Labor Reallocation and Wage Growth: Evidence from East Germany

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IN PROGRESS

Introduction

- Resource misallocation a source of cross-country income gaps
    1. Capital across firms, managers across technologies...
    2. Possibly due to bad policies, market imperfections...

- **Can reallocation of inputs lead to convergence across regions?**
    1. Theoretical evidence is obvious
    2. Empirical evidence is scant

- **This Paper:** historical evidence from German Reunification
    * **FIrm-worker reallocation** contributed significantly to **wage catchup**

Ideal Empirical Setting to Study Labor Reallocation

- Policy change that is
  1. Exogenous, or sudden
  2. Efficient benchmark to compare the evolution of allocations
  3. Related only to the reallocation of a fixed set of firms and workers
  4. Data *before* and *after* to compare the allocations

- Most existing counterfactuals are artificial:

  based on hypothetical reforms, and/or against U.S. as a benchmark

German Reunification is Quasi-Ideal

1. Quick and largely unexpected
2. Comparison against West Germans provides natural benchmark
3. Three treatments: change in labor market + firm entry/exit + mobility
   $\Rightarrow$ follow workers “from” East, decompose each
4. Scarce data before, but matched employer-employee data afterward
   $\Rightarrow$ quasi-experimental variation (exposure) across cohorts

$\Rightarrow$ Separate **between-firm effects** from **within-firm effects**, for **each East cohort, at all ages, relative to West**

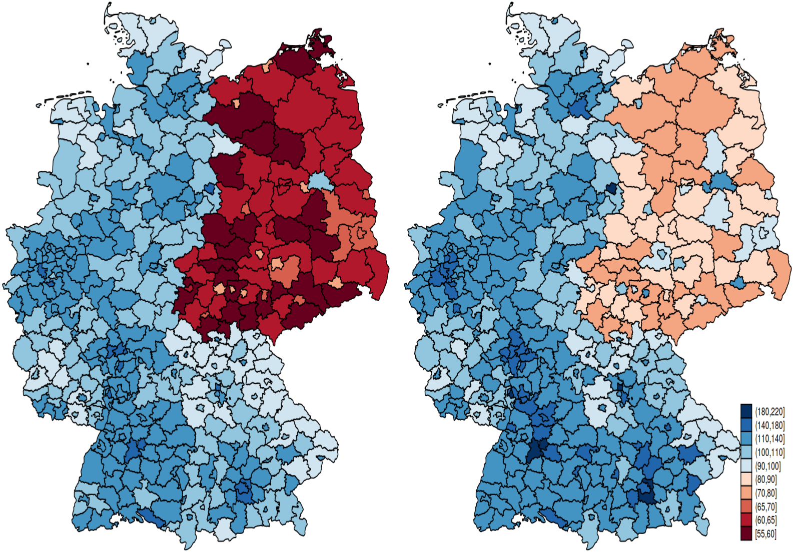
Main Results

- Decompose initial wage gap and ensuing catchup into:
  1. Between-firm: difference in firms East/West workers work
  2. Within-firm: difference in worker productivities, “human capital”?

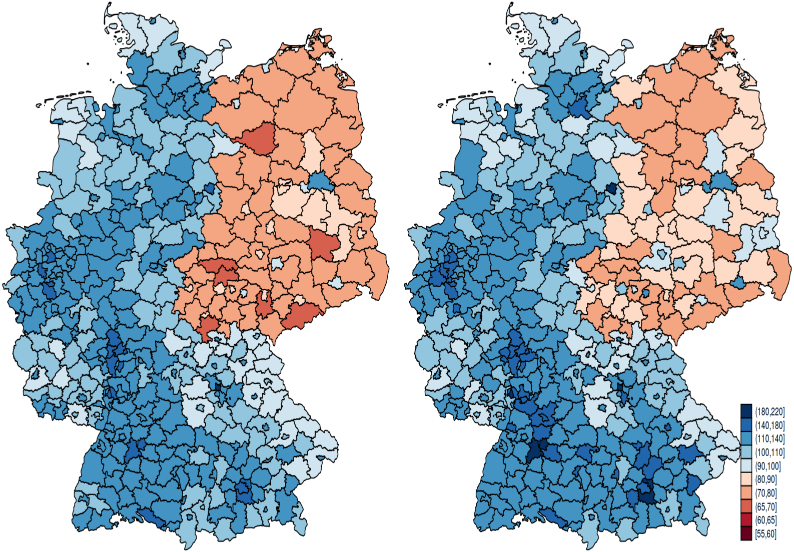
- $\sim$8 of the 20 ppt catchup up to 2014 happens between-firms
  1. 1992-1997: $\sim$4 ppt due to reallocation of workers across firms in East,
  2. 1997-2014: rest due to reallocation of workers to West firms

$\Rightarrow$ **Speed and magnitude points to the possibility of labor market efficiency as a potent policy directive**

Average Wages, 1992 vs 2014



Average Wages, 1995 vs 2014



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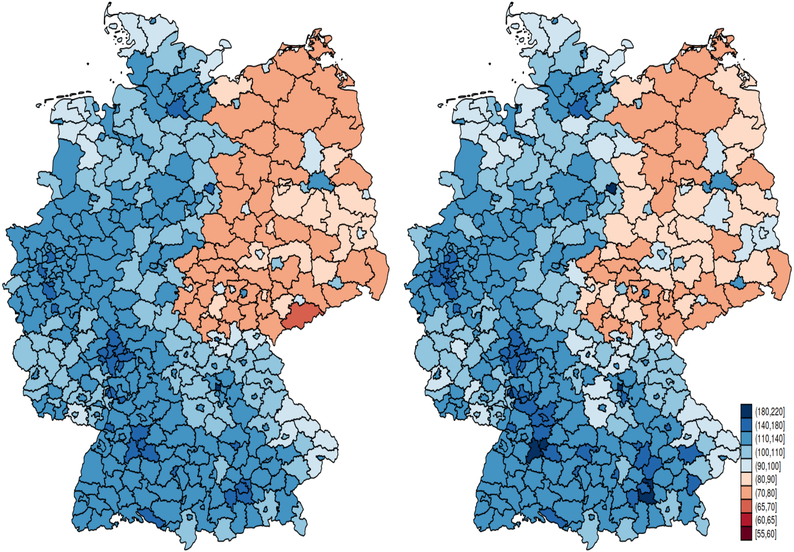
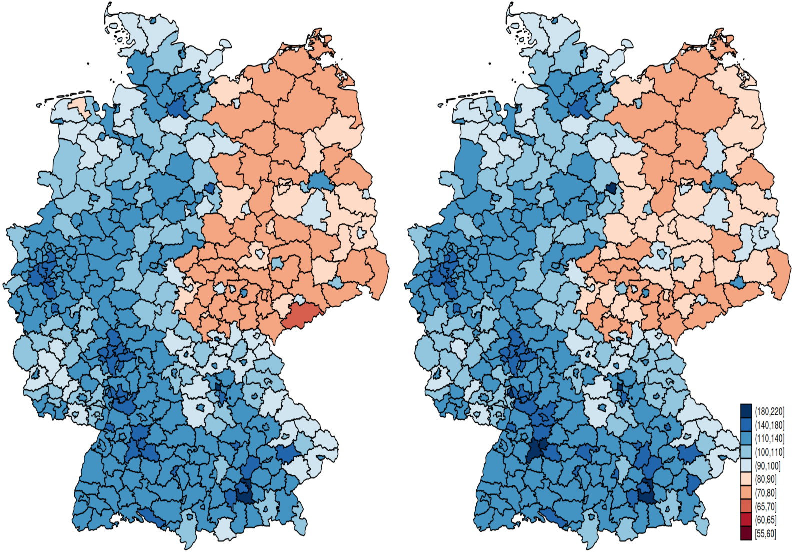
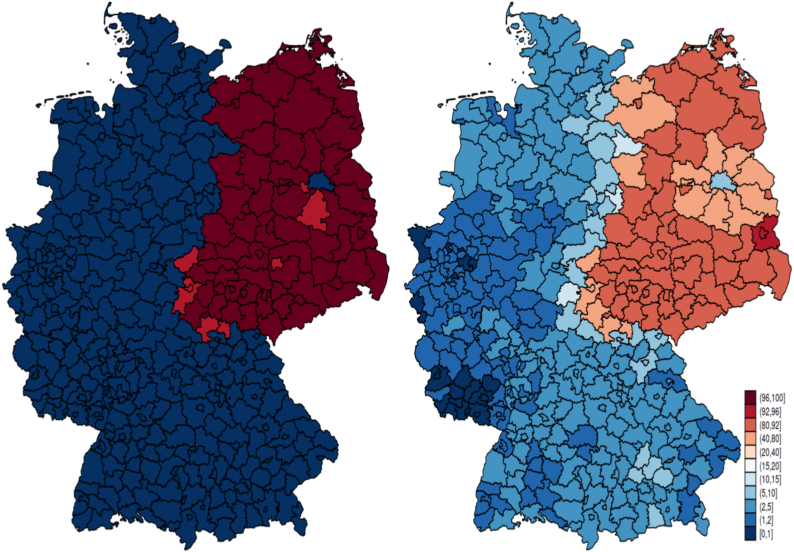


