{\ell \ell'} = \frac{\left( \phi_t^{\ell \ell'*} \right)^{\sigma-\theta-1} M_t^{\ell'} \left( \kappa^{\ell \ell'*} \tilde{\ell}^{\ell'} \omega_t^{\ell'} \right)^{1-\sigma}}{\sum_{\ell'' = 1}^{N} \left( \phi_t^{\ell \ell'*} \right)^{\sigma-\theta-1} M_t^{\ell''} \left( \kappa^{\ell \ell''} \tilde{\ell}^{\ell''} \omega_t^{\ell''} \right)^{1-\sigma}},$$

- Mass of entrants

$$M_t^\ell = \frac{\sigma - 1}{\sigma \theta} \frac{L_t^\ell}{f^{\ell \ell'}},$$

- Note that migration generates Home Market Effects
Equilibrium

Definition

Given \((L_0, \Theta_t)\), a **sequential competitive equilibrium** of the model is a sequence of \(\{L_{n,t}, \mu_{n,t}, V_{n,t}, w(L_t, \Theta_t)\}_{t=0}^{\infty}\) that solves HH dynamic problem and the temporary equilibrium at each \(t\).

- Solving for an equilibrium of the model requires information on \(\Theta_t\)
  - Large number of unknowns
  \[
  \Theta_t \equiv \left(\{\tilde{\ell}_{n,t}\}, \{\kappa_{n,t}\}, \{\tau_{n,t}\}, \{f^E_{\ell}\}, \{f^{\ell_{n,t}}\}\right)_{n=1, \ell=1, \ell'=1}^{N,N,N}
  \]
- We compute the equilibrium dynamics of the model in time differences as in DEK, EKNR, and CDP
  - Condition on last period (or entire evolution of) migration flows, trade flows, and production
    - Solve for the value function in time differences
Equilibrium conditions

- Expected lifetime utility
  
  \[ u_{n,t}^\ell = \left[ \sum_{\ell' = 1}^{N} (\omega_t^\ell)^{1/\nu} (u_{n,t+1}^\ell')^{\beta/\nu} (\tilde{\tau}_{n,t}^\ell')^{-1/\nu} \right]^{1/\nu} \]

- Transition matrix (migration flows)
  
  \[ \mu_{n,t}^{\ell\ell'} = \frac{(u_{n,t+1}^\ell')^{\beta/\nu} (\tilde{\tau}_{n,t}^\ell')^{-1/\nu}}{\sum_{\ell'' = 1}^{N} (u_{n,t+1}^{\ell''})^{\beta/\nu} (\tilde{\tau}_{n,t}^{\ell''})^{-1/\nu}} \]

- where
  
  \[ u_{n,t}^\ell \equiv \exp V_{n,t}^\ell, \quad \tilde{\tau}_{n,t}^{\ell\ell'} \equiv \exp \tau_{n,t}^{\ell\ell'} \]
Equilibrium conditions - Time differences

- **Expected lifetime utility**

  \[
  \hat{u}^l_{n,t} = \left[ \sum_{l'=1}^N \mu_{n,t-1}^{l,l'} (\hat{\omega}_t^{l})^{1/v} (\hat{u}^l_{n,t+1})^{\beta/v} (\hat{\tau}^{l,l'}_{n,t})^{-1/v} \right]^{v}
  \]

- **Transition matrix (migration flows)**

  \[
  \hat{\mu}^{l,l'}_{n,t} = \frac{(\hat{u}^l_{n,t+1})^{\beta/v} (\hat{\tau}^{l,l'}_{n,t})^{-1/v}}{\sum_{l''=1}^N \mu_{n,t-1}^{l,l''} (\hat{u}^{l''}_{n,t+1})^{\beta/v} (\hat{\tau}^{l,l''}_{n,t})^{-1/v}}
  \]

where “hats” mean time differences, and \( \hat{\omega}_t^l \equiv \hat{w}_t^{l+1} / \hat{P}_t^{l+1} \) is the solution to the temporary equilibrium in time differences.
Temporary equilibrium conditions

How to solve for the temporary equilibrium in time differences?

- Price index,

\[ P_t^l = \gamma \left( \sum_{l'=1}^{N} (\varphi_{t}^{l' \ell'})^{\sigma-\theta-1} M_t^{l'} (k^{l' \ell'} t^l w_t^{l'})^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \]

- Trade shares,

\[ \pi_t^{l \ell'} = \frac{(\varphi_{t}^{l \ell'})^{\sigma-\theta-1} M_t^{l'} (k^{l \ell'} t^{l \ell'} w_t^{l'})^{1-\sigma}}{\sum_{\ell''=1}^{N} (\varphi_{t}^{l \ell''})^{\sigma-\theta-1} M_t^{l''} (k^{l \ell''} t^{l \ell''} w_t^{l''})^{1-\sigma}}, \]

- Mass of entrants

\[ M_t^l = \frac{\sigma - 1}{\sigma \theta} \frac{L_t^l}{f E^l} \]

- Note that migration generates Home Market Effects
Temporary equilibrium conditions

How to solve for the temporary equilibrium in time differences?

