Trade Liberalization and Inequality: a Dynamic Model with Firm and Worker Heterogeneity

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Motivation

- The impact of international trade on inequality is a central issue
  - Empirically trade liberalization is strongly associated with rise in inequality (Goldberg and Pavcnik (2007) survey)

- What are the dynamic effects of trade liberalization on the wage distribution?
  - Literature focused on comparative steady states and comparative statics
  - By nature these approaches do not address the question

- I examine the evolution of inequality after 37 liberalization episodes
  - Gradual increase in inequality and suggestive evidence of overshooting
  - What explains the dynamics?
Project overview

- Build a model with endogenous dynamics, firm and worker heterogeneity
  - Relevant level of heterogeneity (Card et al. ('13), Helpman et al. ('12), Frias et al. ('09))
  - Combine worker screening a la Helpman et al. (ECMA ’10) and the wage posting mechanism of Kaas and Kircher (AER ’15)
  - Obtain analytical predictions for individual responses during the transition

- Show that the model mechanisms are consistent with micro-level facts
  - Estimate the magnitude of the central micro-mechanism using matched employer-employee data from France

- Numerical predictions from the calibrated model to examine aggregates
  - Qualitatively consistent with the event study: inequality overshooting
**Related literature**

**Steady state models without transition dynamics** but with
- *worker heterogeneity:*
  - Helpman, Itskhoki and Redding ('10), Caliendo and Rossi-Hansberg ('11)
- *firm growth (no worker heterogeneity):*
  - Fajgelbaum ('13), Felbermayr et al. ('14), Ritter ('14), Cosar et al. ('14), Kaas and Kircher ('15)

**Transitional dynamic models with**
- *no firm dynamics or homogeneous firms:*
  - Kambourov ('09), Cosar ('10), Dix-Carneiro ('10), Emami and Namini-Lopez ('12), Suverato ('13), Danziger ('14)
- *no wage dispersion:*
  - Ghironi and Melitz ('05), Atkeson and Burstein ('10), Cacciatore ('14)
- *no worker heterogeneity and limited firm dynamics:*
  - Helpman and Itskhoki ('15)
Presentation outline

1. Macro level empirical analysis
   - Event study

2. A two-sector symmetric two-country model
   - Micro-foundations: labor supply and demand
   - Steady state equilibrium properties
   - The transition equilibrium following a reduction in trade costs

3. Empirical relevance at the micro-level, calibration, and numerical results
   - Data, estimation and calibration
   - The response of aggregates to liberalization

4. Conclusion
Event study of 37 liberalization reforms (no causality)

- What happens in the data when countries open to trade?
- Liberalization dates from Wacziarg and Welch (2008)
  - relied on comprehensive survey of country case studies
- Gini time series from the micro studies collected in the World Income Inequality Database
- Follow the evolution of inequality before and after the liberalization dates
Steady increase of trade after liberalization reforms

Figure 1: Average evolution of openness (the ratio of imports and exports over GDP) before and after liberalization dates. The dotted lines correspond to 95% confidence intervals of dummy variables. Sources: WIID, WDI.

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Figure 2: Average evolution of Gini coefficients before and after liberalization dates. The dotted lines are the 95% confidence intervals of year dummies. Sources: WIID, WDI.

- Run a polynomial regression controlling for country specific trends:
  - The peak is estimated to be 7 years after the liberalization
  - Statistical tests point to a significant decrease from the peak
Hump shaped evolution of inequality

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Labor supply: the unemployed arbitrage between jobs

- Employed workers quit with exogenous probability ($s_0$) and can get fired
- Ex-ante identical unemployed workers apply to one vacancy type
  - service sector single-type vacancy: immediately hired at constant wage rate
  - differentiated sector vacancy of type-$\omega$ defined by 3 characteristics:
    1. wage schedules delivering a stochastic present value $V_{e,t}(\omega)$
    2. a probability $\mu$ of getting an interview is a function of the vacancy/searcher ratio
    3. a screening cutoff $\alpha_c$ and the associated probability $\frac{1}{\chi}$ to get the job
   * candidates get the job if a match-specific productivity draw $\alpha$ is above $\alpha_c$

