Productivity and Reallocation
Motivation

- Recent studies highlight role of reallocation for productivity growth. Market economies exhibit:
  - Large pace of output and input reallocation with substantial role for entry/exit.
  - Large differences in measured productivity across producers
  - Productivity enhancing market selection and reallocation from less to more productive businesses
  - Magnitude depends upon sector, country, measure (labor vs. TFP) – open questions:
    - Impact on workers vs. Impact on firms
    - Role of institutions/market structure
The challenge of cross-country analysis

- **Macro data**
  - e.g. SNA, PWT
  - Difficult to identify effects (e.g. 2 million growth regressions)

- **Sectoral data**
  - e.g. OECD-STAN; Unido
  - aggregate sectors obscure causal mechanism

- **Meta-analysis of results from micro studies**
  - A challenge to control for data, method, and context
  - Little within-country variation in policy (e.g. before and after)

- **Cross-country longitudinal micro dataset**
  - Generally not possible (disclosure)
  - EUROSTAT attempting to build EU panel, but from existing databases
Distributed micro-data collection

- **OECD sample**
  - Demographics (entry/exit) for 10 countries
  - Productivity decompositions for 7 countries
  - Survival analysis 7 countries

- **World Bank sample**
  - Same variables, 14 Central and Eastern Europe, Latin America and South East Asia

- **EU Sample (10 countries)**, updates and a few new countries
  - Productivity decompositions
  - Sample Stats and correlations by quartile
Data sources

- Business registers for firm demographics
  - Firm level, at least one employee, 2/3-digit industry
- Production Stats, enterprise surveys for productivity analysis
- Countries:
  - 10 OECD
  - 5 Central and Eastern Europe
  - 6 Latin America
  - 3 East Asia
- Data are disaggregated by:
  - industry (2-3 digit);
  - size classes 1-9; 10-19; 20-49; 50-99; 100-249; 250-499; 500+ (for OECD sample the groups between 1 and 20 and the groups between 100 and 500 are combined)
  - Time (late 1980s – late 1990s)
Measurement Error

- Three sources of error potentially affect comparability of indicators built from firm level data:
  - Classical Error of firm-level measure
    \[ X = X^* + \varepsilon \]
  - Errors in sample
    \[ \Omega = \Omega^* + \Psi \]
  - Method of Aggregation of Indicator
    \[ I = A[ X_f | f \in \Omega ] \]

- Aggregation is harmonized in our approach, but other errors may or may not cancel out in aggregation
Cross-country Comparisons

- Harmonization
  - Sample frames; Variable definitions; Classifications; Aggregation Methods

- Make comparisons that ‘control’ for errors
  - Exploit the different dimensions of the data (size, industry, time)
  - Use difference in difference techniques

- Even in absence of measurement error, interpretation of cross-country indicators requires theory
The different dimensions of producer dynamics

1. Firm size
2. Firm demographics:
   1. Employment and # of firms for entry, exit, continuers: by industry and size class
3. Firm survival:
   1. Employment and # of survivors, by cohort, industry, year
4. Static and dynamic analysis of allocative efficiency:
   1. Decompositions of entry/exit contribution
   2. Higher moments, covariances, means by quartile

- In lecture, focus on 2 and 4
Evidence of firm turnover

- No major differences across OECD countries, especially after controlling for sector and size effects
- But large differences in size at entry
- Large net entry in transition economies: filling the gaps (?)
Interpretation of Gross Turnover

- Theoretical explanations
  - Entry explained by ‘push’ and ‘pull’ factors
  - Exit barriers may affect characteristics of exiting firm more than number of exits

- Measurement errors
  - Conceptual differences in measure (e.g. labor)
  - Differences in underlying data sources
Gross and net firm turnover: how the time dimension sheds light on the evolution of market forces in transition economies.
Entry rate by size: how the **size dimension** may shed light on the nature of firm dynamics

- Monotonic decline in entry rate by size in US
- Less clear link between size and entry rate in other EU countries;
- Any role for entry costs?
Allocative efficiency: static analysis – Olley-Pakes decompositon

\[ P_t = \left(\frac{1}{N_t}\right) \sum_i P_{it} + \sum_i \Delta \theta_{it} \Delta P_{it} \]

The Gap Between Weighted and Un-Weighted Labor Productivity, 1990s
Five-Year Differencing, Real Gross Output, Manufacturing

Data for Hungary, Indonesia and Romania use Three-Year Differencing. Excluding Brazil and Venezuela.
Allocative efficiency: how the allocative efficiency evolved over time in transition economies