Average Wages, 2007 vs 2014



▸ Means

East Share of Population, 1992 vs 2014



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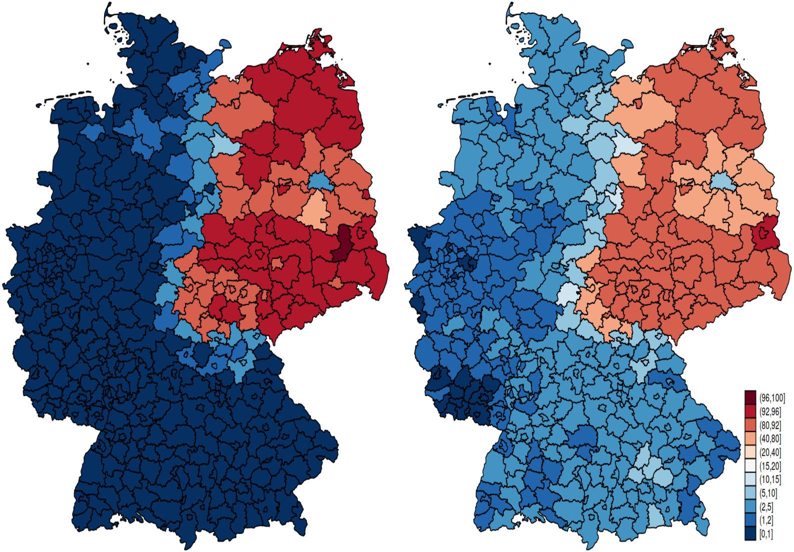

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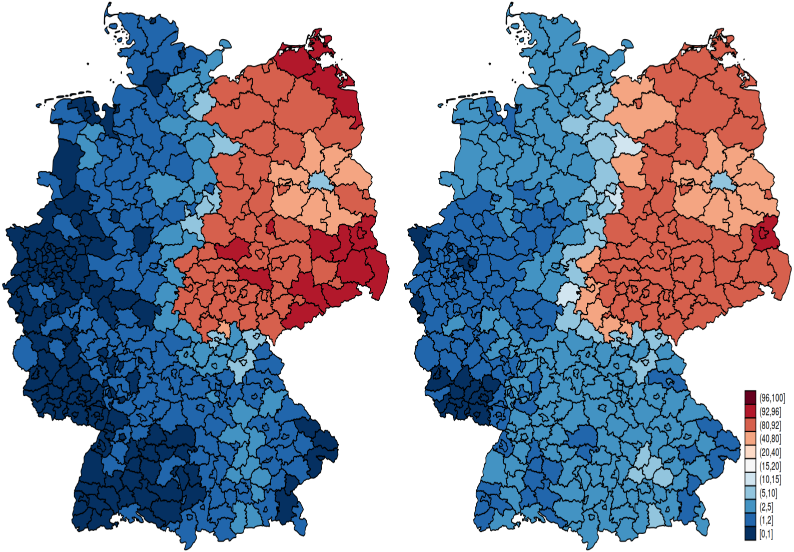

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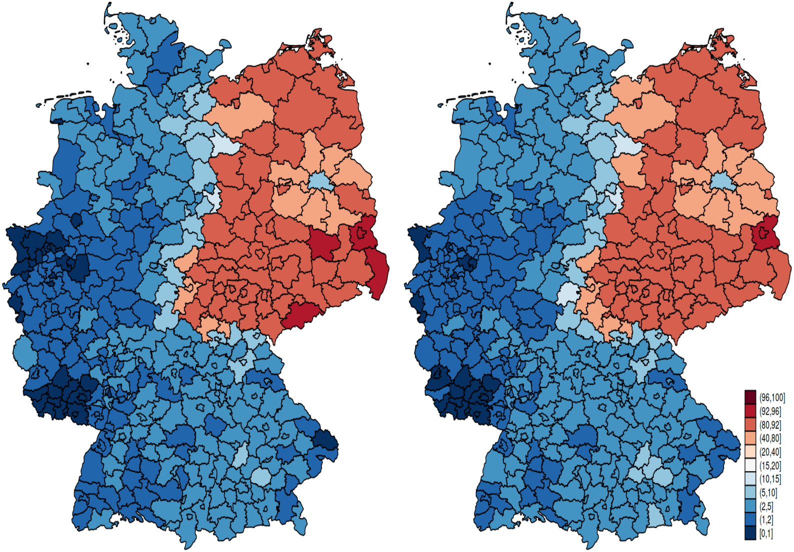


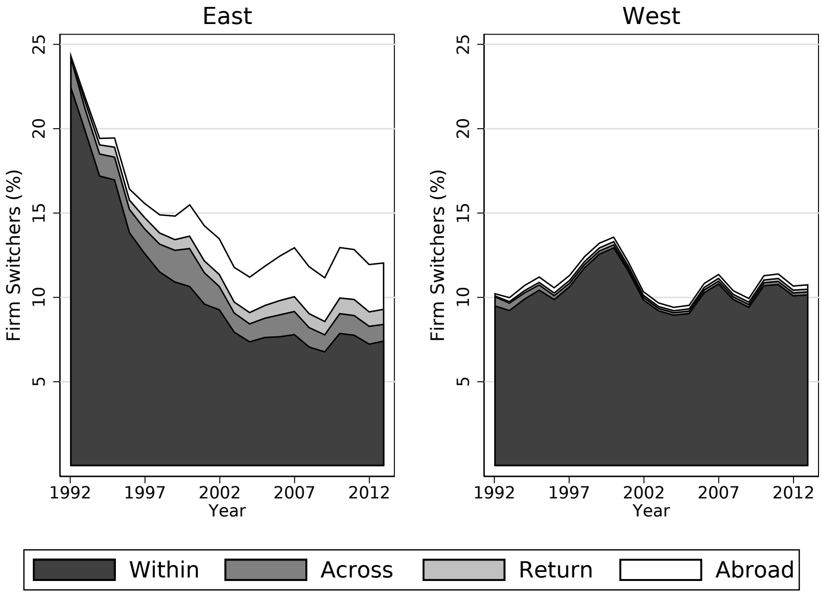
▸ Means

Data

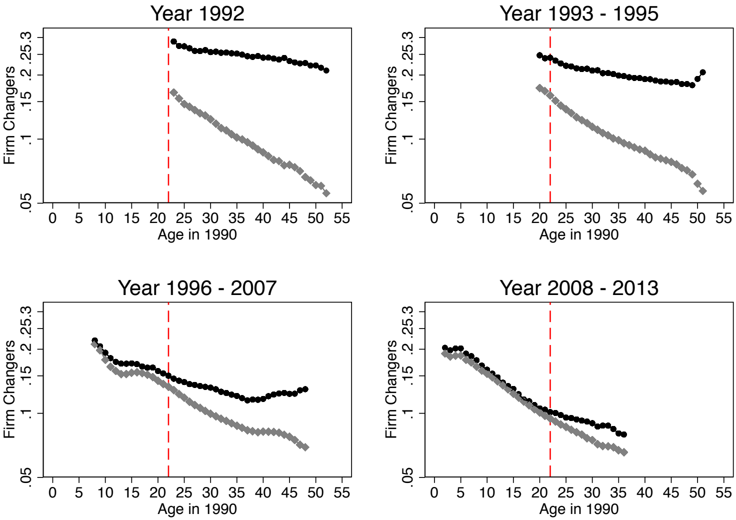
1. Source: IAB, research center associated with (un)employment agency
   - universe of work histories - civil servants and self-employed ($\sim$85%)
   - $\sim$50 million workers followed over their life-cycles **100% sample!**
2. Sample restriction: average daily wage of working-age German men*
   - Years: $[\underline{t}, \bar{t}] = [1992, 2014]$ (earlier data used to identify origin)
3. Divide sample into East/West-"Born"
   - Berlin treated as West (for now)

* i.e., non-Germans are dropped. For women, patterns are more distinct in employment, not wages

E-E Transitions for East/West-Born



E-E Transitions by Cohort (East in black)



