Productivity and Efficiency Analysis

8) Structural change

b) Share weights

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Alternative decompositions with entry and exit

- Melitz and Polanec (2015) *Rand J Econ*

TABLE 1 Productivity Contributions of Surviving, Entering, and Exiting Firms

Group	GR	FHK	DOPD
Surviving firms	$s_{S2}(\Phi_{S2} - \bar{\Phi}) - s_{S1}(\Phi_{S1} - \bar{\Phi})$	$s_{S2}(\Phi_{S2} - \Phi_1) - s_{S1}(\Phi_{S1} - \Phi_1)$	$\Phi_{S2} - \Phi_{S1}$
Entering firms	$s_{E2}(\Phi_{E2} - \bar{\Phi})$	$s_{E2}(\Phi_{E2} - \Phi_1)$	$s_{E2}(\Phi_{E2} - \Phi_{S2})$
Exiting firms	$s_{X1}(\bar{\Phi} - \Phi_{X1})$	$s_{X1}(\Phi_1 - \Phi_{X1})$	$s_{X1}(\Phi_{S1} - \Phi_{X1})$

GR = Griliches and Regev (1995)
FHK = Foster, Haltiwanger, Krizan (2001)
DOPD = Dynamic Olley-Pakes Decomposition by Melitz and Polanec (2015)

Share weights s

- Previous studies assume that the data covers all firms in the industry (complete census data)
- It is not self-evident how to measure the market share: revenue share, value added share, something else?

- **Note**: consistent aggregation of the firm-level productivity to industry-level productivity is not always possible (see, e.g., Blackorby and Russell, 1999; Färe and Zelenyuk, 2003; Zelenyuk 2006).

Share weights s

- If data are collected by random sampling (e.g., rotating panel design), then
  - entry to sample does not necessarily imply market entry
  - exit from the sample does not necessarily imply exit from the market

- If sampling weights are known, we can estimate the average productivity in the subgroups of survivors S, entrants E, and exiting firms X.

Decomposing aggregate productivity without share weights: intuition

- Consider Melitz and Polanec (2015) decomposition:

$$P_t - P_{t-1} = \left(P_{S,t} - P_{S,t-1}\right) + s_{E,t}\left(P_{E,t} - P_{S,t}\right) + s_{X,t-1}\left(P_{S,t-1} - P_{X,t-1}\right)$$

Survivors + Entry + Exit

Decomposing aggregate productivity without share weights: intuition

- Consider Melitz and Polanec (2015) decomposition:

$$P_t - P_{t-1} = \left(P_{S,t} - P_{S,t-1}\right) + s_{E,t}\left(P_{E,t} - P_{S,t}\right) + s_{X,t-1}\left(P_{S,t-1} - P_{X,t-1}\right)$$

- The net contribution on entry and exit can be calculated as the residual

$$s_{Et}\left(P_{Et} - P_{St}\right) + s_{X,t-1}\left(P_{S,t-1} - P_{X,t-1}\right) = \left(P_t - P_{t-1}\right) - \left(P_{S,t} - P_{S,t-1}\right)$$

Olley-Pakes reallocation component

- Applying the same reasoning, we have the Olley-Pakes reallocation component as

$$P_t = \bar{p}_t + \sum_{i=1}^{N_t} \Delta s_{it} \Delta p_{it}$$

$$\Leftrightarrow$$

$$\sum_{i=1}^{N_t} \Delta s_{it} \Delta p_{it} = P_t - \bar{p}_t$$

Product-switch effect

- Inspired by Bernard et al. (2010) *AER* observation that product switch is common among multi-product firms
- Entry and exist could also occur through product switch: consider Apple introducing iPhone, and Nokia selling its mobile phone division
- Introduce subgroup Sn of non-switching survivors within the group of surviving firms S
- *Product switch effect* =

$$\overline{p}_{S,t} - \overline{p}_{Sn,t}$$

New decomposition: productivity levels

$$\textit{Industry productivity } (P_t)$$

$$= \textit{Productivity of non-switching surviving firms } (\bar{p}_{Sn,t})$$

$$+ \textit{Product switch effect } (\bar{p}_{S,t} - \bar{p}_{Sn,t})$$

$$+ \textit{Entry and exit effect } (\bar{p}_t - \bar{p}_{S,t})$$

$$+ \textit{Reallocation effect } (P_t - \bar{p}_t)$$

For further details, see: Kuosmanen & Kuosmanen (2019): Measuring the contribution of structural change on productivity growth without share weights

New decomposition: productivity change

$$\frac{P_t}{P_{t-1}} = \frac{\overline{p}_{Sn,t}}{\overline{p}_{Sn,t-1}} + \left[\frac{\overline{p}_{S,t}}{\overline{p}_{S,t-1}} - \frac{\overline{p}_{Sn,t}}{\overline{p}_{Sn,t-1}}\right] + \left[\frac{\overline{p}_t}{\overline{p}_{t-1}} - \frac{\overline{p}_{S,t}}{\overline{p}_{S,t-1}}\right] + \left[\frac{P_t}{P_{t-1}} - \frac{\overline{p}_t}{\overline{p}_{t-1}}\right]$$

- Unlike DOPD by Melitz and Polanec (2015), this decomposition allows one to add up percentage changes (%) of the components

For further details, see: Kuosmanen & Kuosmanen (2019): Measuring the contribution of structural change on productivity growth without share weights

Next lesson

8c) Application to Finnish agriculture