The Evolution of the Gap Between Weighted and Un-Weighted Labor Productivity in Transition Economies over the 1990s

Five-Year Differencing, Real Gross Output, Manufacturing. Data for Hungary and Romania use Three-Year Differencing.
Dynamic allocative efficiency: the role of entry and exit in reallocating resources towards more productive uses

We used the FHK approach, but also compared with Griliches-Regev and Baldwin-Gu

$$\Delta P_t = \sum_{i \in C} \bar{\theta}_i \Delta p_{it} + \sum_{i \in C} \Delta \theta_{it} (p_{i} - \bar{P})$$

$$+ \sum_{i \in N} \theta_{it} (p_{it} - \bar{P}) - \sum_{i \in X} \theta_{i-k} (p_{i-k} - \bar{P})$$
Dynamic allocative efficiency: the importance of “technology factors”

We decompose our data for manufacturing into a low technology group and a medium high tech group

→ Stronger contribution of entry to productivity growth in medium high tech industries

![Graph showing contribution of entry to labor productivity growth, five year differencing, gross output](image)

Legend:
- **Low tech industries**
- **Medium high-tech industries**
## Labor Productivity Dispersion

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Units: Thousand US$ per worker
Producer Heterogeneity: What are we measuring?

- Limitation of most studies of productivity and reallocation:
  - Plant-level output measured as deflated revenue using industry deflator
  - More than just a measurement problem
  - Differences in measured productivity may be capturing differences in market power so results on productivity and reallocation may be capturing demand factors
  - Market selection should be on profitability but positive/normative aspects of selection depend critically on whether selection is on efficiency or market power
Measurement of Plant-level Productivity

\[ tfp_i = y_i - \alpha_l l_i - \alpha_k k_i - \alpha_m m_i - \alpha_e e_t \]

All variables in logs, difficult measurement Issues on outputs and inputs and factor elasticities
Measurement and Conceptual Issues Interact with Policy Implications

- Many reforms in transition/emerging economies aimed at making markets more competitive
  - And obviously plays role in all countries (e.g., antitrust, deregulation, etc. in U.S.)
- Which and how much do product, credit, labor market distortions matter?
- Focus in this lecture – market power
Price/Demand Factors

- Theory: Differentiated product model
  - Prices depend upon both cost/efficiency (-) and demand factors (+)
  - Selection on efficiency (costs/productivity) and demand factors
  - Raises some questions regarding welfare (why demand elasticities vary across producers)

- Empirical analysis:
  - Rich data on businesses with measures of physical quantities and prices (Direct approach as opposed to indirect approach of Melitz, Tybout, etc.)
  - Productivity, prices and reallocation with “corrected” measure of productivity
\[ U = y + \alpha \int_{i \in I} q_i \, di - \frac{1}{2} \left( \eta + \frac{\gamma}{N} \right) \left( \int_{i \in I} q_i \, di \right)^2 + \int_{i \in I} \delta_i q_i \, di - \frac{1}{2} \gamma \int_{i \in I} (q_i - \bar{q})^2 \, di \]

\[ q_i = \frac{\alpha}{\eta N + \gamma} + \frac{\eta N}{\eta N + \gamma} \frac{1}{\bar{p}} + \frac{1}{\gamma} \delta_i - \frac{1}{\gamma} p_i \]

\[ q_i = \omega_i x_i \]

\[ \pi_i = \left( \frac{\alpha}{\eta N + \gamma} + \frac{\eta N}{\eta N + \gamma} \frac{1}{\bar{p}} + \frac{1}{\gamma} \delta_i - \frac{1}{\gamma} p_i \right) \left( p_i - \frac{w_i}{\omega_i} \right) \]
\[ p_i = \frac{1}{2} \frac{\gamma \alpha}{\eta N + \gamma} + \frac{1}{2} \frac{\eta N}{\eta N + \gamma} - \bar{p} + \frac{1}{2} \frac{\delta_i}{\omega_i} + \frac{1}{2} \frac{w_i}{\omega_i} \]

\[ \phi_i \equiv \delta_i - \frac{w_i}{\omega_i} \]

\[ \phi^* = -\frac{\gamma \alpha}{\eta N + \gamma} - \frac{\eta N}{\eta N + \gamma} \bar{p} \]

\[ \phi_i < \phi^* \text{ will not find operations profitable} \]

