FIRM DYNAMICS AND RESIDUAL INEQUALITY IN OPEN ECONOMIES

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ESSIM, 29/05/14
Residual Wage Inequality

- Since 1990, increasing **wage inequality** in almost all OECD countries
- **Mincer regressions**: only 1/5 to 1/3 increase explained by worker observables: education, experience measures and their interactions (plus industry and region dummies)
Residual Inequality in West Germany

German social security records. Real daily wage, full-time, West German, male workers.

- Raw inequality (std.dev. of log wages)
- Residual inequality (std.dev. of log wage residuals)
Wage Inequality and Trade in Germany: the Fall of the Iron Curtain
Labor and Product Market Reforms

- **Labor market Reforms**
  - **Hartz III**: reduction unemployment benefit by 30%
  - **Hartz IV**: reform of Federal Employment Agency to increase job search efficiency -> Hertweck and Sigrist (2012) estimate 20% increase in matching function efficiency

- **Product market Reforms**
  - **Single Market Program** in 1990s -> OECD index of product market regulation (PMR) intensity drops 24% by 2003 and a 36% by 2008.
Decomposition of Total Wage Variance

<table>
<thead>
<tr>
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</thead>
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<td></td>
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<td>Person effects</td>
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<td>Plant effects</td>
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<td>Covariate index</td>
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<td>Cov(person, plant)</td>
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<td>2</td>
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<tr>
<td>Sum</td>
<td>0.137</td>
<td>0.147</td>
<td>0.184</td>
<td>0.249</td>
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</table>

Notes. Table based on variance decomposition in Card et al. (2012) using log daily wage data for West German, male, full-time workers, aged 20-60, as reported in German social security data; covariates include year dummies, a quadratic and cubic term in age, all fully interacted with educational attainment.

- **Firm** component and **assortative matching** are relevant, worker characteristics are not
Research Questions

- How do trade and firm characteristics shape the dynamics of residual inequality?
  - Model of trade with firm heterogeneity (Melitz, 2003) and directed search (Kass and Kircher, 2011) → wage dispersion across homogenous workers
  - Effects of Trade, Labor and Product Market reforms on inequality

- Calibrate model to matched employer-employee (LIAB) German data and quantify link between trade, institutional reforms and inequality
Why Directed Search?

- **Matching key facts**: captures key features of firm and labor market dynamics in the data (Kaas & Kircher, 2011):

1. Workers **direct** their search, firms commit to long-term contracts (Hall & Krueger, 2012)
2. Vacancy **filling rates** correlate with firm’s **growth** rates (Davis, Faberman, Haltiwanger, 2010) → DT provides a theory linking growth and wages
3. **Within-firm vintage** effects; recruitment wages fall with firm age (Haltiwanger, Jarmin, Miranda, 2010) → Within-firms inequality
Final good technology

\[ Y = M^{-\frac{1}{\sigma-1}} \left[ \int_{\omega \in \Omega} y(\omega) \frac{\sigma-1}{\sigma} d\omega \right]^{\frac{\sigma}{\sigma-1}}, \sigma > 1, \]

\( M \) mass of varieties, \( y(\omega) \) quantity of input, \( M^{-1/(\sigma-1)} \) neutralizes love for variety.
Intermediate inputs

- Firm pay a sunk cost to draw a productivity $z$ from an initial distribution $G(z)$
- Linear production function
  \[ y(z) = z \ell, \]
- Fixed costs: domestic $f$ and export $f_X$
- Iceberg-type variable trade cost $\tau \geq 1$
- Since $p_X(z) = \tau p_D(z)$ and $y_X(z) = \tau^{1-\sigma} y_D(z)$, from the isoelastic demand we obtain total revenues
  \[ R(\ell, I; z) = \left[ \frac{Y}{M} \left( 1 + I(z) \tau^{1-\sigma} \right) \right]^{\frac{1}{\sigma}} (z \ell)^{\frac{\sigma-1}{\sigma}}, \]
  where $I(z) > 0$ for exporters
Firms post openings with a **fixed** wage offer

