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Structural Change through Diversification: A Conceptual Framework

CHRIS PAPAGEORGIOU
(IMF)

FIDEL PEREZ-SEBASTIAN
(Alicante and Hull)

NIKOLA SPATAFORA
(IMF)

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Big Picture

- There is a consensus that economic development critically involves **structural transformation**

- At the same time, broad patterns uncovered in the relationship between sectoral/export **diversification** and income per capita

- While both literatures flourish, they move independently, as if there isn't a close relationship between the two processes

- This paper tries to close this gap by incorporating diversification and structural transformation in a unified growth model

- Subsequently, the aim is to use the model to calibrate LICs experiences and contribute to the policy debate
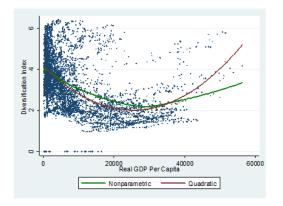
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Diversification and Structural Transformation

Two key patterns of the development process

1. **Structural transformation** – reallocation of resources to more productive activities; increasing importance of manufacturing and services in GDP

   - Changes in *sectoral shares*

2. **Diversification** – increase in the number of goods produced or exported and quality upgrading measured by their unit value

   - *Horizontal* and *vertical* diversification

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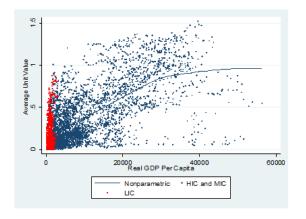## Horizontal Diversification: Number of types of goods

Diversification first increases with GDP per capita and then decreases
Imbs and Wacziarg (2003) find similar patterns

Source: Papageorgiou and Spatafora (2012), trade data

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Vertical Diversification: Quality upgrading index

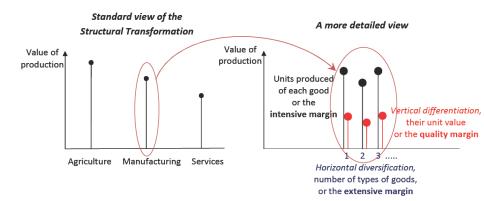Unit values increase across per capita GDP, faster at first

Source: Papageorgiou and Spatafora (2012), manufacturing

Main Goals

- To build a unified conceptual framework that answers the following questions:

  1. What is the inter-relationship between growth, structural transformation, and the different dimensions of diversification?

  2. What are the joint drivers of all these phenomena?

- Subsequently, take the model to the data through calibration

  3. What is behind the heterogeneous performance of countries?

  4. Do policies affect growth largely through their effect on the pace of structural transformation / diversification? What are the critical policy failures?

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The Intensive, Extensive and Quality Margins

Standard view of the Structural Transformation

Value of production

Agriculture   Manufacturing   Services

A more detailed view

Value of production

Units produced of each good or the **intensive margin**

Vertical differentiation, their unit value or the **quality margin**

1 2 3 .....

Horizontal diversification, number of types of goods, or the **extensive margin**

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Consumers

- Economy populated by families composed of L_t infinitely-lived agents

- Family size grows at rate n.

- Utility defined over per-member consumption of agricultural (c_{ai}), manufacturing (c_{mj}), and service (c_{sv}) goods

- Goods are weighted by their quality using the quality index q_{zx} for product zx

The Family Problem: Objective

$$\max U_1 = \sum_{t=1}^{\infty} \rho^t \frac{c_t^{1-1/\sigma_c} - 1}{1 - 1/\sigma_c}$$

- Consumption across sectors

$$c_t = \left[\sum_{z=a,m,s} v_z \left(c_{zt} - \bar{c}_z \right)^{1-1/\sigma_v} \right]^{\frac{1}{1-1/\sigma_v}}$$

- Consumption within sectors

$$c_{zt} = \left[\sum_{x=1}^{N_{zt}} \left(q_{zxt} c_{zxt} \right)^{1-1/\sigma_x} \right]^{\frac{1}{1-1/\sigma_z}}, \quad z = a, m, s$$

The Family Problem: Constraints

- Individual split time between schooling (f_{et}) and labor (f_{zt})

$$f_t w_t + b_t(1 + r_t) = \sum_{z=a,m,s} \sum_{x=1}^{N_{zt}} p_{zxt} c_{zxt} + b_{t+1}(1 + n)$$

$$\text{where } f = f_{at} + (f_{mt} + f_{st}) \exp(\xi e_t)$$

- Accumulation of education:

$$e_{t+1} = \frac{f_{et} + e_t}{1 + n}$$

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The Intensive Margin

- Production in agriculture

$$Y_{axt} = B_{at}k_{axt}^{\alpha}l_{axt}^{1-\alpha}$$

- Production in manufacturing ($z = m$) and services ($z = s$)

$$Y_{zxt} = B_{zt}k_{zxt}^{\alpha}\left[\exp(\xi e_t)l_{zxt}\right]^{1-\alpha}$$

- Improvements in goods quality require additional units of physical capital (K_{zxt}) and labor (L_{zxt})

$$k_{zxt} = \frac{K_{zxt}}{d_{zxt}}, \quad l_{zxt} = \frac{L_{zxt}}{d_{zxt}}$$

where d_{zxt} an input quality index

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The Quality Margin

- Q_{zx} – fixed cost today needed to produce higher quality tomorrow

- Product quality (q_{zx}), input quality (d_{zx}), and investment (Q_{zx}):

$$q_{zxt+1} = \min \left\{ \eta_z \exp(\xi e_t) d_{zxt}^{\varepsilon} Q_{zxt}^{\varphi} \, , \, d_{zxt+1}^{\beta} \right\}$$