- Price index,

\[ \hat{P}_t^\ell = \left( \sum_{\ell' = 1}^{N} \pi_t^{\ell\ell'} (\hat{\varphi}_t^{\ell\ell'})^{\sigma-\theta-1} \hat{M}_t^{\ell'} (\hat{\kappa}^{\ell\ell'}\hat{t}^{\ell}\hat{w}_t^{\ell'})^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \]

- Trade shares,

\[ \pi_t^{\ell\ell'} = \frac{\pi_{t-1}^{\ell\ell'} (\hat{\varphi}_t^{\ell\ell'})^{\sigma-\theta-1} \hat{M}_t^{\ell'} (\hat{\kappa}^{\ell\ell'}\hat{t}^{\ell}\hat{w}_t^{\ell'})^{1-\sigma}}{\sum_{\ell'' = 1}^{N} (\hat{\varphi}_t^{\ell\ell''})^{\sigma-\theta-1} \hat{M}_t^{\ell''} (\hat{\kappa}^{\ell\ell''}\hat{t}^{\ell}\hat{w}_t^{\ell''})^{1-\sigma}}, \]

- Mass of entrants

\[ \hat{M}_t^\ell = \hat{L}_t^\ell \]

- Note that migration generates Home Market Effects
Solving the model for counterfactuals

**Proposition**

Given \((L_n, 0, \mu_n, -1, \pi_0, V A_0, G O_0)\), \((\nu, \theta, \sigma, \beta)\), and \(\{\hat{\Theta}_t\}_{t=1}^{\infty}\) solving the equilibrium in time differences does not require the level of \(\Theta\).

- Want to study the effects of changes in fundamentals \(\hat{\Theta} = \Theta'/\Theta\)
  - Recall that \(\Theta_t \equiv \left(\{\tilde{Z}_{\ell \ell'}\}, \{k_{\ell \ell'}\}, \{\tau_{n,t}\}, \{f^E_{\ell}\}, \{f^{E}_{\ell \ell'}\}\right)_{n=1, \ell=1, \ell'=1}^{N, N, N}\)
- We can use our solution method to study the effects of changes in \(\Theta\)
  - One by one or jointly, changes across time and space
Taking the model to the data

- Model with 39 countries (EU, NMS, ROW)
- Need data for \((L_{n,0}, \mu_{n,-1}, \pi_0, VA_0, GO_0)\)
  - Population and Migration shares, \(L_{n,0}, \mu_{n,-1}\) from EUROSTAT
  - Trade and production data, \(\pi_0, VA_0, GO_0\), from WIOD
- Need values for parameters \((\nu, \theta, \sigma, \beta)\)
  - Estimation + calibration
- Need data on bilateral tariffs
  - WITS and WTO
- Need to deal with trade deficits
  - Add a local factor and follow CPRHS (2015)
Migration Data

- Use the European labour force survey (EU-LFS)
  - Access to the confidential microdata
- The largest European household survey
  - Quarterly/annual data on labour participation and persons outside the labor force, aged 15 and over
  - Covers residents in private households (excluding conscripts)
- The basis for the harmonized unemployment rate, also an important source for other European statistics
  - e.g. education statistics or regional statistics
- Construct migration flows based on information on past year residence
  - Consistent data for the following set of countries
    - **NMS** = CZ, EE, CY, LV, LT, HU, PL
    - **EU** = AT, BE, DE, GR, DK, PT, ES, FR, IT, UK
    - **NMS2** = RO, BG
Migration Flows

How migration shares changed for NMS and EU countries?

Average emigration shares, by country of origin

Years

EU15 members
New member states

Emigration shares

0 .01 .02 .03 .04 .05

Emigration shares

0 0.1 0.2 0.3 0.4 0.5


Years

EU15 members
New member states

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Migration and Trade by destination, Sufficient Statistic

- Where did each NMS migrate to?
- By destination:
  - EU, and NMS regions
    - Cyprus, Czech Republic, Estonia, Latvia, Lithuania
    - Hungary, Poland
  - EU countries
    - Cyprus, Czech Republic, Estonia, Latvia, Lithuania
    - Hungary, Poland
  - NMS countries
    - Cyprus, Czech Republic, Estonia, Latvia, Lithuania
    - Hungary, Poland

- Where did each EU members migrate to? EU
- Trade effects? Trade
- “Welfare” effects? SufficientSTAT
Need to measure migration costs (changes)

- Use a transformation of the Head and Ries index

$$\frac{\mu_{n,t}^{l'l'} \mu_{n,t}^{l'l'}}{\mu_{n,t}^{l'l} \mu_{n,t}^{l'l'}} = (\tilde{\tau}_{n,t}^{l'l'} \tilde{\tau}_{n,t}^{l'l'})^{-1/\nu}$$

- Computed using migration shares, delivering a theory-consistent measure of migration costs between pairs of countries

- Figures showing \( \tilde{\tau}_{n,t}^{l'l'} \tilde{\tau}_{n,t}^{l'l'} \)