Search is **directed**: Workers have info about job offers prior to search

Labor market segmented over continuum of **submarkets** with different wage contracts

Transaction impeded by **matching frictions**

- $\theta \triangleq V/S$, ratios of open vacancies to job seekers
- CRS matching function in each submarket: $q(\theta)$, vacancy-filling rate, $\theta q(\theta)$ job-finding rate.
Directed Labor Market Search

- Time is continuous
- Shocks:
  - Two death shocks: firm-specific $\delta > 0$, worker-specific shock $\chi > 0$
- $b > 0$ unemployment benefits
- Assumption: commitment $\rightarrow$ post contracts stipulating wages in every future period
- Simplification: workers are offered a constant income stream.
Directed Labor Market Search

- **Workers’ asset values**

\[
\begin{align*}
    rE(w) &= w + (\delta + \chi)[U - E(w)] \\
    w_r &\equiv rU = b + \theta q(\theta)[E(w) - U]
\end{align*}
\]

imply

\[
    w_r = b + \theta q(\theta) \left( \frac{w(\theta) - w_r}{r + \delta + \chi} \right). \\
    \triangleq \rho
\]
Directed Labor Market Search

- Workers’ asset values

\[ rE(w) = w + (\delta + \chi)[U - E(w)] \]
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imply

\[ w_r = b + \theta q(\theta) \left( \frac{w(\theta) - w_r}{r + \delta + \chi} \right) \]

- Dynamic worker indifference condition

\[ w(\theta) = w_r + \frac{1}{\theta q(\theta)} (r + \delta + \chi) \rho. \]

Given \( w_r \), negative correlation between \( w(\theta) \) and job find rate \( \theta q(\theta) \), positive between \( w(\theta) \) and job fill rate \( q(\theta) \).
Dynamic Problem of firm of age \( a \)

- State variables \( \ell_a \) and cumulated wage bill
  \[ W_a \triangleq \int_0^a e^{-\chi(a-s)} q(\theta_s) v_s w(\theta_s) \, ds \]
- \( W_a \) sunk at age \( a \)
Dynamic Problem of firm of age $a$

- State variables $\ell_a$ and cumulated wage bill
  $$W_a \triangleq \int_0^a e^{-\chi(a-s)} q(\theta_s) v_s w(\theta_s) \, ds$$
- $W_a$ sunk at age $a$

$$\Pi(\ell_a, W_a; z) \triangleq \max_{\{v_s, \theta_s, I_s\}} \int_a^\infty e^{-(r+\delta)(s-a)} [R(.) - W_s - C(v_s) - f - I_s f_x] \, ds$$

s.t.
$$\dot{\ell}_s = q(\theta_s) v_s - \chi \ell_s ;$$
$$\dot{W}_s = q(\theta_s) v_s w(\theta_s) - \chi W_s ;$$
$$w(\theta_s) = w_r + \frac{\rho}{\theta_s q(\theta_s)} (r + \delta + \chi) .$$
Optimal Recruitment Policy

First order conditions with respect to $v_s$ and $\theta_s$ yield

$$\theta_a = \frac{1 - \eta}{\eta} \frac{\rho}{C'(v_a)}$$

- $\eta$ . . . elasticity of the matching function

If $C''(v_a) > 0$, firms posting more vacancies recruit in markets with lower $\theta_a$... and they pay higher wages.

Firms face a trade off between job-fill rate and wages.