- **Arbitrage between vacancies:** high-value jobs are hard to get

⇒ A wage offer at $t_0$: 
$$w_{t_0}(\omega) = w_0 + \frac{1}{\mu(\omega)} \frac{1}{\chi(\omega)} \frac{c_u}{c_w}$$

  - is the outside option and a premium,
  - compensates for low job-finding rate, high screening rate, and search costs

⇒ Thereafter, wages increase with screening: 
$$w_t = w_0 + \beta R_{t_0,t} \frac{1}{\mu_{t_0}} \frac{1}{\chi_t} \frac{c_u}{c_w}$$
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   * Candidates get the job if a match-specific productivity draw \( \alpha \) is above \( \alpha_c \).

- Arbitrage between vacancies: high-value jobs are hard to get.

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Labor demand from heterogeneous evolving firms

- Final good sector with CES demand and monopolistic competition
  - Production function with size and average worker ability complementarity
  - Free entry and endogenous exit (+exogenous exit shocks)
  - Overlapping generations of evolving heterogeneous firms ($x \sim \text{Pareto}$)
  - Convex costs of posting vacancies, fixed and variable costs of exporting

- Firms
  - accumulate workers and wage premium commitments
    - assume a single cutoff per firm: firms screen new hires ($\Delta$) and incumbents alike
    - assume for distressed firms in case of an unexpected bad shock (the trade liberalization reform) that: either commitments cut to restore firm profitability (profits=0) or firm exit
  - choose a number of workers $l'$ and a screening cutoff $\alpha'_c$ to maximize profits subject to the labor supply equation
Optimal evolution for firms starting small with unselected workers:
- Attract more and/or better workers with more vacancies and higher wages
- **Wage demand equation:**
  \[ w_t = w_o + \frac{(1-\xi)}{c_w} \frac{c_A}{\gamma} \left( \frac{\Delta}{l} \right)^{\gamma-1} \left( \frac{\alpha'_c}{\alpha_{min}} \right)^{\kappa \gamma} \] (1')
- Gradually grow to optimal size to save on convex adjustment costs
- Gradually raise screening to the optimal level
- If export, only when big enough to cover fixed costs
- Without bad shocks: no causes for downsizing, less screening or exit

In steady states, conditional on age, more productive firms:
- are relatively larger, have a higher screening cutoff, and pay better
Extending steady state canonical results

With some restrictions on parameter values, it can be shown that:

Prop. ??: Welfare is higher in steady states with trade than in autarky
  ▶ Trade implies tougher competition, a higher entry cutoff and more selection
  ▶ Higher average firm productivity and consumer gains from greater variety

Prop. ??: The dispersion of firm average wages is higher under trade when only some firms export
  ▶ Bigger, high-paying exporters screen and pay more than domestic firms

Prop. ??: Sectoral unemployment is strictly larger under trade
  ▶ Reallocation towards more productive firms that choose more screening
  ▶ More screening translates into vacancies with more rejections
Transition: exporters expand, domestic firms decline

- The transition following a once-and-for-all reduction trade costs

Special case analytical results

- Future stationary exporters (all firms with \( x \geq x_{X,\infty,\infty} \)) expand
  - Permanently raise wages because of higher new desired level of screening
  - Temporarily raise wage offers to higher levels to speed growth

- Domestic firms (\( x < x_{X,\infty,\infty} \)) grow more slowly, shrink or exit
  - Lower wages from lower growth, lower screening level, wage cuts
  - Temporary survival of some firms with \( x \) below the new steady state cutoff
    - These firms can survive for a period as they don’t need to pay hiring costs
  - Exit of the youngest (smallest) and least productive (\( x < x_{\text{exi}(a)} \))

Aggregating individual outcomes requires numerical computations.
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Calibration overview