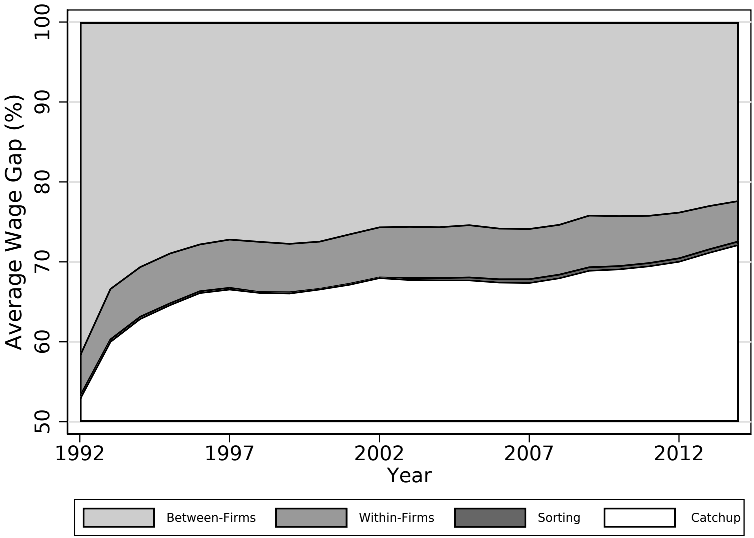
▸ Wage Growth

Baseline Regression

$$\log w_{isrct} = \log \theta_{j(i,t),t} + \underbrace{\tau_{srt} + \kappa_{src} + \alpha_{srct} + \epsilon_{isrct}}_{\log h_{isrct}}$$

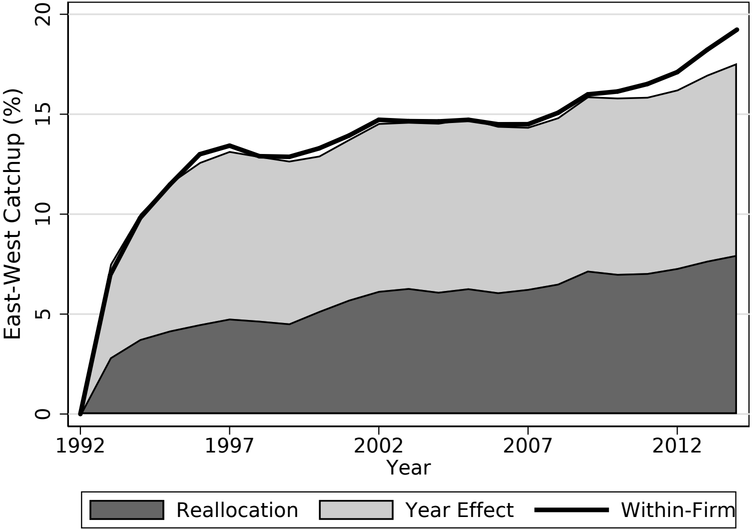
- individual i, skill s, from r, birth year c, working at firm j at time t
- Firm effects θ are not fixed, allowed to vary over time
  1. Cannot include individual worker fixed effects
  2. Fully stratified by skill, region and cohort
- α_{srct}: skill-origin-cohort-specific age effects

Wage Gap: Firms and Workers



Equations

Wage Convergence: Firms and Workers



- College cannot explain much

college moments
Equations

Growth Decomposition of θ

- Extend Olley and Pakes (1996); Melitz and Polanec (2015) to consider worker migration

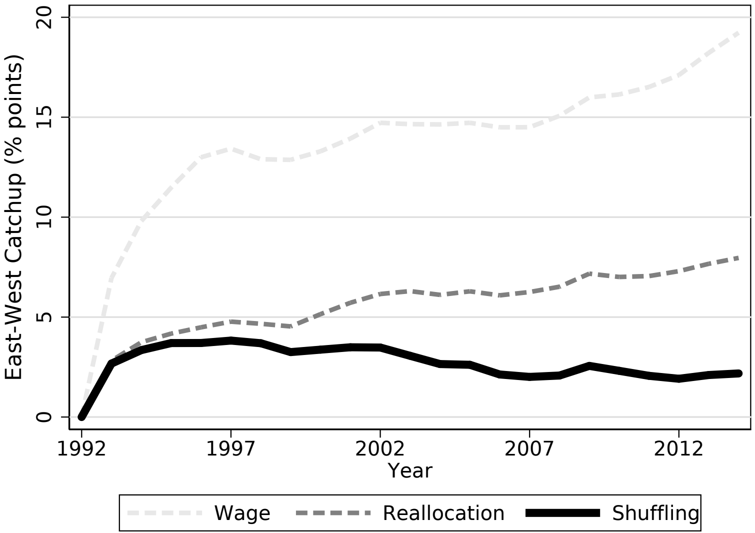
X Differences in average firm wage growth (unexplained)

1. Change in covariance across firms and workers
2. Firm entry/exit
3. Migrants and migration

Formulae

- Then decompose each explainable component further

Growth Decomposition of θ: Within-Region

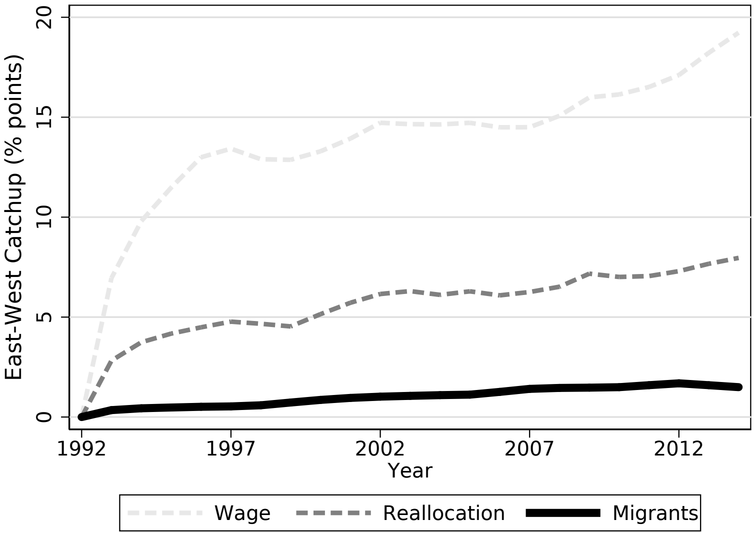


Formulae

Growth Decomposition of θ: Firm Entry/Exit

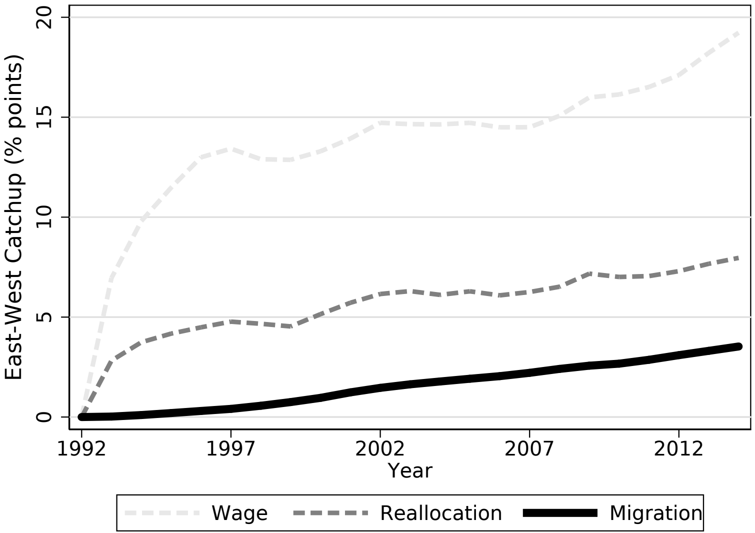
Formulae

Growth Decomposition of θ: Migrants



Formulae

Growth Decomposition of θ: Migration



Formulae

Sum Up in Numbers

Decomposition		Contribution to Catchup First 5 years: **13 ppt**	All years: **19 ppt**
I	w/i firms	0 ppt	1.5 ppt
	b/w firms	13 ppt	17.5 ppt
II	unexplained	8 ppt	9.5 ppt
	explained	5 ppt	8 ppt
III	w/i region	**4 ppt**	2 ppt
	entry/exit	0 ppt	1 ppt
	migrants	0.5 ppt	1.5 ppt
	migration	0.5 ppt	**3.5 ppt**

- **Within region in first 5 years, then across region**

Details short

Decomposition by Cohort

- Old cohorts are initially allocated worse, catchup faster
- Can similarly decompose reallocation effects by cohort
- Shuffling effect in first years dominant
- Out-migration strong for post-RU cohorts

figures

Lessons Learned So Far

1. Firm-worker reallocation effects can be large and quick
   - Explains about a quarter of East-West wage convergence
   - Most within-region reallocation occurs in first 5 years

2. Migration plays persistent, growing role
   - Need to understand intensive/extensive margins (*in progress*)
   - East-West effects are opposite (*in progress*)

3. Almost no difference/catchup from human capital firm entry/exit

Understanding Shuffling Effects

- Workers moving across firms (gross flows of hiring, firing, job-to-job)
- Changes the size distribution over θ_j's, but also the θ_j's:
  θ_j's are not fixed but change over time ▸ Evidence
- Wage growth from change in θ-size correlation (Olley and Pakes, 1996):