With convex $C(v)$, firms grow by posting more vacancies and filling them faster (Davis et al., 2012, 2013).
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Export Status

- Static problem given the non-sunk nature of $f_X$
- Optimal $I_a$ solves
  $$I_a(z) = \arg \max_{I \in \{0,1\}} \{ R(\ell, I; z) - I f_X \}$$
- Minimum size for starting export $\ell^X(z)$ for firm $z$
- Set of exporters is $\{(z, a) | \ell_a(z) > \ell^X(z)\}$
Export Status

- Static problem given the non-sunk nature of $f_X$

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$$I_a(z) = \arg \max_{I \in \{0,1\}} \{ R(\ell, I; z) - I f_X \}$$

- Minimum size for starting export $\ell^X(z)$ for firm $z$

- Set of exporters is $\{(z, a) | \ell_a(z) > \ell^X(z)\}$

$\implies$ i.e., firms grow into exporting; overlap of productivity distributions of exporters and non-exporters (Impullitti, Irrarazabal, Opromolla, 2013)
Optimal evolution of $\ell$ satisfies

$$
\frac{\eta}{\rho} [R_1 (\ell_a, \Pi_a; z) - w_r] = \left( \frac{\dot{\ell}_a + \chi \ell_a}{\xi_0} \right)^{\xi_1} \left[ r + \delta + \chi - \xi_1 \frac{\ddot{\ell}_a + \chi \dot{\ell}_a}{\dot{\ell}_a + \chi \ell_a} \right],
$$

with the constants $\xi_0 > 0, \xi_1 > 0$; closed form if $R(\ell, z) = z - \sigma \ell$. 

The wage schedule for firm $z$ is

$$
w_a(z) = w_r + \left( \dot{\ell}_a(z) + \chi \ell_a(z) \right) \frac{\xi_0}{\xi_1} \left[ r + \delta + \chi - \xi_1 \frac{\ddot{\ell}_a + \chi \dot{\ell}_a}{\dot{\ell}_a + \chi \ell_a} \right].$$
Optimal Firm Growth and Wage Schedule

Optimal evolution of $\ell$ satisfies

$$\frac{\eta}{\rho} \left[ R_1 (\ell_a, I_a; z) - w_r \right] = \left( \frac{\dot{\ell}_a + \chi \ell_a}{\xi_0} \right)^{\xi_1} \left[ r + \delta + \chi - \xi_1 \frac{\ddot{\ell}_a + \chi \dot{\ell}_a}{\ell_a + \chi \ell_a} \right],$$

- with the constants $\xi_0 > 0, \xi_1 > 0$; closed form if $R(\ell, z) = z - \sigma \ell$
- The wage schedule for firm $z$ is

$$w_a(z) = w_r + \left( \frac{\dot{\ell}_a(z) + \chi \ell_a(z)}{\xi_0} \right)^{\xi_1} (r + \delta + \chi) (w_r - b)$$
General Equilibrium

- Discounted profits

\[ \Pi(0, 0; z) = \frac{1}{r + \delta} \left[ \frac{C'(v_0(z))}{q(\theta_0(z))} l_0(z) - C(v_0(z)) - f - e^{-(r+\delta)a_x(z)} f_x \right] \]

with \( a_x(z) \triangleq \inf \{ a : \Pi_a = 1 \} \)
General Equilibrium

- **Discounted profits**

\[
\Pi(0, 0; z) = \frac{1}{r + \delta} \left[ \frac{C'(v_0(z))}{q(\theta_0(z))} l_0(z) - C(v_0(z)) - f - e^{-(r+\delta)a_x(z)}f_x \right]
\]

with \(a_x(z) \triangleq \inf \{a : \Pi_a = 1\}\)

- **Productivity cutoffs**

  Domestic cutoff \(z_D^*\) : \(\Pi(0, 0; z_D^*) = 0\)

  Export cutoff \(z_X^*\) : \(z_X^* = \inf \left\{ z : l(z) \geq l^X(z) \right\} \)

  Free entry condition : \(\int \Pi(0, 0; z) \mu(z) dz = f_E / (r + \delta)\)

  to solve for \(\{Y/M, w_r, z_D^*\}\)
General Equilibrium

- **Discounted profits**
  \[ \Pi(0, 0; z) = \frac{1}{r + \delta} \left[ \frac{C'(v_0(z))}{q(\theta_0(z))} l_0(z) - C(v_0(z)) - f - e^{-(r+\delta)a_x(z)} f_x \right] \]
  with \( a_x(z) \triangleq \inf \{ a : \Pi_a = 1 \} \)