- No analytical results for dynamic aggregate effects on inequality

- Use numerical solution from a calibrated version of the model
  - Get estimates and methods from the literature for standard parameters

- Calibrate the other parameter values to match French micro data:
  Set the labor market parameters $c_A, \frac{\kappa}{\psi}, \gamma$ to match 3 elasticities:
  - the elasticity of firm wage w.r.t firm size
  - the elasticity of the hiring rate w.r.t firm employment growth
  - the elasticity of wage offer w.r.t firm hiring rate $\gamma$
Faster growing firms have more worker separations

Figure 3: Nonparametric bi-variate regressions of hiring rates and separation rates on growth. Histogram of employment growth rate. Sources: DADS-Postes and EAE, 95-07. Rates were trimmed (2%) and deviated from year dummies.
Estimation of $\gamma$ the wage elasticity w.r.t the hiring rate

- Extended wage equation: 
  
  \[ w_{i,t} - w_{o,t} = e_{i,t} \gamma \frac{c_A}{c_w\alpha^\kappa_{min}} \left( \frac{\Delta}{l} \right)^{\gamma - 1} \alpha_{j,t}^{\kappa\gamma} \]

- Regress wage offers on hiring rate while controlling for firm screening with incumbents’ wage to recover $\gamma$

- Endogeneity concern: *downward bias because of omitted variables*
  - recruiting costs $c_{A,j,t}$, labor supply shocks $e_{i,t}$ are not fully controlled for

- Instrument the hiring rate $(\Delta/l)_{t,j}$ with product demand shocks
  - restrict the sample to exporters
  - use changes in the demand of foreign partners (Hummels et al. 2014)
Faster growing firms offer wage premia

Equation:  
\[ \ln w_{j,t}^{\text{hires}} = (\gamma - 1) \ln (\Delta/i)_{j,t} + \delta_j + \delta_t + \beta_0 \ln w_{j,t}^{\text{incumbents}} + Z'_{j,t} \beta_1 + \epsilon_{j,t} \]

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<tbody>
<tr>
<td>log hiring rate ( \ln (\Delta/i)_{j,t} )</td>
<td>0.019*** (0.002)</td>
<td>0.083* (0.043)</td>
<td>0.099* (0.057)</td>
<td>0.090 (0.089)</td>
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<td>incumbents’ avg. wage</td>
<td>0.540*** (0.017)</td>
<td>0.511*** (0.028)</td>
<td>0.527*** (0.028)</td>
<td>0.498*** (0.042)</td>
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<td>Weak identification</td>
<td>10% max IV size</td>
<td>10% max IV size</td>
<td>20% max IV size</td>
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Table 1: Employment-weighted firm-fixed-effect estimations of the elasticity of wage offers w.r.t firm growth. In a preliminary step, individual wages are partial-ed out from worker observable characteristics. Regressions are weighted by the number of hires. Sources: DADS-Postes and EAE. Manufacturing sector, 1995-2007.
Overshooting inequality after trade liberalization

- Consider a country under autarky that opens up to trade:
  - Trade costs decrease to a level at which 10% of firms exports, and 30% of their revenues comes from foreign sales in the future new steady state
  - Inequality peaks 3 years after and $\frac{1}{4}$ gets undone in the next 10 years
    * Wage inequality between and within firm overshoot (Frias et al. 2012)

Figure 4: Evolution of inequality in log-deviation from the autarky level. Inequality is measured by coefficient of variations. The dashed line are the future steady state values towards which the economy converges.
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Context
- Prior literature showed that liberalization reforms raise wage inequality
- It did not address the dynamics of inequality across firms and workers

Contributions
- Document the average evolution of inequality in a panel of 37 countries
- Build a trade model of firm and worker heterogeneity with endogenous firm dynamics
- Relate the predictions to the data and in particular to facts from French micro data

Results
- Steady state results are consistent with prior literature
- The model can explain the dynamic pattern of the macro event study
- Both suggest that a significant fraction of the inequality increase gets undone in the decade following the peak
APPENDIX