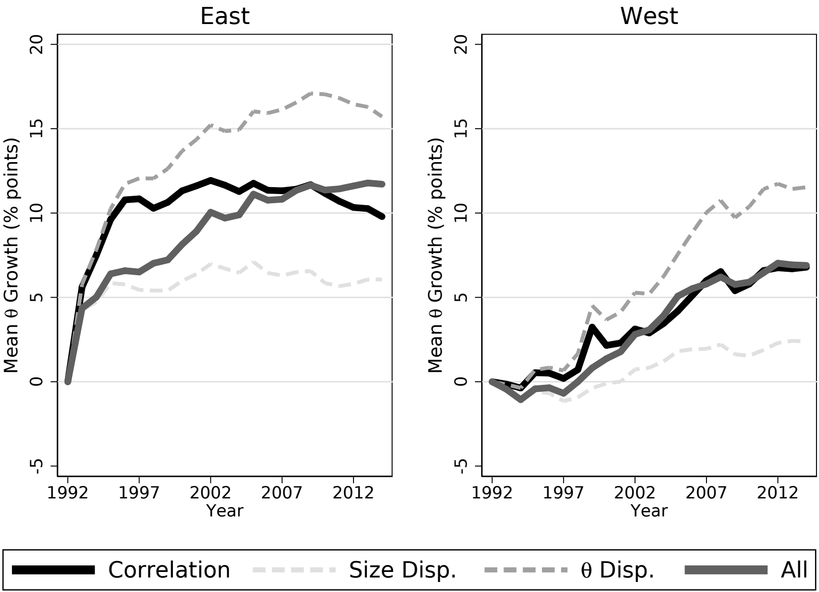
$$S_r \equiv \underbrace{\bar{\theta}'(\mathbf{S}_r')/\bar{\theta}(\mathbf{S}_r)}_{\text{change in mean } \theta \text{ across workers}} \Big/ \underbrace{\bar{\theta}'(\tilde{\mathbf{S}}_r)/\bar{\theta}(\tilde{\mathbf{S}}_r)}_{\text{change in mean } \theta \text{ across firms}}$$

$$= \eta'(\tilde{\mathbf{S}}_r)/\eta(\tilde{\mathbf{S}}_r) \quad \text{where}$$

$$\eta(\tilde{\mathbf{S}}_r) \equiv 1 + \text{Corr}\left[\frac{\theta_j}{\bar{\theta}(\tilde{\mathbf{S}}_r)}, \frac{s_j}{\bar{s}(\tilde{\mathbf{S}}_r)}\right] \cdot \text{StD}\left[\frac{\theta_j}{\bar{\theta}(\tilde{\mathbf{S}}_r)}\right] \cdot \text{StD}\left[\frac{s_j}{\bar{s}(\tilde{\mathbf{S}}_r)}\right]$$

- First verify correlation vs. dispersion effect

Reallocation Comes from Change in Correlation



Size or θ?

- We can think of the following types of counterfactual correlations:

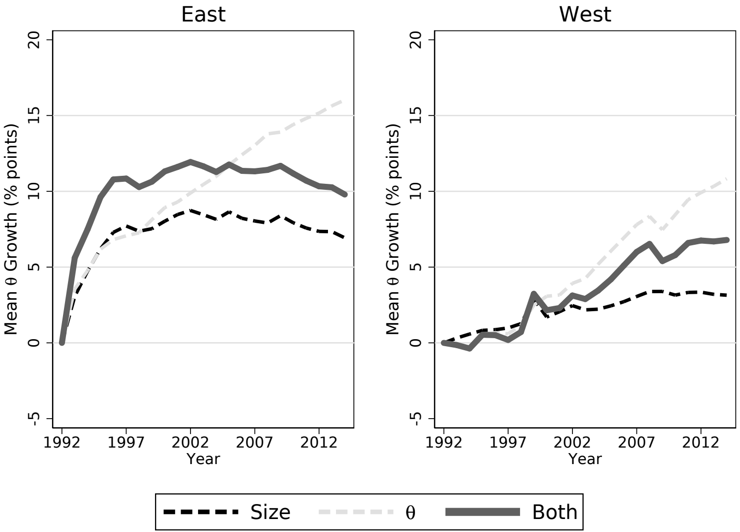
- Keep θ distribution constant, change size distribution:

$$\text{Corr}\left[\frac{\theta_j}{\bar{\theta}(\tilde{\mathbf{S}}_r)}, \frac{s'_j}{\bar{s}'(\tilde{\mathbf{S}}_r)}\right]$$

- Keep size distribution constant, change θ distribution:

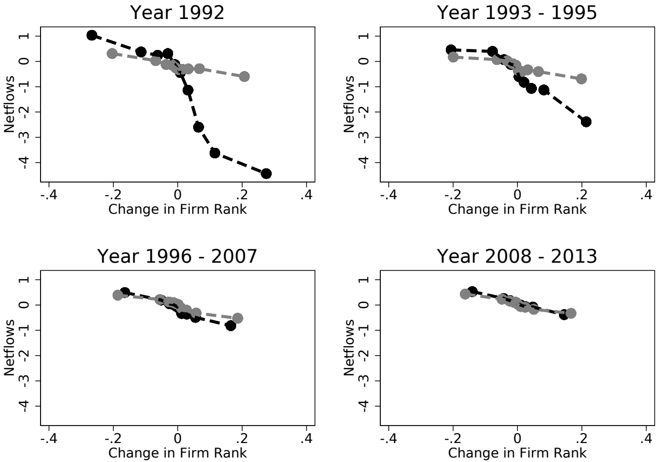
$$\text{Corr}\left[\frac{\theta'_j}{\bar{\theta}'(\tilde{\mathbf{S}}_r)}, \frac{s_j}{\bar{s}(\tilde{\mathbf{S}}_r)}\right]$$

Size and θ



Moments

ΔRank(θ) – ΔSize Correlation



- East in black
- On average, θ-growth firms are shrinking

short

Understanding Plows and Flows I

- We view a firm as a collection of workers
- Abstract from skill-origin-cohort-age for illustration
- Suppose individual i's wage is determined by

$$w_i = \underbrace{\zeta_{j(i)}(\omega_i)}_{\text{match quality}} \cdot \underbrace{\psi_{j(i)}\Big(\{\omega_n\}_{n \in \mathcal{I}_{j(i)}}}_{\text{worker complementarities}} ; \lambda_j, s_j\Big)$$

where $\mathcal{I}_j$ are the set of workers in firm j and

ω_i: vector of individual-specific components (partially observable)
ζ_j: firm-specific function that depends only on ω_i
ψ_j: firm-specific wage function that depends on all workers' ω_n
λ_j: firm-specific inputs

Understanding Plows and Flows II

- Our $\log\theta_j$'s are basically mean firm log wages:

$$\epsilon_i = \log\zeta_{j(i)}(\omega_i) - \overline{\log\zeta_j(i)(\omega_n)}^{n\in\mathcal{I}_{j(i)}}$$

$$\theta_j = \exp\left[\overline{\log\zeta_j(\omega_i)}^{i\in\mathcal{I}_j}\right]\cdot\psi_j\left(\{\omega_i\}_{i\in\mathcal{I}_j};\lambda_j,s_j\right)$$

- Suppose ζ_j,ψ_j are increasing in ω_i's
- So θ_j's may rise from swapping ω_i's due to
  1. Rise in average match quality
  2. Rise in worker complementarities
- Negative growth correlation can be understood as letting go of low ω_i workers (firms are too large...*in progress*)

Conclusion

1. Use German micro-level employment data to study East German wage convergence from 1992-2014

2. Labor market efficiency potentially an important source of income gaps and development
   - Misallocation of workers across firms explains bulk of initial East-West wage gap
   - Evidence that older cohorts were more misallocated due to longer communist exposure

3. Firm-Worker reallocation plays major role in catchup
   - More misallocated older East German cohorts reallocate faster
   - Younger cohorts persistently migrate with larger gains

Way Ahead

- Individual firm-worker understanding of size and θ effects
  1. Firm wages grow by relieving low-wage movers
     $\Leftrightarrow$ Stayers gain more than movers by staying in high-growth firms
  2. High-growth firms are NOT those with initially high wage!

- Cohort effects for migrants

- Control for further observables (industries, unions, etc.)
  - Occupation composition and premia may also be changing

- Tractable model that explains negative growth correlation

Way Ahead

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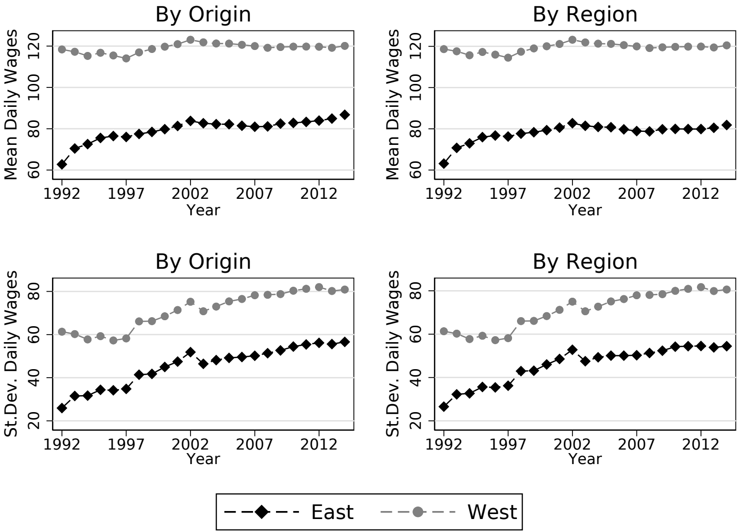
THANK YOU!