- **Productivity cutoffs**
  - Domestic cutoff \( z^*_D \): \( \Pi(0, 0; z^*_D) = 0 \)
  - Export cutoff \( z^*_X \): \( z^*_X = \inf \{ z : l(z) \geq l^X(z) \} \)
  - Free entry condition: \( \int \Pi(0, 0; z) \mu(z) dz = \frac{f_E}{r + \delta} \)

  to solve for \( \{ Y/M, w_r, z^*_D \} \)

- **Determine \( M \) by aggregating** \( s(z) = l(z) / [\theta(z)q(z)] \) over all firms and ages
General Equilibrium

- **Discounted profits**

  \[
  \Pi(0, 0; z) = \frac{1}{r + \delta} \left[ \frac{C'(v_0(z))}{q(\theta_0(z))} l_0(z) - C(v_0(z)) - f - e^{-(r+\delta)a_x(z)} f_x \right]
  \]

  with \( a_x(z) \triangleq \inf \{ a : \Pi_a = 1 \} \)

- **Productivity cutoffs**

  - Domestic cutoff \( z^*_D \): \( \Pi(0, 0; z^*_D) = 0 \)
  - Export cutoff \( z^*_X \): \( z^*_X = \inf \left\{ z : l(z) \geq l^X(z) \right\} \)

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  to solve for \( \{ Y/M, w_r, z^*_D \} \)

- Determine \( M \) by aggregating \( s(z) = l(z) / [\theta(z)q(z)] \) over all firms and ages

- Determine \( u \) by computing

  \( L = M (1 + \varsigma) \int (\int_0^\infty l_a(z) \delta e^{-\delta a} da) \mu(z) dz \)
One period model

Simplifying assumptions:

- Shut down firm and match level shocks: $\delta = 0, \chi = 0$
- No unemployment benefit: $b = 0$
Combining first order conditions

\[ \theta = \frac{1 - \eta}{\eta} \left( \frac{W}{C'(v)} \right). \]

**Intuition**: convexity → costs increase over-proportionately with size → firms post higher wages to increase job filling rates (same as dynamic model)
Goods Market Equilibrium

**Definition**

*(Representative firm).* Let $\tilde{z}$ be the productivity level such that $p_D(\tilde{z}) = 1$.

As in Melitz, Free entry and Cutoff condition determine $(\pi(\tilde{z}), z^*_D)$

\[(ZCP) \quad : \quad \pi(\tilde{z}) = f \left\{ \left[ \frac{\tilde{z}(z^*_D)}{z^*_D} \right]^\beta - 1 \right\},\]

\[(FE) \quad : \quad \pi(\tilde{z}) = \frac{f_E + \{1 - G [z^*_X (z^*_D)]\} (f_X - f)}{2 - G (z^*_D) - G [z^*_X (z^*_D)]}.\]
Trade Liberalization

\[ \pi(\hat{Z}) \]

\[ \hat{Z}_D \]

\[ Z_D^* \]

\[ \text{FE} \]

\[ \text{ZCP} \]
Trade and Avg. Wages

- Given equilibrium $z^*_D$, value of search $W$ follows from cutoff condition:

$$
\pi(z^*_D; W) = KW^{-\frac{\eta}{1-\eta}} \left(\frac{\alpha}{\alpha-1}\right) \tilde{z}^\gamma z^*_D^\beta - f = 0.
$$

- $W$ increasing in $z^*_D$ and $\tilde{z}$

- Trade increases efficiency $\rightarrow$ labor market more competitive $\rightarrow$ $\uparrow W$
Trade and Employment

Two offsetting forces

- Positive **Efficiency effect** on $W$: for each $w$ firms must offer higher $q(\theta)\theta$ to attract workers
- Negative **Composition effect** → firms become on average larger → they operate in submarkets with lower $\theta$

Additional composition effect (**New Exporters**)