\[ V^e = \int \int \int \int \frac{1}{4\gamma} (\phi_i - \phi^*)^2 f(\delta, \omega, w)d\delta d\omega dw - s = 0 \]
\[
\frac{d \phi^*}{d \gamma} = -\frac{\partial V^e}{\partial \gamma} \frac{\partial V^e}{\partial \phi^*}
\]

\[
\frac{\partial V^e}{\partial \gamma} = \int \int \int_{\omega_i, \omega, \omega} \int \int \int_{\phi^*, \omega} \frac{1}{4 \gamma^2} \left( \delta - \frac{w}{\omega} - \phi^* \right)^2 f(\delta, \omega, w) d\delta d\omega dw < 0
\]

\[
\frac{\partial V^e}{\partial \gamma} = \int \int \int_{\omega_i, \omega, \omega} \int \int \int_{\phi^*, \omega} \frac{1}{4 \gamma^2} \left( \phi^* + \frac{w}{\omega} - \frac{w}{\omega} - \phi^* \right)^2 f(\phi^* + \frac{w}{\omega}, \omega, w) d\omega dw
\]

\[
- \int \int \int_{\omega_i, \omega, \omega} \int \int \int_{\phi^*, \omega} \frac{1}{2 \gamma^2} \left( \delta - \frac{w}{\omega} - \phi^* \right)^2 f(\delta, \omega, w) d\delta d\omega dw < 0
\]

**Key predictions:**

\[
d\phi^*/d\gamma < 0 \quad \quad \quad \quad d\phi^*/ds < 0
\]
Data and Measurement

- Physical quantity/price data available for selected sectors:
  - 11 very detailed sectors
- TFPQ (physical) and TFPR (revenue) measured using std. index number approach (output less cost-share weighted inputs)
- Materials measured as cost of materials with industry materials deflator
  - Implications for interpretation of TFPQ:
Estimation and Conceptual Issues

- TFP measured using cost shares
- Demand equations estimated using TFP as an instrument
  - Elasticities vary by product but not within product
- All exercises control for complete set of product/year interactions
Basic Facts

- Heterogeneity and persistence in prices, TFPQ, TFPR
- Prices and TFPQ inversely related
  - Makes sense – more efficient/low cost producers have lower prices
- \( \text{Var}(\text{TFPQ}) > \text{Var}(\text{TFPR}) \)
- High rates of entry/exit
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<th>Price</th>
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| Standard Deviations     | 1.03               | 1.03           | 1.05            | 0.18  | 0.21            | 0.22        | 0.26         |
Three main exercises

- Selection equation:
  - Exit = f(TFPQ, prices)
    - TFPQ is, in principle, a good index of cost/efficiency
    - Controlling for TFPQ implies controlling for cost/efficiency so can isolate demand factors

- Evolution of TFPR, TFPQ, prices (continuers, entry, exit)

- Productivity and reallocation decompositions using TFPQ and TFPR
## Differences Between Continuing, Entering and Exiting

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## Productivity Decompositions

| Productivity Measure | Total Growth | | | | | | | | Components of Decomposition |
|----------------------|--------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                      |              | Within          | Between         | Cross           | Entry           | Exit            | Net Entry       |                 |                 |                 |                 |
| Traditional          | 2.31         | 39.35           | -16.62          | 47.72           | 23.22           | 6.34            | 29.55           |                 |                 |                 |                 |
| Revenue              | 5.09         | 66.43           | -10.08          | 25.95           | 13.99           | 3.71            | 17.70           |                 |                 |                 |                 |
| Physical             | 5.09         | 67.78           | -7.91           | 13.81           | 23.97           | 2.35            | 26.32           |                 |                 |                 |                 |
Main Findings

- Exiting businesses have lower prices and lower productivity (either TFPQ or TFPR) than incumbents or entrants.
- Entering businesses have lower prices than incumbents.
- Entering businesses have higher TFPQ but not higher TFPR than incumbents.
- Decompositions of aggregate TFPQ vs. TFPR suggests that the results in the existing literature may have understated the contribution of entry (entrants have low prices).
Demand vs. Efficiency in Selection?

- Lower productivity establishments and lower price establishments are more likely to exit.
- Controlling for both price and productivity effects simultaneously shows that both factors are important for survival as implied by the theory.
Where do we go from here?

- **Theory:**
  - Nature of product differentiation/market structure:
    - Welfare consequences?

- **Evidence:**
  - More sectors and countries
  - How to estimate differences in elasticities across businesses producing same product?

- **The World?**
  - Distortions in product, credit, labor markets all are relevant for productivity and reallocation.
  - See Eslava et. al. (2005)