East-West German Wages



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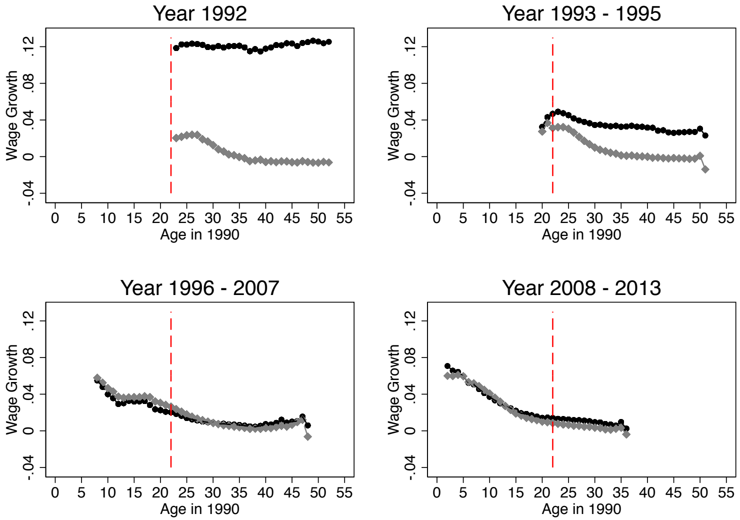
Wage Growth by Cohort



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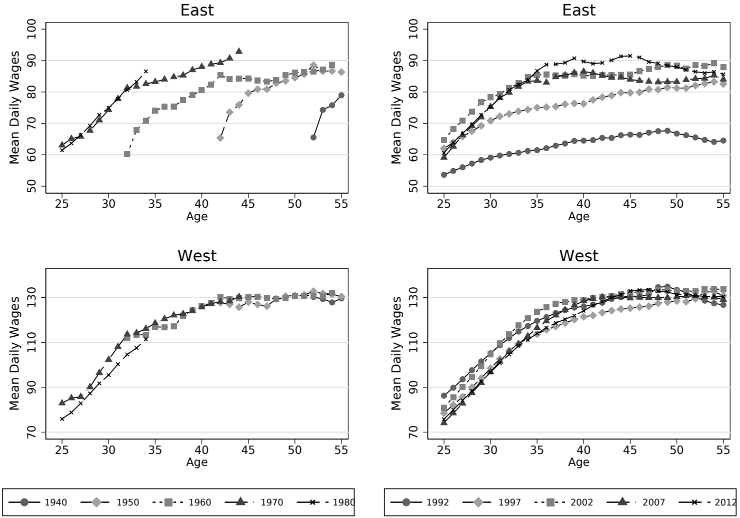
Raw Profiles in the Data



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Definitions and Level Decomposition

- For any period t, drop time subscripts to ease notation
- Define $\mathbf{R}_r$: set of workers from r
- For any set $\mathbf{A}$ of workers, $\tilde{\mathbf{A}}$: set of firms with at least worker in $\mathbf{A}$
  For any set $\tilde{\mathbf{A}}$ of firms, $\mathbf{A}$: set of all workers working in $\tilde{\mathbf{A}}$
- $\bar{x}(\mathbf{A}) \equiv \mathbb{E}\left[x_i | i \in \mathbf{A}\right]$: mean of x over workers in set $\mathbf{A}$
  $\bar{x}(\tilde{\mathbf{A}}) \equiv \mathbb{E}\left[x_j | j \in \tilde{\mathbf{A}}\right]$: mean of x over firms in set $\tilde{\mathbf{A}}$
- At any time t, E-W wage gap is

$$\frac{\bar{w}(\mathbf{R}_E)}{\bar{w}(\mathbf{R}_W)} = \underbrace{\frac{\bar{\theta}(\mathbf{R}_E)}{\bar{\theta}(\mathbf{R}_W)}}_{\text{between-firm gap}} \cdot \underbrace{\frac{\bar{h}(\mathbf{R}_E)}{\bar{h}(\mathbf{R}_W)}}_{\text{within-firm gap}} \cdot \underbrace{\frac{\rho(\mathbf{R}_E)}{\rho(\mathbf{R}_W)}}_{\text{type-correlation}}$$

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Wage Growth Decomposition

- Change in E-W wage gap ($\equiv$ growth rate gap)

$$\Delta \log \frac{\bar{w}(\mathbf{R}_E)}{\bar{w}(\mathbf{R}_W)} \approx \Delta \log \frac{\bar{\theta}(\tilde{\mathbf{S}}_E \cap \tilde{\mathbf{R}}_E)}{\bar{\theta}(\tilde{\mathbf{S}}_W \cap \tilde{\mathbf{R}}_W)} \quad \text{: unexplained firm wage growth}$$

$$+ \Delta \log \frac{\bar{\theta}(\mathbf{R}_E)/\bar{\theta}(\tilde{\mathbf{S}}_E \cap \tilde{\mathbf{R}}_E)}{\bar{\theta}(\mathbf{R}_W)/\bar{\theta}(\tilde{\mathbf{S}}_W \cap \tilde{\mathbf{R}}_W)} + \Delta \log \frac{\bar{h}(\mathbf{R}_E)}{\bar{h}(\mathbf{R}_W)}$$

where $\tilde{\mathbf{S}}_{\mathbf{r}}$: set of surviving firms in $r \in E, W$

- Cannot explain why East firms grow faster ($\sim$"TFP shocks")

- But can extract allocative gain

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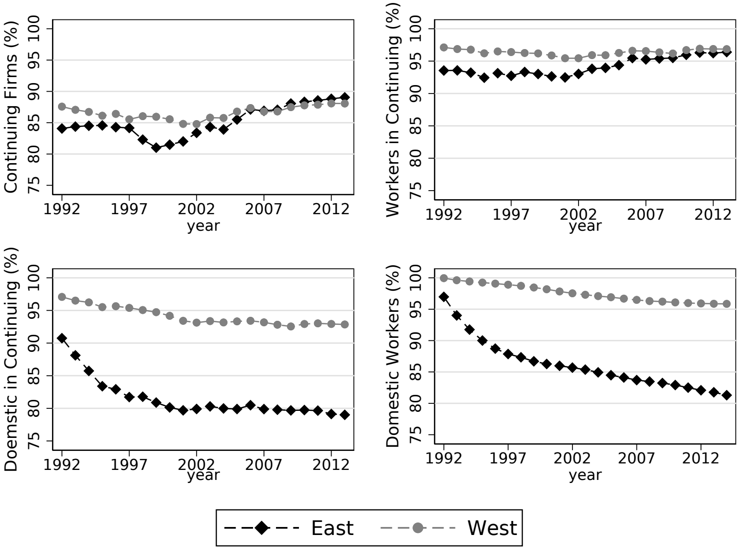
Firm Survival



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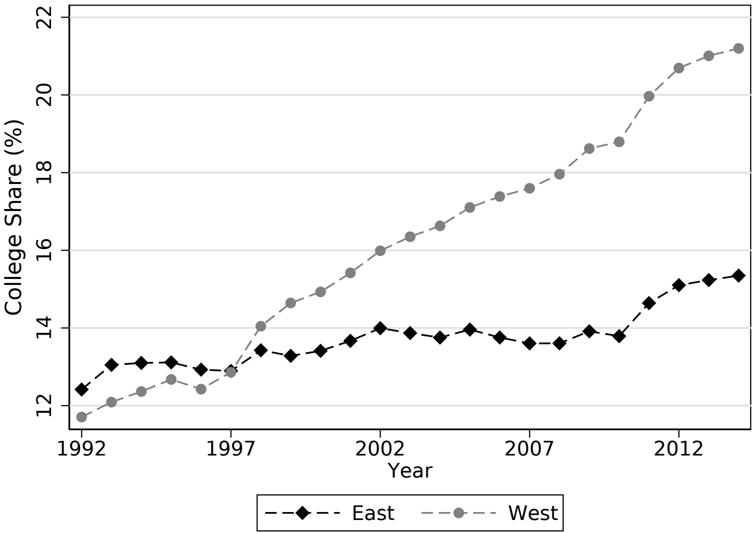
College Attainment by Year