- If all firms have same $\theta$ (no inequality) ⇒ composition effect disappears
Trade liberalization: Wages

- Wages profile in logs

\[
\ln w(z; \tilde{z}) = \ln \left( \eta \frac{\sigma - 1}{\sigma} \right) + \frac{\beta}{\sigma - 1} \ln \tilde{z} + \left( 1 - \frac{\beta}{\sigma - 1} \right) \ln z + (\sigma - 1 - \beta) \ln \left[ 1 + \mathbb{I}(z) \tau^{1-\sigma} \right]
\]

- Result. Trade liberalization increases real wages for all workers as well as the exporter premium.

  - **Efficiency**: as firms become more productive \( \rightarrow \uparrow W \rightarrow \) all firms must pay higher \( w \)
  - **Export Premium**: size premium for exporting increases \( \rightarrow \) exporters willing to pay \( w \)
Wage Dispersion

- Wage dispersion

\[
\text{var} \left[ \ln w (z) \right] = (\sigma - 1 - \beta)^2 \left\{ \frac{\text{var} \left[ \ln z \right]}{(\sigma - 1)^2} + \text{var} \left[ \ln (1 + \Pi(z) \tau^{1-\sigma}) \right] + \frac{2\text{cov} \left[ \ln z, \ln (1 + \Pi(z) \tau^{1-\sigma}) \right]}{\sigma - 1} \right\} 
\]

all firms export, \( \Pi(z) = 1 \), no firms export \( \Pi(z) = 0 \) \( \implies \)

\[
\text{var} \left[ \ln w (z) \right] = (\sigma - 1 - \beta)^2 \frac{\text{var} \left[ \ln z \right]}{(\sigma - 1)^2}
\]

- Result (Inequality). Wage dispersion under autarky and free trade is the same. For intermediate values it is inverted U-shape
Calibration to German data → target 1996
- Matched employers-employees data (LIAB) 1996-2007, plus aggregate data
- Data fit potential → fitting key firm dynamics and labor market facts
- Exercise I (Trade): feed 1996-2007 change in trade shares → inequality
- Exercise II (Hartz): feed 1996-2007 change in unemployment benefit and matching efficiency → inequality
- Exercise III (Product Market Reforms):...
## Aggregate Statistics for Germany

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<tr>
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<th>1996</th>
<th>2007</th>
<th>Source</th>
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<tr>
<td><strong>Openness</strong></td>
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<tr>
<td>Agg. export openness (VA based)&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>16.69%</td>
<td>27.75%</td>
<td>OECD-WTO TiVA data base</td>
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<tr>
<td>Share of plants with exports&lt;sup&gt;2)&lt;/sup&gt;</td>
<td>18.00%</td>
<td>28.00%</td>
<td>LIAB data base</td>
</tr>
<tr>
<td>Share of exports in exporter sales&lt;sup&gt;2)&lt;/sup&gt;</td>
<td>19.00%</td>
<td>31.00%</td>
<td>LIAB data base</td>
</tr>
<tr>
<td><strong>Institutions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross replacement rate&lt;sup&gt;3)&lt;/sup&gt;</td>
<td>26.00%</td>
<td>22.00%</td>
<td>OECD, tax benefits models</td>
</tr>
<tr>
<td>Product market regulation (index)&lt;sup&gt;4)&lt;/sup&gt;</td>
<td>2.00</td>
<td>1.27</td>
<td>OECD, Woelfl et al. (2009)</td>
</tr>
<tr>
<td><strong>Labor market outcomes</strong></td>
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<tr>
<td>Std.dev. of raw log wages</td>
<td>0.40</td>
<td>0.53</td>
<td>SIAB data base</td>
</tr>
<tr>
<td>Std.dev. of residual log wages</td>
<td>0.34</td>
<td>0.43</td>
<td>SIAB data base</td>
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<td>Gini coefficient of wage inequality</td>
<td>0.20</td>
<td>0.27</td>
<td>SIAB data base</td>
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<td>85-15 quartile ratio</td>
<td>0.68</td>
<td>0.83</td>
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<tr>
<td>50-15 quartile ratio</td>
<td>0.29</td>
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<tr>
<td>Unemployment rate</td>
<td>9.90%</td>
<td>8.30%</td>
<td>Destatis</td>
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<tr>
<td><strong>Firm-level average employment levels&lt;sup&gt;2)&lt;/sup&gt;</strong></td>
<td></td>
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<tr>
<td>non-exporter plants</td>
<td>12.74</td>
<td>14.87</td>
<td>LIAB data base</td>
</tr>
<tr>
<td>exporter plants</td>
<td>96.61</td>
<td>89.47</td>
<td>LIAB data base</td>
</tr>
<tr>
<td>all plants</td>
<td>27.56</td>
<td>35.89</td>
<td>LIAB data base</td>
</tr>
</tbody>
</table>