  - All
  - By member
  - EUNMS

NMS states:

- Cyprus
- Czech Republic
- Estonia
- Latvia
- Lithuania
- Hungary
- Poland

EU states:

- Austria
- Belgium
- Germany
- Greece
- Denmark
- Portugal
- Spain
- France
- Italy
- UK
Measuring migration costs (changes)

- **Methodology**: *Difference-in-difference* approach
  - Dependent variable: Head and Ries index
  - Identifying assumption: trends in migration costs between treated countries would have been the same as those with (and between) control countries in the absence of the entry into the EU

- **Example**: Free movement of workers between NMS from 2004 on
  - Treatment period: 2004 and after
  - Treatment group: each pair of NMS countries
  - Romania and Bulgaria (NMS2) joined the EU later, in 2007

- Two control groups:
  1. All pairs (NMS country, NMS2 country): controls for the variation that is NMS-specific and not necessarily due to the policy change
  2. (NMS2 country, NMS2 country) pair: controls for the trend in other non affected countries
Measuring migration costs (changes)

- **Findings**
  - Migration costs between UK and NMS countries declined 15% after 2004
  - Similar magnitudes when computing changes for other economies
- With these figures, we now quantify the gains from trade and migration using our model
  - Evaluate the trade and welfare effects from the actual policy
  - More to come
Conclusion

- Research on welfare effects from economic integration mostly focus on trade
  - In this study the focus is on Trade and Migration
- Develop a dynamic model for trade and migration policy analysis
  - Model accounts for specific issues related to migration policy (i.e. stock versus flows)
- Estimate changes in migration costs and compute gains using actual variation in migration policies (EU enlargement)
- Preliminary results:
  - We find welfare gains from migration and trade
    - Larger gains from deeper Migration integration than from Trade
    - Especially for NMS
- Future work:
  - Use the model to compute general equilibrium effects
  - Compute effects of changes in migration policies on other labor market outcomes (i.e. wages)
This is the END
Migration shares by destination

AT: Emigration shares towards EU and New member states

Years

Emigration shares

EU15
NMS

AT: Emigration shares towards EU and New member states

Years

Emigration shares

EU15
NMS
Migration shares by destination

BE: Emigration shares towards EU and New member states

- Emigration shares towards EU and New member states over the years 2000 to 2008.
- The chart shows the emigration shares as a percentage for EU15 and NMS (New member states).
- The emigration share towards EU15 generally increases from 2000 to 2005, then decreases from 2005 to 2008.
- The emigration share towards NMS remains relatively stable throughout the period.

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Migration shares by destination

DE: Emigration shares towards EU and New member states

Emigration shares
Years
EU15 NMS

back
PT: Emigration shares towards EU and New member states

Migration shares by destination

Years

Emigration shares


EU15 NMS
Migration shares by destination

ES: Emigration shares towards EU and New member states

Years

EU15
NMS

Emigration shares


Emigration shares

0 .005 .01 .015

Years


EU15 NMS

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Migration shares by destination

FR: Emigration shares towards EU and New member states

Emigration shares

Years
EU15 NMS
Migration shares by destination

IT: Emigration shares towards EU and New member states

Years

EU15 NMS

Emigration shares towards EU and New member states
Migration shares by destination

UK: Emigration shares towards EU and New member states

Years

Emigration shares

EU15 NMS

back
Migration shares by destination, conditional on migrating

AT: Emigration shares towards EU member states
Migration shares by destination, conditional on migrating

BE: Emigration shares towards EU member states

Years

AT BE DE DK ES FI FR GR IT LU PT UK

Emigration shares


Back
Migration shares by destination, conditional on migrating

DE: Emigration shares towards EU member states
Migration shares by destination, conditional on migrating

DK: Emigration shares towards EU member states

Years

Emigration shares

AT BE DE DK ES FI FR GR IT LU PT UK

DK: Emigration shares towards EU member states

Emigration shares

AT BE DE DK ES FI FR GR IT LU PT UK

Years
Migration shares by destination, conditional on migrating

PT: Emigration shares towards EU member states

Years

Emigration shares

AT BE DE DK ES FI FR GR
IT LU PT UK

Emigration shares towards EU member states


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Migration shares by destination, conditional on migrating

ES: Emigration shares towards EU member states
Migration shares by destination, conditional on migrating

FR: Emigration shares towards EU member states

Years

AT BE DE DK ES FI FR GR IT LU PT UK
Migration shares by destination, conditional on migrating back

IT: Emigration shares towards EU member states

Years

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<th>AT</th>
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Emigration shares


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Migration shares by destination, conditional on migrating

UK: Emigration shares towards EU member states
Migration shares by destination, conditional on migrating back

AT: Emigration shares towards NMS member states

Years

Emigration shares
0 .2 .4 .6

CY CZ EE HU LT LV PL SK
Migration shares by destination, conditional on migrating