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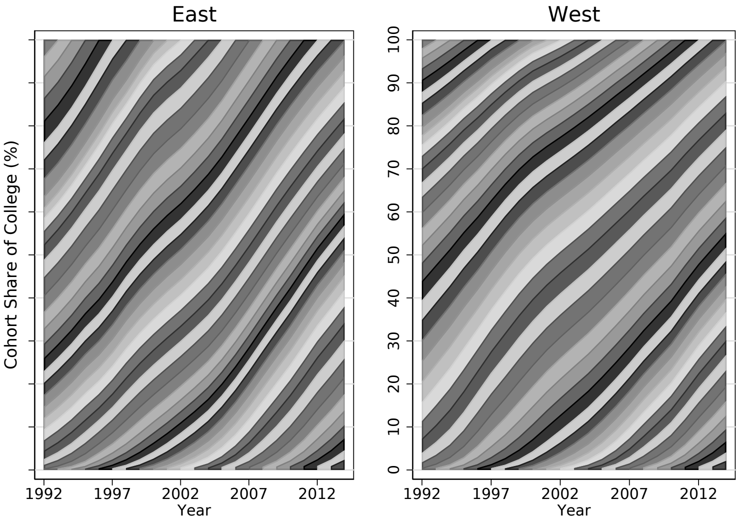
Cohort Share of College by Year



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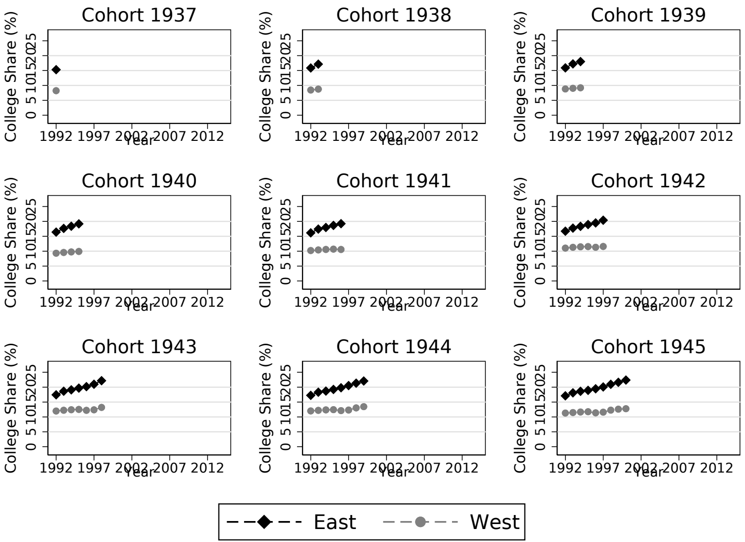
College Attainment by Cohort



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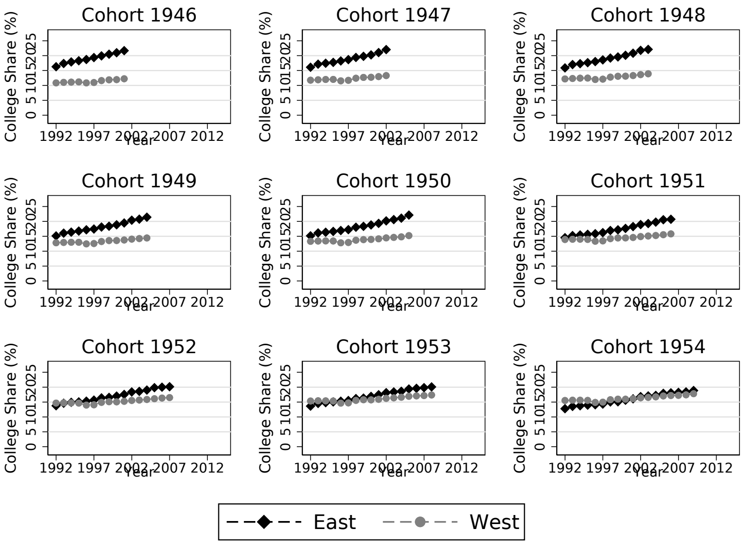

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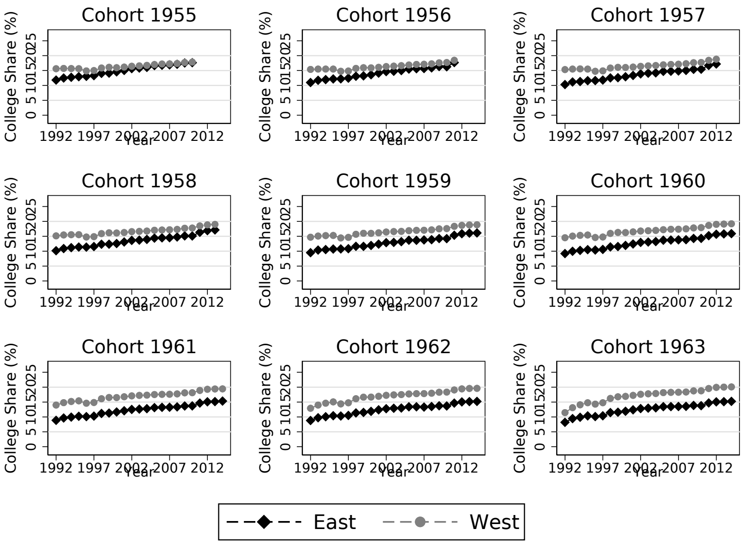

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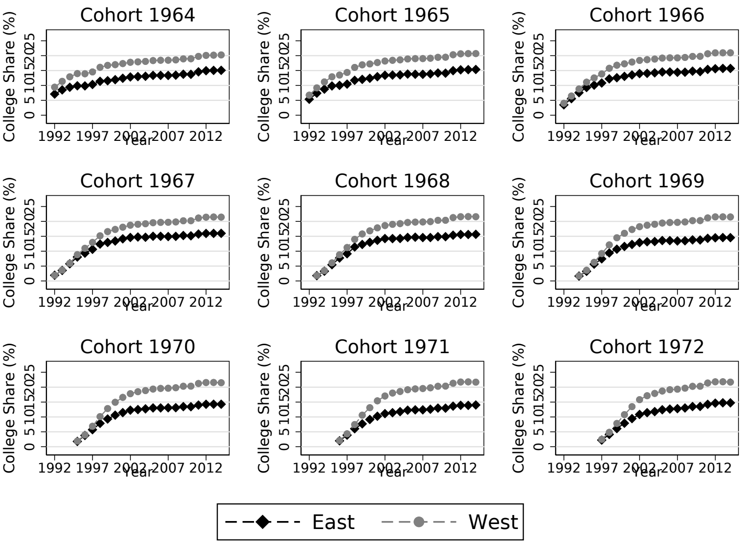

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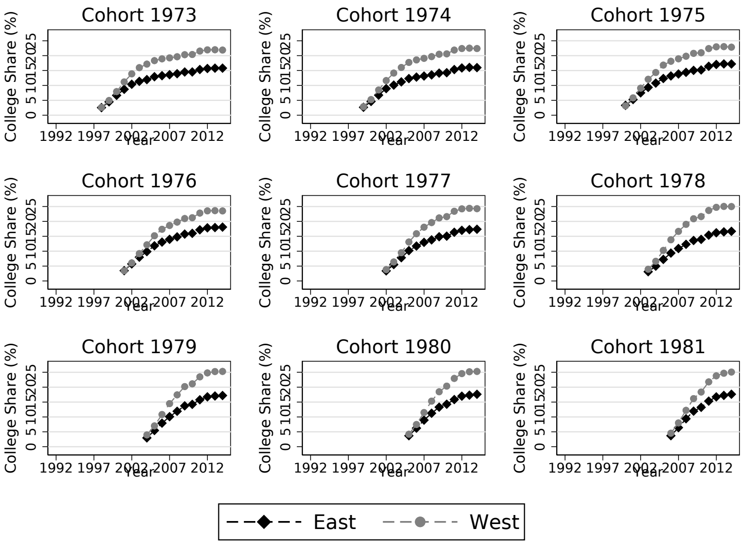

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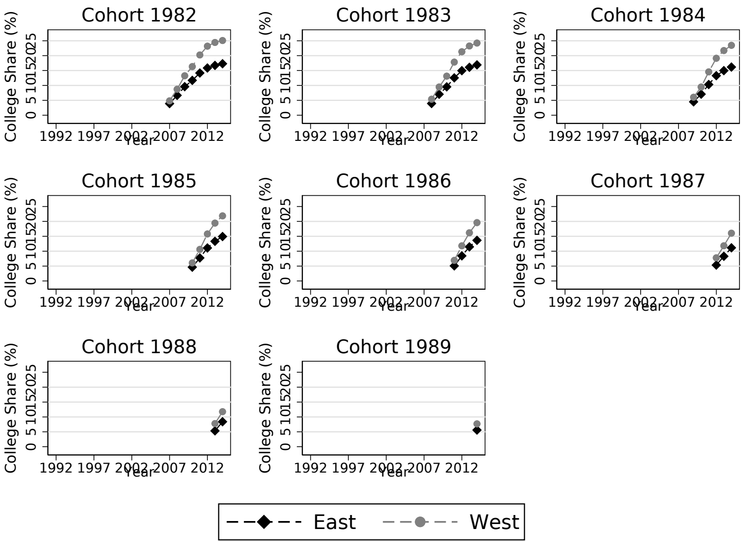