- With the upgrade, firm obtains monopoly power

- Schooling (e_t) and intertemporal spillovers ($\varepsilon > 1$) save on the fixed cost

- $\beta > 1$ to guaranty that consumers prefer newer versions

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The Extensive Margin

- F_z – fixed cost today needed to produce new goods in sector z tomorrow

- Again monopoly power

- Investment (F_z) and the increase in the number of goods (N_z):

$$N_{zt+1} - N_{zt} = \psi_z N_{zt}^\lambda F_{zt}^\phi, \quad \lambda, \phi \in (0,1)$$

- We include a TFP effect of diversification

$$B_{zt} = \mu_z N_{zt}^\gamma$$

Market Clearing

- Goods markets

$$s_{ct} Y_{zxt} = c_{zxt} L_t$$

- Saving market

$$b_{t+1} L_{t+1} = K_{t+1} + \sum_{z=a,m,s} \left(F_{zt} + \sum_{x=1}^{N_{zt}} Q_{zxt} \right)$$

where

$$K_{t+1} = \sum_{z=a,m,s} \sum_{x=1}^{N_{zt+1}} K_{zxt+1} = I_t + (1-\delta) K_t$$

- Labor market

$$\left(f_{at} + f_{mt} + f_{st} \right) L_t = \sum_{z=a,m,s} \sum_{x=1}^{N_{zt}} L_{zxt}$$

Growth

- By assumption, horizontal diversification through is effect on TFP is the engine of growth

- This can be easily seen along the asymptotic balanced-growth path

- Over there, the wage rate grows at rate

$$G_w = G_{Na}^{1/(1-\alpha)}$$

  which also gives the growth of GDP per capita

Within-Sector Symmetric Equilibrium

- No intra-sector effects

- Products within sectors give same utility, and use same production technology

- Then, in equilibrium, each good receives the same expenditure within the sector

- $p_{zxt}/q_{zxt} = p_{zt}/q_{zt} \ \forall x$ in z

Impact Across Sectors: Main Forces

- Sectoral shares in consumption expenditure move because of two standard forces

    1. *Income effect* – due to consumption endowments
    2. *Price effect* – impact of changes in relative TFP

- And two new forces

    3. *Quality effect* – due to better versions of existing products
    4. *Variety effect* – caused by diversification through utility

Impact Across Sectors

Sector-z share in total consumption expenditure

$$\frac{P_{zt}c_{zt}}{P_{ct}c_t} = v_z^{\sigma_v} \left[\frac{p_{zt}}{N_{zt}^{1/(\sigma_z - 1)}q_{zt}} \frac{1}{P_{ct}} \right]^{1-\sigma_v} + \frac{p_{zt}}{N_{zt}^{1/(\sigma_z - 1)}q_{zt}} \frac{\bar{c}_z}{P_{ct}c_t}$$

where

$$p_{zt} = \text{markup} * q_{zt}^{1/\beta} \frac{\mu_a N_{at}}{\mu_z N_{zt}}$$

1. *Income effect* has opposite sign than $\bar{c}_z$
2. *Price effect*, because of N_{at}/N_{zt}, is negative
3. *Quality effect*, given by $q_{zt}^{1-1/\beta}$, is negative ($\beta > 1$)
4. *Variety effect*, caused by $N_{zt}^{1/(\sigma_z - 1)}$, also negative

Impact on the Structural Transformation

- Trends in sectoral consumption shares are a consequence of the income effect

- Impact of other forces depends on relative sector diversification

  We have that $\frac{q_{zt}}{q_{at}}$ moves with $\frac{N_{zt}}{N_{at}}$ because both depend on future profits

  And relative diversification investment rises with the consumption share $\frac{Q_{zt}}{Q_{at}} = f\left(\frac{c_{zt}}{c_{at}}\right)$

- *Implications:*

  1. The increase in the consumption shares of manufacturing and services slows down due to the other three effects

  2. Higher quality products, which demand more resources, will not contribute to decrease general diversification measures

Summary

- Development critically involves several inter-related processes: structural transformation, horizontal diversification, and quality upgrading.

- Models that focus exclusively on one of the above aspects can provide misleading policy conclusions.

- Structural transformation involves increases in relative importance of human-capital intensive activities, which in turn further promotes quality upgrading.

- *Implications with a measurement angle*

  1. The process of diversification can slow down the rise of the share of non-agricultural products in consumption expenditure
  2. A faster movement along the quality margin of some sector always contributes to make an economy look more diversified

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Future Work

- Our next challenge is carrying out a quantitative evaluation of the model

- In particular, its capacity to generate the observed differences across regions

- This will also serve to develop more precise policy recommendations

- Are different policies required to accelerate transformation and hence growth, depending on the level of development? E.g., basic infrastructure in initial stages of structural transformation, education later on to promote quality upgrading?

- The main issue for the computational implementation is the large dimensionality of the model