BE: Emigration shares towards NMS member states

Years

CY CZ EE HU LT LV PL SK

Emigration shares


Back
Migration shares by destination, conditional on migrating

DE: Emigration shares towards NMS member states

Years

0.2 0.4 0.6 0.8
Emigration shares


CY CZ EE HU LT LV PL SK
Migration shares by destination, conditional on migrating

GR: Emigration shares towards EU member states

Years
AT BE DE DK ES FI FR GR
IT LU PT UK

Emigration shares
0 0.2 0.4 0.6 0.8 1

Emigration shares

Years
AT BE DE DK ES FI FR GR
IT LU PT UK

Emigration shares
0 0.2 0.4 0.6 0.8 1

Emigration shares

Years
AT BE DE DK ES FI FR GR
IT LU PT UK
Migration shares by destination, conditional on migrating back
Migration shares by destination, conditional on migrating

GR: Emigration shares towards EU and New member states

Years

EU15 NMS

Emigration shares

Migration shares by destination, conditional on migrating back.
Migration shares by destination, conditional on migrating

PT: Emigration shares towards NMS member states

- CY
- CZ
- EE
- HU
- LT
- LV
- PL
- SK

Migration shares by destination, conditional on migrating back

ES: Emigration shares towards NMS member states

Years


Emigration shares

CY CZ EE HU LT LV PL SK

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Migration shares by destination, conditional on migrating

FR: Emigration shares towards NMS member states

<table>
<thead>
<tr>
<th>CY</th>
<th>CZ</th>
<th>EE</th>
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<th>LT</th>
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<td>0.3</td>
<td>0.1</td>
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<td>0.4</td>
<td>0.2</td>
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Years:
Migration shares by destination, conditional on migrating back

UK: Emigration shares towards NMS member states

Years
CY CZ EE HU LT LV PL SK

Emigration shares
0 0.2 0.4 0.6

Migration shares by destination

CY: Emigration shares towards EU and New member states

Years

Emigration shares

EU15  NMS

CY: Emigration shares towards EU and New member states
Migration shares by destination

CZ: Emigration shares towards EU and New member states

Years

EU15 NMS

Emigration shares

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

back
Migration shares by destination

EE: Emigration shares towards EU and New member states

Years

Emigration shares
0 .005 .01 .015

EU15 NMS

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Migration shares by destination

LV: Emigration shares towards EU and New member states

Years

Emigration shares

EU15 NMS

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Migration shares by destination

LT: Emigration shares towards EU and New member states

Emigration shares

Years

EU15 NMS

Back
Migration shares by destination

HU: Emigration shares towards EU and New member states

Years

EU15 NMS

Emigration shares

Years

0 .005 .01 .015 .02 .025

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Migration shares by destination

PL: Emigration shares towards EU and New member states

Emigration shares towards EU and New member states from 2000 to 2008 for EU15 and NMS.
Migration shares by destination, conditional on migrating

CY: Emigration shares towards EU member states

Years
AT BE DE DK ES FI FR GR IT LU PT UK
Migration shares by destination, conditional on migrating

CZ: Emigration shares towards EU member states

Years

Emigration shares
0.2 0.4 0.6 0.8

AT BE DE DK ES FI FR GR IT LU PT UK
Migration shares by destination, conditional on migrating

EE: Emigration shares towards EU member states

Years

Emigration shares

AT BE DE DK ES FI FR GR IT LU PT UK

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Migration shares by destination, conditional on migrating

LV: Emigration shares towards EU member states

Years

Emigration shares

AT BE DE DK ES FI FR GR IT LU PT UK

Emigration shares
0 .2 .4 .6 .8 1

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Migration shares by destination, conditional on migrating back

LT: Emigration shares towards EU member states
Migration shares by destination, conditional on migrating

HU: Emigration shares towards EU member states
Migration shares by destination, conditional on migrating

PL: Emigration shares towards EU member states

Emigration shares

Years

AT BE DE DK ES FI FR GR IT LU PT UK

Emigration shares

0 .2 .4 .6 .8

Years

Migration shares by destination, conditional on migrating back

CY: Emigration shares towards NMS member states

Years

Emigration shares

CY: Emigration shares towards NMS member states
Migration shares by destination, conditional on migrating

CZ: Emigration shares towards NMS member states

Years

CY CZ EE HU LT LV PL SK
Migration shares by destination, conditional on migrating

EE: Emigration shares towards NMS member states

Years

CY CZ EE HU LT LV PL SK

Emigration shares


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Migration shares by destination, conditional on migrating back

LV: Emigration shares towards NMS member states

Emigration shares
Years
CY CZ EE HU LT LV PL SK

Back
Migration shares by destination, conditional on migrating

LT: Emigration shares towards NMS member states

Years

Emigration shares
0 .2 .4 .6 .8 1

CY CZ EE HU LT LV PL SK
Migration shares by destination, conditional on migrating

HU: Emigration shares towards NMS member states

Emigration shares
Years
CY CZ EE HU LT LV PL SK

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Trade and Migration
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Migration shares by destination, conditional on migrating

PL: Emigration shares towards NMS member states
Welfare gains from Trade and Migration by state

AT: Welfare, (2002=0)

Years

Welfare, from 2002

Total

Trade

Migration
Welfare gains from Trade and Migration by state

BE: Welfare, (2002=0)

Years

2002 2003 2004 2005 2006 2007 2008

Welfare, from 2002

Total

Trade

Migration

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Welfare gains from Trade and Migration by state

![Graph showing welfare gains from trade and migration from 2002 to 2008.]