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Growth Decomposition Formula

- For any time t, define the sets
  1. $\tilde{\mathbf{T}}_r$: all firms in $r \in \{\text{East, West}\}$
  2. $\mathbf{M}_r$: set of workers who migrate out, or only appear in $t+1$
- Decompose firm component as:

$$\frac{\bar{\theta}'(\mathbf{R}_r')}{\bar{\theta}(\mathbf{R}_r)} = \underbrace{\frac{\bar{\theta}'(\tilde{\mathbf{S}}_r)}{\bar{\theta}(\tilde{\mathbf{S}}_r)}}_{\Upsilon_r:\text{ year effect}} \cdot \underbrace{\frac{\frac{\bar{\theta}'(\tilde{\mathbf{R}}_r'\cap\tilde{\mathbf{S}}_r)}{\bar{\theta}(\tilde{\mathbf{R}}_r\cap\tilde{\mathbf{S}}_r)}}{\frac{\bar{\theta}'(\tilde{\mathbf{S}}_r)}{\bar{\theta}(\tilde{\mathbf{S}}_r)}}}_{\text{extensive}} \cdot \underbrace{\underbrace{\frac{\bar{\theta}'(\mathbf{S}_r')/\bar{\theta}'(\tilde{\mathbf{S}}_r)}{\bar{\theta}(\mathbf{S}_r)/\bar{\theta}(\tilde{\mathbf{S}}_r)}}_{\text{regional shuffling}} \cdot \frac{\frac{\bar{\theta}'(\mathbf{R}_r'\cap\mathbf{S}_r')/\bar{\theta}'(\tilde{\mathbf{R}}_r'\cap\tilde{\mathbf{S}}_r)}{\bar{\theta}(\mathbf{R}_r\cap\mathbf{S}_r)/\bar{\theta}(\tilde{\mathbf{R}}_r\cap\tilde{\mathbf{S}}_r)}}{\frac{\bar{\theta}'(\mathbf{S}_r')/\bar{\theta}'(\tilde{\mathbf{S}}_r)}{\bar{\theta}(\mathbf{S}_r)/\bar{\theta}(\tilde{\mathbf{S}}_r)}}}_{S_r:\text{domestic shuffling}}$$

$$\times \underbrace{\frac{\frac{\bar{\theta}'(\mathbf{R}_r'\cap\mathbf{T}_r')}{\bar{\theta}(\mathbf{R}_r\cap\mathbf{T}_r)}}{\frac{\bar{\theta}'(\mathbf{R}_r'\cap\mathbf{S}_r')}{\bar{\theta}(\mathbf{R}_r\cap\mathbf{S}_r)}}}_{\text{firm entry/exit}} \cdot \underbrace{\frac{\frac{\bar{\theta}'(\mathbf{R}_r'\setminus\mathbf{M}_r)}{\bar{\theta}(\mathbf{R}_r\setminus\mathbf{M}_r)}}{\frac{\bar{\theta}'(\mathbf{R}_r'\cap\mathbf{T}_r')}{\bar{\theta}(\mathbf{R}_r\cap\mathbf{T}_r)}}}_{\text{migrants}} \cdot \underbrace{\frac{\frac{\bar{\theta}'(\mathbf{R}_r')}{\bar{\theta}(\mathbf{R}_r)}}{\frac{\bar{\theta}'(\mathbf{R}_r'\setminus\mathbf{M}_r)}{\bar{\theta}(\mathbf{R}_r\setminus\mathbf{M}_r)}}}_{\text{migration}}$$

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Component Decomposition

- For shuffling, note that for any set of workers $\mathbf{A}$,

$$\frac{\bar{\theta}'(\mathbf{A}')/\bar{\theta}'(\tilde{\mathbf{A}}')}{\bar{\theta}(\mathbf{A})/\bar{\theta}(\tilde{\mathbf{A}})} = \frac{\eta'(\mathbf{A}')}{\eta(\mathbf{A})}$$

  captures θ-size correlation

- Each component can be split into firm extensive and sub-shuffling gains, since for sets $\mathbf{A} \subset \mathbf{B}$:

$$\frac{\frac{\bar{\theta}'(\mathbf{B}')}{\bar{\theta}(\mathbf{B})}}{\frac{\bar{\theta}'(\mathbf{A}')}{\bar{\theta}(\mathbf{A})}} = \underbrace{\frac{\bar{\theta}'(\tilde{\mathbf{B}}')/\bar{\theta}(\tilde{\mathbf{B}})}{\bar{\theta}'(\tilde{\mathbf{A}}')/\bar{\theta}(\tilde{\mathbf{A}})}}_{\text{extensive gain}} \cdot \underbrace{\frac{\frac{\bar{\theta}'(\mathbf{B}')/\bar{\theta}'(\tilde{\mathbf{B}})}{\bar{\theta}(\mathbf{B})/\bar{\theta}(\tilde{\mathbf{B}})}}{\frac{\bar{\theta}'(\mathbf{A})/\bar{\theta}'(\tilde{\mathbf{A}})}{\bar{\theta}(\mathbf{A})/\bar{\theta}(\tilde{\mathbf{A}})}}}_{\text{shuffling gain}} = \frac{\bar{\theta}'(\tilde{\mathbf{B}}')/\bar{\theta}(\tilde{\mathbf{B}})}{\bar{\theta}'(\tilde{\mathbf{A}}')/\bar{\theta}(\tilde{\mathbf{A}})} \cdot \frac{\eta'(\mathbf{B}')/\eta(\mathbf{B})}{\eta'(\mathbf{A}')/\eta(\mathbf{A})}$$

- Shuffling: domestic, firm entry/exit, foreign
- Not considered across borders: all soaked into migration

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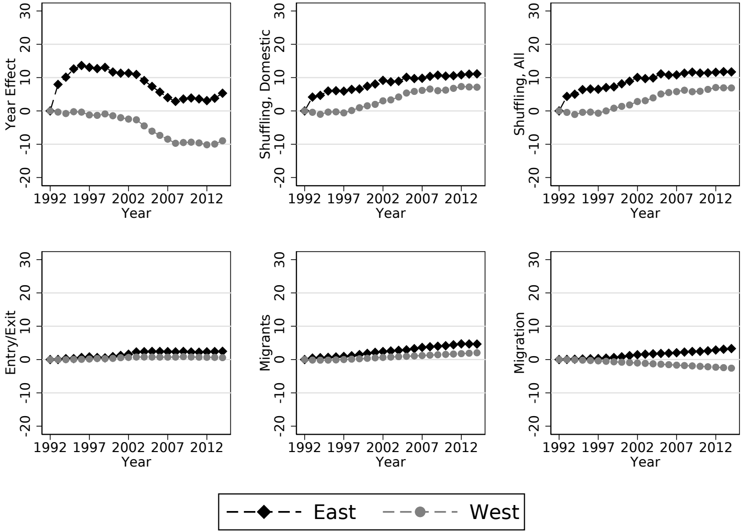
Growth Decomposition of θ



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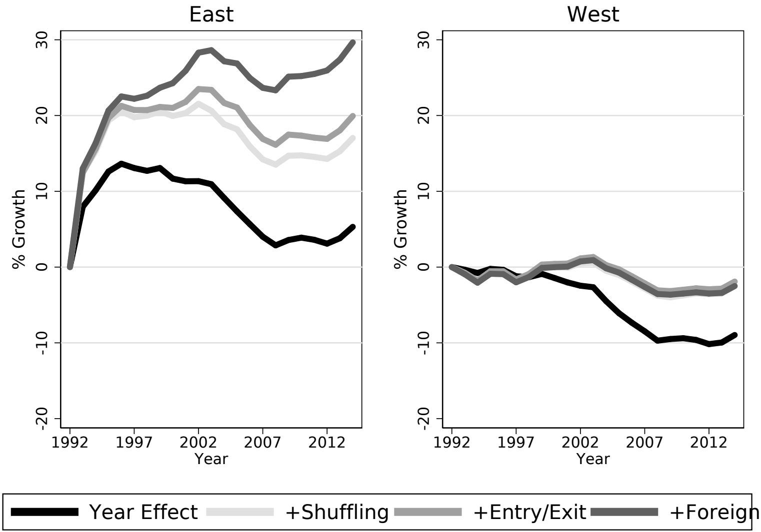
Growth Decomposition of θ: Levels