**Notes.**  
1) Domestic value added embodied in foreign final demand as % of total value added (GDP); data refer to 1995 and 2008.  
2) based on information from LIAB data base, manufacturing sector.  
3) first year refers to 1995.  
4) years refer to 1998 and 2008.
## Calibration

### Parameters taken from external sources

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Interpretation</th>
<th>Source</th>
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<tbody>
<tr>
<td>$\sigma$</td>
<td>4.0</td>
<td>Elasticity of substitution</td>
<td>Bernard et al., 2007</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.5</td>
<td>Elasticity matching function</td>
<td>Standard</td>
</tr>
<tr>
<td>$r$</td>
<td>0.04</td>
<td>Annual interest rate</td>
<td>Standard</td>
</tr>
<tr>
<td>$b$</td>
<td>0.35</td>
<td>Replacement rate</td>
<td>Kohlbrecher et al. (2013)*</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.05</td>
<td>Firm destruction rate</td>
<td>Fuchs and Weyh (2010)*</td>
</tr>
<tr>
<td>$\chi$</td>
<td>0.07</td>
<td>Match destruction rate</td>
<td>Fuchs and Weyh (2010)*</td>
</tr>
</tbody>
</table>

### Calibrated Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Moment</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed costs, $f$</td>
<td>1.82</td>
<td>Average firm size</td>
<td>26.7</td>
<td>27.5</td>
</tr>
<tr>
<td>Fixed export costs, $f_x$</td>
<td>0.82</td>
<td>Share of exporting firms</td>
<td>18.2%</td>
<td>18%</td>
</tr>
<tr>
<td>Iceberg Costs, $\tau$</td>
<td>1.58</td>
<td>Exports share among exporters</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Shape parameter, $\kappa$</td>
<td>3.19</td>
<td>Average size exporters</td>
<td>97.7</td>
<td>96.6</td>
</tr>
<tr>
<td>Entry costs, $f_{E}$</td>
<td>2.34</td>
<td>Export wage premium</td>
<td>9.6%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Vacancy costs, $\alpha$</td>
<td>2.59</td>
<td>Std. deviation log-wages</td>
<td>8.1%</td>
<td>8.2%</td>
</tr>
<tr>
<td>Matching function, $A$</td>
<td>3.25</td>
<td>Unemployment rate</td>
<td>9.9%</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

Notes. When applicable, data refer to annual periodicity.

* Parameter estimates are based on German social security data provided by the IAB.
Size Distribution: base year
Wage Distribution: base year
Wages to new hires
Increase in Trade Shares