- **Total** (blue line)
- **Trade** (red dashed line)
- **Migration** (green dashed line)
Welfare gains from Trade and Migration by state

GR: Welfare, (2002=0)

Years

2002 2003 2004 2005 2006 2007 2008

Welfare, from 2002

Total Trade Migration
Welfare gains from Trade and Migration by state

DK: Welfare, (2002=0)
Welfare gains from Trade and Migration by state

PT: Welfare, (2002=0)

Years

Total

Trade

Migration

Welfare, from 2002
Welfare gains from Trade and Migration by state

ES: Welfare, (2002=0)


Total Trade Migration

Welfare, from 2002: -.005, 0, .005, .01, .015
Welfare gains from Trade and Migration by state

FR: Welfare, (2002=0)

Years
2002 2003 2004 2005 2006 2007 2008
Welfare, from 2002
Total
Migration
Trade
Welfare gains from Trade and Migration by state

IT: Welfare, (2002=0)

Years

2002 2003 2004 2005 2006 2007 2008

Welfare, from 2002

Total

0.005

Trade

Migration

-0.005

0.01

0
Welfare gains from Trade and Migration by state

UK: Welfare, (2002=0)

Welfare, from 2002

Years

Total

Trade

Migration

UK: Welfare, (2002=0)

Years

Total

Trade

Migration

back
Welfare gains from Trade and Migration by state

CY: Welfare, (2002=0)

Years:
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008

Total Trade Migration

Welfare, from 2002
Welfare gains from Trade and Migration by state

CZ: Welfare, (2002=0)

Years

Total

Trade

Migration

Welfare, from 2002

0.08

0.06

0.04

0.02

0

-0.01

2002

2003

2004

2005

2006

2007

2008

Welfare gains from Trade and Migration by state

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Welfare gains from Trade and Migration by state

EE: Welfare, (2002=0)

Years
2002 2003 2004 2005 2006 2007 2008

Total Trade Migration

Welfare, from 2002
-0.01 -0.005 0.005 0.01 0.015
Welfare gains from Trade and Migration by state

LV: Welfare, (2002=0)

Years

Total Trade Migration

Welfare, from 2002
-0.01 0.01 0.02 0.03 0.04

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Welfare gains from Trade and Migration by state

LT: Welfare, (2002=0)

Years
Total Trade Migration

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Welfare gains from Trade and Migration by state

HU: Welfare, (2002=0)

Years

Welfare, from 2002

Total Trade Migration

2002 2003 2004 2005 2006 2007 2008

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Welfare gains from Trade and Migration by state

PL: Welfare, (2002=0)


Total
Trade
Migration
Production - Static sub-problem - Equilibrium conditions

- $N \times N$ ZCP conditions,

$$\varphi_{\ell \ell',*} = \left( \frac{\sigma}{\sigma - 1} \right) \left( \frac{\sigma w^{\ell} f^{\ell'}}{Y^{\ell'}} \right)^{\frac{1}{\sigma-1}} w^{\ell} \kappa^{\ell \ell'} \left( 1 + t^{\ell \ell'} \right)^{\frac{\sigma}{\sigma-1}} P^{\ell'},$$

- $N$ goods market equilibriums,

$$Y^{\ell} = \left( w^{\ell} L^{\ell} + T^{\ell} \right),$$

- $N$ price index,

$$P^{\ell} = \left( \sum_{\ell'}^N \varphi_{\ell' \ell,*} - \theta M^{\ell'} \left( \frac{\sigma}{\sigma - 1} \frac{\kappa^{\ell' \ell} w^{\ell'} \left( 1 + t^{\ell' \ell} \right)}{\tilde{\varphi}^{\ell' \ell}} \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}},$$

- $N \times N$ expenditure shares,

$$\lambda^{\ell' \ell} = \varphi_{\ell' \ell,*} - \theta M^{\ell'} \left( \frac{\sigma}{\sigma - 1} \frac{\kappa^{\ell' \ell} w^{\ell'} \left( 1 + t^{\ell' \ell} \right)}{P^{\ell} \tilde{\varphi}^{\ell' \ell}} \right)^{1-\sigma},$$
Equilibrium conditions

- Transition matrix (migration flows) at $t = -1$, Data

$$
\mu_{n,-1}^{\ell \ell'} = \frac{(u_{n,0}^{\ell'})^{\beta/\nu} (\tilde{\tau}_{n,-1}^{\ell \ell'})^{-1/\nu}}{\sum_{\ell''=1}^{N} (u_{n,0}^{\ell''})^{\beta/\nu} (\tilde{\tau}_{n,-1}^{\ell \ell''})^{-1/\nu}}
$$
Equilibrium conditions

