

Firm Heterogeneity in Taiwan's Industrial Structure and Employment: Size, Ownership, and Trade Status

Topic: Input-Output Analysis: Trade and Global Value Chains policies (4)

Author: Yoko Uchida

Conventional input-output analysis assumes that firms within the same industry share the same production technology. However, firm characteristics such as size, ownership type, and export status lead to significantly different production structures, intermediate input compositions, and GVC participation patterns. Hagino and Kim (2021) demonstrated for Japan that incorporating firm heterogeneity into input-output tables increases the vertical specialization indicator by approximately 70%, confirming that the homogeneity assumption introduces substantial bias in trade in value-added estimates.

Although Taiwan plays a critical role in global semiconductor and ICT supply chains—with foreign-owned firms concentrated in export-oriented electronics and domestic SMEs forming the backbone of supporting industries—no input-output table accounting for firm heterogeneity has been compiled for Taiwan. This study asks: how do production structures, industrial linkages, and employment effects differ across firm types within the same industry, and what are the implications for industrial and trade policy?

We disaggregate Taiwan's 2016 non-competitive import type input-output table along three dimensions—firm size (large enterprises vs. SMEs), ownership type (domestic vs. foreign-owned), and trade status (exporting vs. non-exporting)—to compile three separate two-way disaggregated tables. The main data sources are the 2016 Taiwan Input-Output Table published by the Directorate-General of Budget, Accounting and Statistics (DGBAS) and the 2016 Industrial and Commercial Census microdata, which provides firm-characteristic-specific data on gross output, employee compensation, depreciation, indirect taxes, and utility expenditure. The original 164-sector table is aggregated into 33 sectors, retaining granularity in ICT-related industries with dedicated sectors for semiconductors and related electronics. Disaggregation is applied to manufacturing sectors where census coverage exceeds 50%.

Existing methods for disaggregating input-output tables by firm characteristics apply uniform industry-level shares to all cells of the intermediate transaction matrix and then use a single-stage optimization or RAS procedure to restore row-sum and column-sum consistency. This approach can distort individual cell values, particularly when the required adjustment is large. Our procedure addresses this through a two-stage cross-entropy (CE) minimization framework. In the first stage, we estimate cell-specific splitting ratios using the original input coefficients as priors, subject to row-sum and column-sum constraints derived from census data. This yields splitting ratios that vary across cells within the same industry, unlike the uniform ratios in existing methods. In the second stage, CE minimization is applied at the individual cell level, using the first-stage ratios to construct priors for 2x2 cell disaggregation. This cell-level approach avoids the cross-cell distortions that arise in matrix-wide optimization.

The results reveal important structural differences hidden in aggregate tables. In the semiconductor industry, exporting and large firms show higher labor productivity and stronger forward linkages, while SMEs and non-exporting firms show higher employment multipliers. Economy-wide analysis using the interdependence index shows that cross-group spillovers are consistently low at approximately 14%, indicating that different firm types operate in relatively segmented production networks. However, the degree of asymmetry differs substantially across dimensions: the interdependence index is highly asymmetric by ownership type (0.71) and trade status (0.49),

suggesting that domestic firms depend more heavily on foreign-owned firms' intermediate inputs than vice versa, and non-exporting firms depend more on exporters than the reverse. By contrast, the index is nearly symmetric by firm size (0.07), indicating relatively balanced interdependence between large enterprises and SMEs.

This study makes three contributions. First, it provides the first firm-heterogeneity-disaggregated input-output table for Taiwan, allowing analysis of structural differences hidden in aggregate tables. Second, the two-stage CE framework improves on existing single-stage approaches by generating cell-specific splitting ratios and performing disaggregation at the individual cell level, which reduces distortions from matrix-wide balancing. Third, the comparative analysis across three dimensions of firm heterogeneity—particularly the finding that inter-group production networks are segmented but asymmetrically dependent—is relevant to industrial policy design, including the role of foreign-owned firms as potential economic enclaves and the indirect GVC participation of non-exporting SMEs.