- Modify $\tau$ to capture increase in openness from 1996 to 2007

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp Share of Exporters</td>
<td>20%</td>
<td>20%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Share of Exp. Firms</td>
<td>18.2%</td>
<td>18%</td>
<td>34.5%</td>
<td>28%</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>9.9%</td>
<td>9.9%</td>
<td>8.8%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Avg. Firm Size</td>
<td>26.7</td>
<td>27.5</td>
<td>29</td>
<td>35.8</td>
</tr>
<tr>
<td>Avg. Size Exporters</td>
<td>97.8</td>
<td>96.6</td>
<td>64.2</td>
<td>89.4</td>
</tr>
<tr>
<td>Std. Wages (residual)</td>
<td>8.1%</td>
<td>8.2%</td>
<td>8.1%</td>
<td>11%</td>
</tr>
<tr>
<td>Export wage premium</td>
<td>9.6%</td>
<td>10.1%</td>
<td>8.9%</td>
<td>10.1%</td>
</tr>
</tbody>
</table>
Increase in Trade Shares

- Standard Selection Effects
- the model reproduces (qualitatively and/or quantitatively):
  - increase % exporting firms
  - increase avg. firm size
  - decrease avg. exporter size
  - reduction in unemployment
- We do not match: increase inequality!
## Trade and Inequality: an Inverted U-Shape

<table>
<thead>
<tr>
<th>Moments</th>
<th>$\tau' = 1.14$</th>
<th>$\tau' = 1.32$</th>
<th>$\tau' = 1.44$</th>
<th>$\tau_{bmk} = 1.58$</th>
<th>$\tau' = 1.78$</th>
<th>$\tau' = 2.08$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp Share of Exporters</td>
<td>40%</td>
<td>30%</td>
<td>25%</td>
<td>20%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Share of Exp. Firms</td>
<td>62.3%</td>
<td>34.5%</td>
<td>26.9%</td>
<td>18.26%</td>
<td>11.5%</td>
<td>4.04%</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>7.4%</td>
<td>8.8%</td>
<td>9.4%</td>
<td>9.9%</td>
<td>10.4%</td>
<td>10.9%</td>
</tr>
<tr>
<td>Avg. Firm Size</td>
<td>32.1</td>
<td>29</td>
<td>27.9</td>
<td>26.7</td>
<td>25.8</td>
<td>24.9</td>
</tr>
<tr>
<td>Avg. Size Exporters</td>
<td>47.3</td>
<td>64.2</td>
<td>77.6</td>
<td>97.8</td>
<td>128.9</td>
<td>249</td>
</tr>
<tr>
<td>Average Wage</td>
<td>1.06</td>
<td>1.01</td>
<td>0.99</td>
<td>0.98</td>
<td>0.97</td>
<td>0.96</td>
</tr>
<tr>
<td>Std. Wages (residual)</td>
<td>8.06%</td>
<td>8.11%</td>
<td>8.11%</td>
<td>8.10%</td>
<td>8.07%</td>
<td>8.03%</td>
</tr>
<tr>
<td>Export wage premium</td>
<td>8.4%</td>
<td>8.9%</td>
<td>9.2%</td>
<td>9.6%</td>
<td>10.1%</td>
<td>12.1%</td>
</tr>
</tbody>
</table>
From 1996 to 2007: Quantitative Results

Adjustment in $\tau$

- **Reduction of unemployment** rate as in data
- **Trade liberalization alone does not increase inequality**
  - Effect of trade costs on inequality is **hump-shaped**, and Germany close to the max
  - The inverted U is fairly flat: other mechanisms at work
- **Role of Firm Dynamics**: smooth firms growth process, attenuates effects of trade-induced reallocations on wages
- **Bottom line**: Trade is not the culprit for German inequality
Labor and Product Market Reforms

- **Labor market Reforms**
  - **Hartz III**: reduction unemployment benefit by 30%
  - **Hartz IV**: 20% increase in matching function efficiency

- **Product market Reforms**
  - OECD index of product market regulation (PMR) intensity drops 24% by 2003 and a 36% by 2008.
## Labor and Product Market Reforms