- Transition matrix (migration flows) at $t = -1$, Data

$$
\mu_{n,-1}^{\ell\ell'} = \frac{(u_{n,0}^{\ell'})^{\beta/\nu}(\tilde{\tau}_{n,-1}^{\ell\ell'})^{-1/\nu}}{\sum_{\ell''=1}^{N}(u_{n,0}^{\ell''})^{\beta/\nu}(\tilde{\tau}_{n,0}^{\ell\ell''})^{-1/\nu}}
$$

- Transition matrix (migration flows) at $t = 0$, Model

$$
\mu_{n,0}^{\ell\ell'} = \frac{(u_{n,1}^{\ell'})^{\beta/\nu}(\tilde{\tau}_{n,0}^{\ell\ell'})^{-1/\nu}}{\sum_{\ell''=1}^{N}(u_{n,1}^{\ell''})^{\beta/\nu}(\tilde{\tau}_{n,0}^{\ell\ell''})^{-1/\nu}}
$$
Equilibrium conditions

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- Transition matrix (migration flows) at $t = 0$, Model

$$
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$$

- Take the time difference

$$
\frac{\mu_{n,0}^{\ell \ell'}}{\mu_{n,-1}^{\ell \ell'}} = \frac{\frac{(u_{n,1}^{\ell'})^{\beta/\nu}(\tilde{\tau}_{n,0}^{\ell \ell'})^{-1/\nu}}{\sum_{\ell''}^N (u_{n,1}^{\ell''})^{\beta/\nu}(\tilde{\tau}_{n,0}^{\ell \ell''})^{-1/\nu}}}{\frac{(u_{n,0}^{\ell'})^{\beta/\nu}(\tilde{\tau}_{n,-1}^{\ell \ell'})^{-1/\nu}}{\sum_{\ell''}^N (u_{n,0}^{\ell''})^{\beta/\nu}(\tilde{\tau}_{n,-1}^{\ell \ell''})^{-1/\nu}}}
$$
Equilibrium conditions

- Take the time difference

\[
\frac{\mu_{n,0}^{\ell \ell'}}{\mu_{n,-1}^{\ell \ell'}} = \frac{\frac{(u_{n,1}^{\ell'})^{\frac{\beta}{\nu}}(\bar{\tau}_{n,0}^{\ell \ell'})^{-1/\nu}}{(u_{n,0}^{\ell'})^{\frac{\beta}{\nu}}(\bar{\tau}_{n,-1}^{\ell \ell'})^{-1/\nu}} \sum_{\ell''=1}^{N_{\ell''}} \frac{(u_{n,1}^{\ell''})^{\frac{\beta}{\nu}}(\bar{\tau}_{n,0}^{\ell \ell''})^{-1/\nu}}{(u_{n,0}^{\ell''})^{\frac{\beta}{\nu}}(\bar{\tau}_{n,-1}^{\ell \ell''})^{-1/\nu}}}
\]
Equilibrium conditions

- Take the time difference

\[ \frac{\mu_{n,0}^{\ell \ell'}}{\mu_{n,-1}^{\ell \ell'}} = \frac{\sum_{\ell''=1}^{N} \frac{(u_{n,1}^{\ell'})^{\beta/v}(\tilde{\tau}_{n,0}^{\ell \ell'})^{-1/v}}{(u_{n,0}^{\ell'})^{\beta/v}(\tilde{\tau}_{n,-1}^{\ell \ell'})^{-1/v}}}{\sum_{\ell''=1}^{N} \frac{(u_{n,1}^{\ell'})^{\beta/v}(\tilde{\tau}_{n,0}^{\ell \ell'})^{-1/v}}{(u_{n,0}^{\ell''})^{\beta/v}(\tilde{\tau}_{n,-1}^{\ell \ell''})^{-1/v}}} \]

- Simplify

\[ \frac{\mu_{n,0}^{\ell \ell'}}{\mu_{n,-1}^{\ell \ell'}} = \frac{(u_{n,1}^{\ell'}/u_{n,0}^{\ell'})^{\beta/v}(\tilde{\tau}_{n,0}^{\ell \ell'}/\tilde{\tau}_{n,-1}^{\ell \ell'})^{-1/v}}{\sum_{\ell''=1}^{N} \frac{(u_{n,1}^{\ell'})^{\beta/v}(\tilde{\tau}_{n,0}^{\ell \ell'})^{-1/v}}{(u_{n,0}^{\ell''})^{\beta/v}(\tilde{\tau}_{n,-1}^{\ell \ell''})^{-1/v}}} \]
Equilibrium conditions

- Take the time difference

\[ \frac{\mu_{n,0}^{\ell \ell'}}{\mu_{n,-1}^{\ell \ell'}} = \frac{\frac{(u_{n,1}^{\ell'})^\beta/v (\bar{\tau}_{n,0}^{\ell \ell'})^{-1/v}}{(u_{n,0}^{\ell'})^\beta/v (\bar{\tau}_{n,-1}^{\ell \ell'})^{-1/v}}}{\sum_{\ell''}^N \frac{(u_{n,1}^{\ell'})^\beta/v (\bar{\tau}_{n,0}^{\ell \ell'})^{-1/v}}{(u_{n,0}^{\ell''})^\beta/v (\bar{\tau}_{n,-1}^{\ell \ell''})^{-1/v}}} \]