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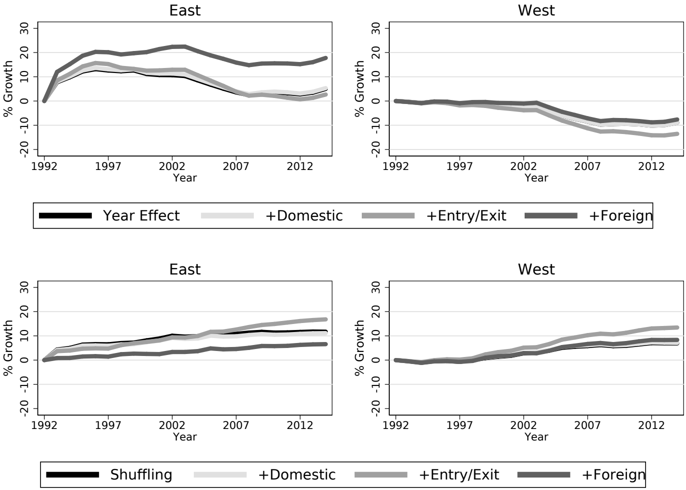
Intensive and Extensive Margins



- Migrants move to high θ firms, but shuffling effect is negative

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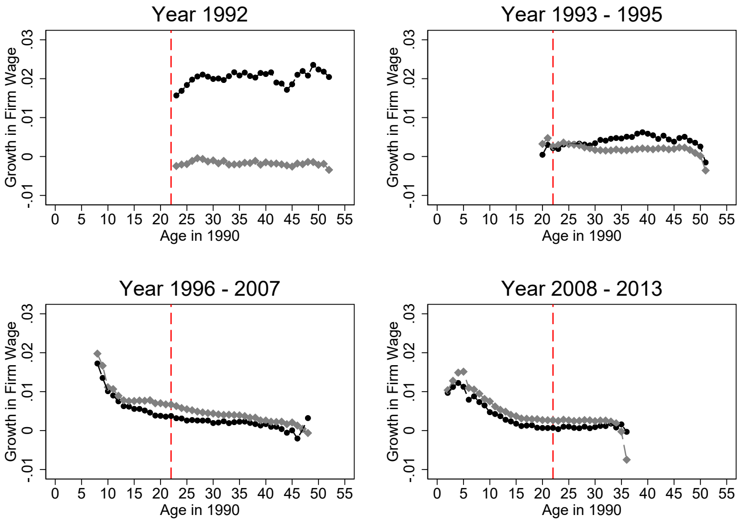
Cohort Shuffling



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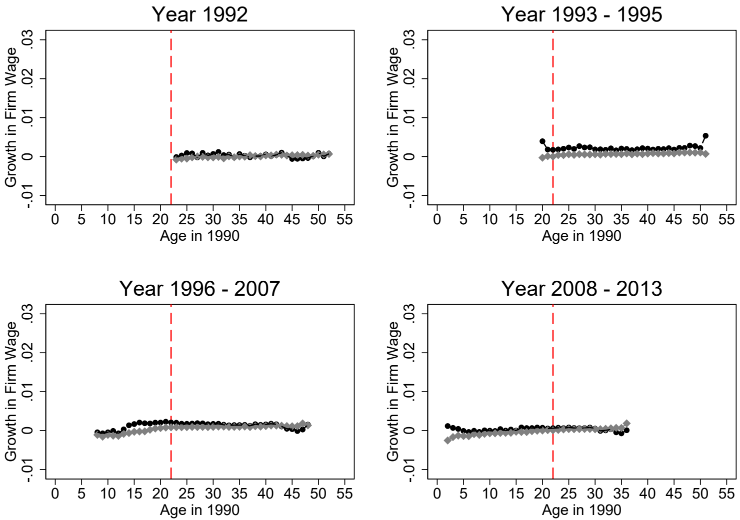
Cohort Seeding N' Weeding



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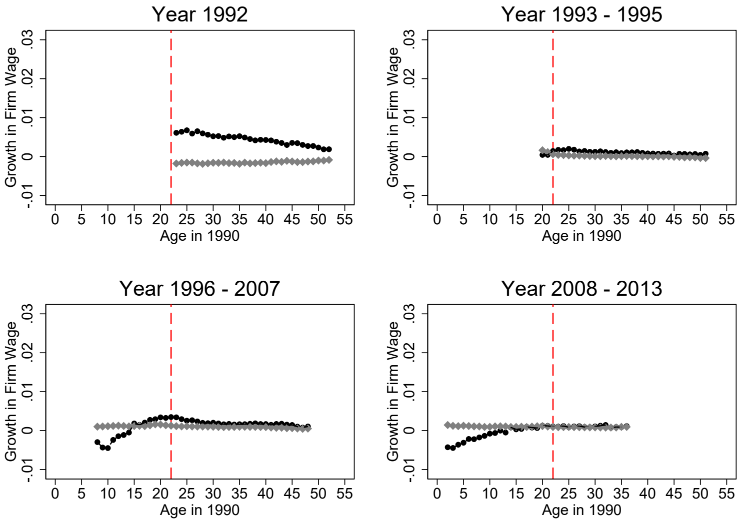
Migrants by Cohort



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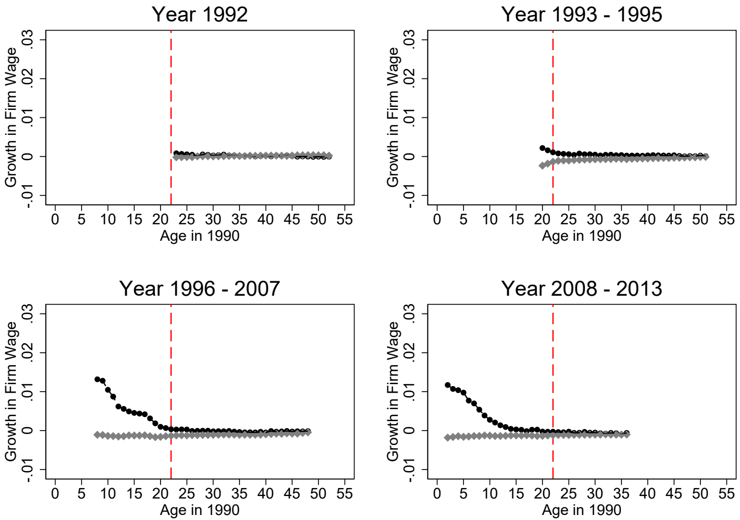
Migration by Cohort



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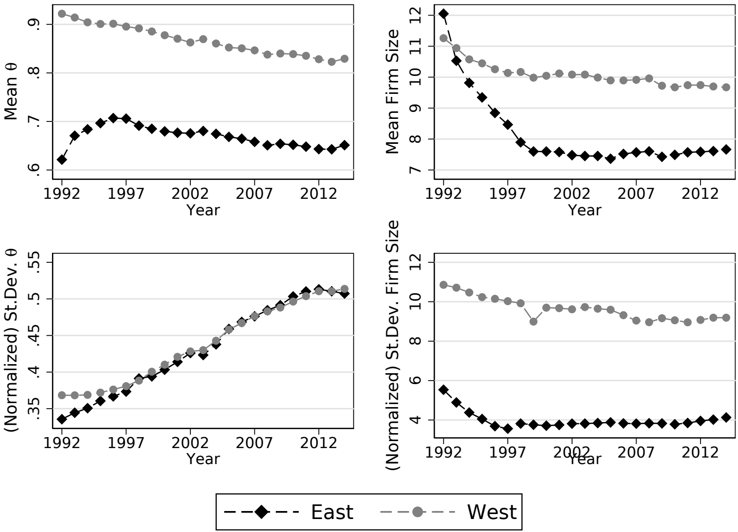
Size and θ moments



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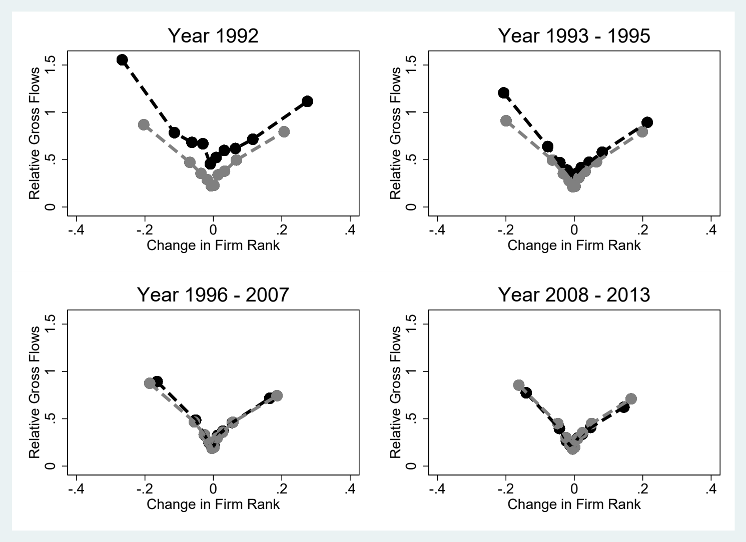
$\Delta\theta$—Relative Gross Flows Correlation



- East in black
- No θ (firm wage) change for firms with no flows

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Melitz, Marc J. and Sašo Polanec, "Dynamic Olley-Pakes productivity decomposition with entry and exit," *RAND Journal of Economics*, June 2015, *46* (2), 362–375.

Olley, G. Steven and Ariel Pakes, "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica*, 1996, *64* (6), 1263–1297.