<table>
<thead>
<tr>
<th>Moments</th>
<th>Benchmark</th>
<th>$b' = 0.25$</th>
<th>$A' = 3.5$</th>
<th>$\sigma' = 4.2$</th>
<th>$f_E = 2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp Share of Exporters</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Share of Exp. Firms</td>
<td>18.2%</td>
<td>17.9%</td>
<td>18.5%</td>
<td>20%</td>
<td>18.3%</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>9.9%</td>
<td>9.2%</td>
<td>9.3%</td>
<td>10.5%</td>
<td>9.6%</td>
</tr>
<tr>
<td>Avg. Firm Size</td>
<td>26.7</td>
<td>26.2</td>
<td>27</td>
<td>29.2</td>
<td>25.5</td>
</tr>
<tr>
<td>Avg. Size Exporters</td>
<td>97.8</td>
<td>95.9</td>
<td>99.2</td>
<td>102.8</td>
<td>93.1</td>
</tr>
<tr>
<td>Avg. Wage</td>
<td>0.98</td>
<td>0.96</td>
<td>1</td>
<td>1.09</td>
<td>1.03</td>
</tr>
<tr>
<td>Std. Wages (residual)</td>
<td>8.1%</td>
<td>8.5%</td>
<td>7.8%</td>
<td>8.8%</td>
<td>7.9%</td>
</tr>
<tr>
<td>Std. Wages (within)</td>
<td>0.66%</td>
<td>0.69%</td>
<td>0.63%</td>
<td>0.52%</td>
<td>0.65%</td>
</tr>
<tr>
<td>Export wage premium</td>
<td>9.6%</td>
<td>10.3%</td>
<td>9.1%</td>
<td>10.6%</td>
<td>9.4%</td>
</tr>
</tbody>
</table>

Baseline situation: $b = 0.35; A = 3.25; \sigma = 4; f_E = 2.34.$
Labor and Product Market Reforms

- **Labor market Reforms**
  - **Hartz III** (unemployment benefits): reduces workers’ outside options
    - => lower selection
  - negligible reduction in unemployment (lower avg productivity offsets lower wages)
  - **Hartz IV** (matching efficiency): substantial reduction in unemployment, but counterfactual reduction in inequality

- **Product market Reforms** -> large increase in inequality
  - mechanism: more competitive product market -> multiplier of the link btw. firm productivity and optimal size
  - Product market competition main driver of inequality in Germany!!
  - **Exogenous markups**: trade cannot affect markups in this model
Interaction between reforms

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Specifications</th>
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<tbody>
<tr>
<td></td>
<td>1996</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4)</td>
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<tr>
<td>Unemployment Rate</td>
<td>9.9%</td>
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<tr>
<td></td>
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<td>10.7%</td>
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<td>Std. Res. log Wages</td>
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<tr>
<td></td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Rev. Share Exp.</td>
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<tr>
<td></td>
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</tr>
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<td>30%</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Share of Exporters</td>
<td>18%</td>
<td>36%</td>
</tr>
<tr>
<td></td>
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<td>Avg. Firm Size</td>
<td>26.7</td>
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<td>Avg. Exporter Size</td>
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<td>88.5</td>
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</tr>
</tbody>
</table>

Notes. Specifications are based on the benchmark calibration with the following differences: (1) $b = 0.25, \tau = 1.32$; (2) as (1) but $\tau = 1.25, \sigma = 4.8$; (3) as (2) but $A = 3.9$; (4) as (3) but $\sigma = 4.84, f = 1.2, f_E = 2.07$.

- **Reforms**: Trade ii) Hartz reforms iii) Product market reforms (25% drop in markup, 30% drop in domestic fixed cost and 17% drop in entry cost)

- **Outcomes**: 2/3 of increase in inequality and 1/2 of decline in unemployment
CONCLUSIONS

1. Tractable one-period Melitz-type GE model with directed search: trade, inequality and unemployment

2. Dynamic insights: distribution of firm growth rates and distribution of wage offers strongly related

3. Quantitative insights: if firms smooth growth, trade has minor implications for inequality

4. German Inequality I: key source is changes in product market competition

5. German Inequality II: Trade, Labor, and Product market reforms explain 2/3rd of inequality (channels left out: bargaining structure, technical change)

6. Extensions: aggregate transitional dynamics, endogenous markups