- Simplify

\[ \frac{\mu_{n,0}^{\ell \ell'}}{\mu_{n,-1}^{\ell \ell'}} = \frac{(u_{n,1}^{\ell'}/u_{n,0}^{\ell'})^\beta/v (\bar{\tau}_{n,0}^{\ell \ell'}/\bar{\tau}_{n,-1}^{\ell \ell'})^{-1/v}}{\sum_{\ell''}^N \frac{(u_{n,1}^{\ell'})^\beta/v (\bar{\tau}_{n,0}^{\ell \ell'})^{-1/v}}{(u_{n,0}^{\ell''})^\beta/v (\bar{\tau}_{n,-1}^{\ell \ell''})^{-1/v}}} \]

- Use \( \mu_{n,-1}^{\ell \ell'} \) once again

\[ \mu_{n,0}^{\ell \ell'} = \frac{\mu_{n,-1}^{\ell \ell'} (u_{n,1}^{\ell'}/u_{n,0}^{\ell'})^\beta/v (\bar{\tau}_{n,0}^{\ell \ell'}/\bar{\tau}_{n,-1}^{\ell \ell'})^{-1/v}}{\sum_{\ell''}^N \mu_{n,-1}^{\ell \ell''} (u_{n,1}^{\ell''}/u_{n,0}^{\ell''})^\beta/v (\bar{\tau}_{n,0}^{\ell \ell''}/\bar{\tau}_{n,-1}^{\ell \ell''})^{-1/v}} \]
Equilibrium conditions

- Expected lifetime utility

\[ u_{n,t}^\ell = \left[ \sum_{\ell'=1}^{N} (\omega_t^\ell)^{1/\nu} \left( u_{n,t+1}^{\ell'} \right)^{\beta/\nu} \left( \tilde{\tau}_{n,t}^{\ell\ell'} \right)^{-1/\nu} \right]^\nu \]

- Transition matrix (migration flows)

\[ \mu_{n,t}^{\ell\ell'} = \frac{\left( u_{n,t+1}^{\ell'} \right)^{\beta/\nu} \left( \tilde{\tau}_{n,t}^{\ell\ell'} \right)^{-1/\nu}}{\sum_{\ell''=1}^{N} \left( u_{n,t+1}^{\ell''} \right)^{\beta/\nu} \left( \tilde{\tau}_{n,t}^{\ell\ell''} \right)^{-1/\nu}} \]
Migration costs

UK: Average Head & Ries Index of Migration

- Years from 2000 to 2008
- Head & Ries Index range from 12 to 22

Lines for:
- EU15 (dotted blue line)
- NMS (solid red line)
Migration costs

IT: Average Head & Ries Index of Migration

Years: 2000 to 2008
EU15 and NMS

COPS (Trade and Migration)
Migration costs

FR: Average Head & Ries Index of Migration

- EU15
- NMS
Migration costs

ES: Average Head & Ries Index of Migration

Head & Ries Index

Years

EU15 NMS

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Migration costs

PT: Average Head & Ries Index of Migration

- **EU15**
- **NMS**

<table>
<thead>
<tr>
<th>Years</th>
<th>EU15</th>
<th>NMS</th>
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<td>2000</td>
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<tr>
<td>2008</td>
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</tbody>
</table>
Migration costs

DK: Average Head & Ries Index of Migration

Years
EU15 NMS
DK: Average Head & Ries Index of Migration

Head & Ries Index

Years
EU15 NMS
Migration costs

GR: Average Head & Ries Index of Migration

Years

Head & Ries Index

EU15 NMS

back
Migration costs

DE: Average Head & Ries Index of Migration

- EU15
- NMS
Migration costs

BE: Average Head & Ries Index of Migration

Years
EU15 NMS

BE: Average Head & Ries Index of Migration

Years
EU15 NMS

back
Migration costs

AT: Average Head & Ries Index of Migration

- **Head & Ries Index**
  - EU15
  - NMS

Graph showing the average Head & Ries Index of migration from 2000 to 2008 for EU15 and NMS.
Migration costs

PL: Average Head & Ries Index of Migration

- **EU15**
- **NMS**

Years:
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008

Head & Ries Index:
- 15
- 20
- 25
- 30
Migration costs

HU: Average Head & Ries Index of Migration

Years

EU15  NMS

Head & Ries Index

20 22 24 26 28

Years


Back
Migration costs

LT: Average Head & Ries Index of Migration

Years

Head & Ries Index
Migration costs

LV: Average Head & Ries Index of Migration

Years
EU15 NMS
LV: Average Head & Ries Index of Migration

Back
Migration costs

EE: Average Head & Ries Index of Migration

Years

Head & Ries Index

EU15 NMS
Migration costs

[Graph showing CY: Average Head & Ries Index of Migration over years 2000 to 2008, with lines for EU15 and NMS, indicating a decline in Head & Ries Index over time.]
Migration costs

CZ: Average Head & Ries Index of Migration

Years

Head & Ries Index


EU15 NMS

CZ: Average Head & Ries Index of Migration
Migration costs

Average Head & Ries Index of Migration

Years

Head & Ries Index

Average Head & Ries Index of Migration

Years
Migration costs

Average Head & Ries Index of Migration

Years

EU15 members
New member states

Average Head & Ries Index of Migration

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Migration costs

Average Head & Ries Index of Migration

- EU15–EU15
- NMS–NMS
- NMS–EU15
Households’ problem

- With a probability of $\rho$ the agent stays in the same country, and with probability of $1 - \rho$ might decide to migrate with a new draw
  - Assume that the likelihood of this event is not location specific
- The value function can be then written as
  \[
  v_{n,t}^\ell = \log(c_{t}^\ell) + \rho \beta E[v_{n,t+1}^\ell] + (1 - \rho) \max_{\{\ell'\}} \left\{ \beta E[v_{n,t+1}^{\ell'}] - \tau_{n,t}^{\ell\ell'} + \nu \epsilon_{n,t}^{\ell\ell'} \right\},
  \]
  - Conditional on moving, the choice probabilities are the same as before only applied to a fraction $(1 - \rho)$ of workers
- However, the evolution of the state is given by
  \[
  L_{n,t+1}^\ell = \rho L_{n,t}^\ell + (1 - \rho) \sum_{\ell' = 1}^{N} \mu_{n,t}^{\ell\ell'} L_{n,t}^\ell' : \text{all } n
  \]
Migration of NMS

Where did NMS migrate to?

Average emigration shares towards EU and New member states

Years
Emigration shares
NMS towards EU15 NMS towards NMS
Average emigration shares towards EU and New member states

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Migration of EU members

Where did EU migrate to?

Average emigration shares towards EU and New member states

- EU15 towards EU15
- EU15 towards NMS


Emigration shares: 0.005, 0.01, 0.015, 0.02, 0.025
Migration by destination

- Where did each EU members migrate to?
- By destination
  - EU, and NMS regions
    - Austria
    - Belgium
    - Germany
    - Greece
    - Denmark
    - Portugal
    - Spain
    - France
    - Italy
    - UK
  - EU countries
    - Austria
    - Belgium
    - Germany
    - Greece
    - Denmark
    - Portugal
    - Spain
    - France
    - Italy
    - UK
  - NMS countries
    - Austria
    - Belgium
    - Germany
    - Greece
    - Denmark
    - Portugal
    - Spain
    - France
    - Italy
    - UK

back
Trade of NMS

Average trade share from EU, NMS and ROW

- NMS from EU15
- NMS from NMS
- NMS from RoW

Years:
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008

Trade share:
- 0.05
- 0.1
- 0.15

Graph shows the average trade share from EU, NMS, and RoW over the years 2000 to 2008.
Trade of EU members

Average trade share from EU, NMS and ROW

Years

Trade share
0 .02 .04 .06 .08 .1

EU15 from EU15
EU15 from NMS
EU15 from RoW
Average trade share from EU, NMS and ROW
Welfare gains: Sufficient Statistic

- Trade and migration model as in Caliendo, Dvorkin and Parro (2015)
  - Countries ($\ell$) instead of regions and sectors
- Then, the gains from trade and migration are given by

$$W^\ell = \log \left( \left( \frac{\pi^{\ell\ell}}{\mu^{\ell\ell}} \right)^{-1/\theta} \right) = \frac{\text{gains from trade}}{\text{gains from migration}}$$

- $\mu^{\ell\ell}$ (1-share of migrants) captures option value of migration in $\ell$
- Sufficient statistic (ACR+) to measure welfare gains from trade and migration
  - Relative to autarky $\pi^{\ell\ell} = 1$, $\mu^{\ell\ell} = 1$
  - Can also be applied relative to a base year
NMS Welfare gains - Trade and Migration

Sufficient Statistic, relative to 2002, $\theta = 4$, and $\nu = 2$
EU Welfare gains - Trade and Migration

Sufficient Statistic, relative to 2002, $\theta = 4$, and $\nu = 2$

EU: Mean Welfare, (2002=0)

<table>
<thead>
<tr>
<th>Years</th>
<th>EU, Mean Welfare, (2002=0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>-0.005</td>
</tr>
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<td>2003</td>
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<td>2008</td>
<td>-0.005</td>
</tr>
</tbody>
</table>
Welfare gains from Trade and Migration by state

- Using the sufficient statistic to measure welfare gains from trade and migration
  - Relative to 2002
  - $\theta = 4$, and $\nu = 2$

- NMS states
  - Cyprus
  - Czech Republic
  - Estonia
  - Latvia
  - Lithuania
  - Hungary
  - Poland

- EU states
  - Austria
  - Belgium
  - Germany
  - Greece
  - Denmark
  - Portugal
  - Spain
  - France
  - Italy
  - UK

back