

Structural Change through Diversification: A Conceptual Framework

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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

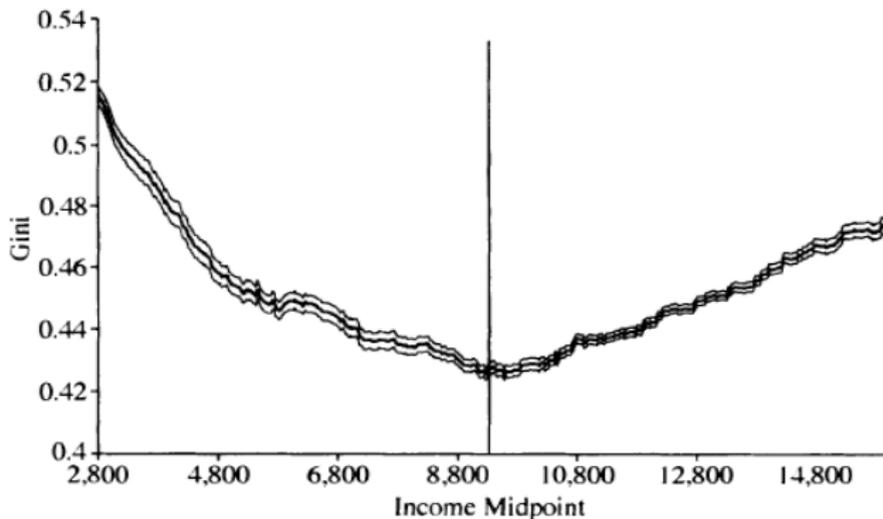
Diversification and Structural Transformation

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** – includes the increase in the number of goods produced/exported, and quality upgrading measured by their unit value
 - *Horizontal* and *vertical* diversification

Diversification Patterns

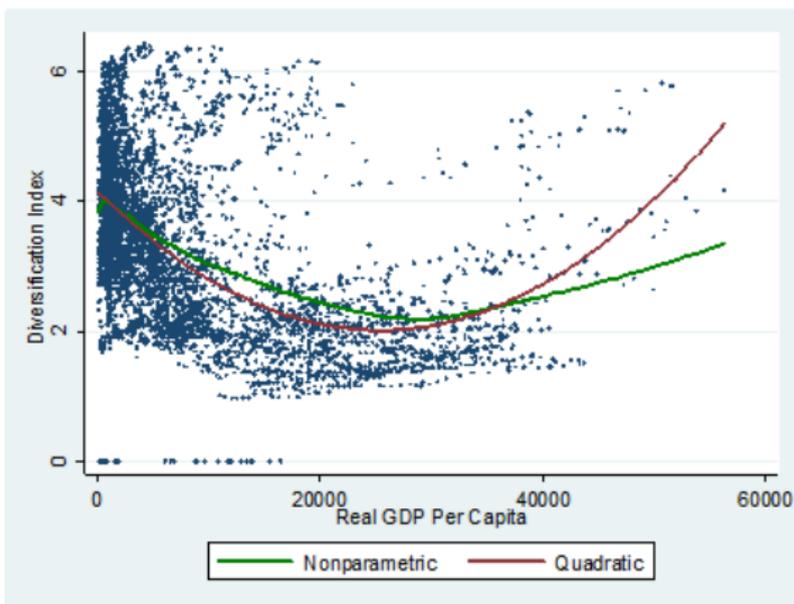
Sectoral diversification and per capita GDP



Source: Imbs and Wacziarg (*AER*, 2003)

Horizontal Diversification: Number of types of goods

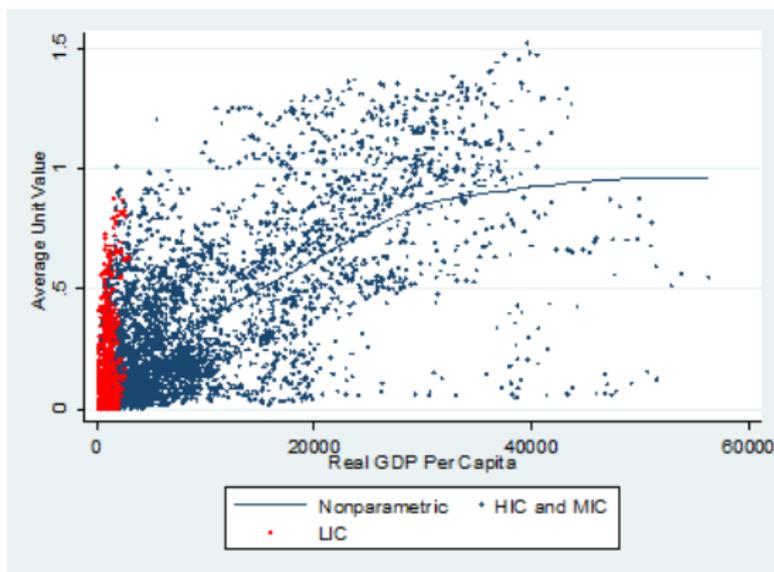
Trade diversification across per capita GDP



Source: Papageorgiou and Spatafora (2012)

Vertical Diversification: Quality upgrading index

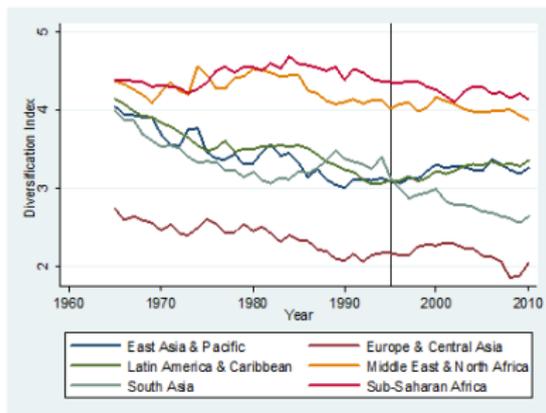
Unit values across per capita GDP (within manufacturing)



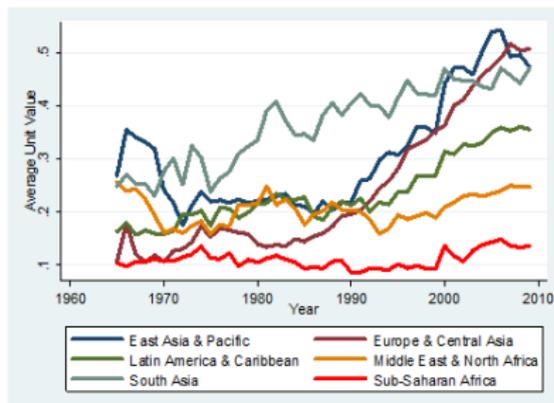
Source: Papageorgiou and Spatafora (2012)

Significant Differences Across Regions

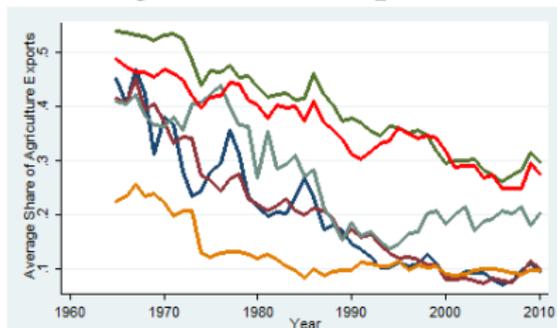
Horizontal diversification



Vertical diversification



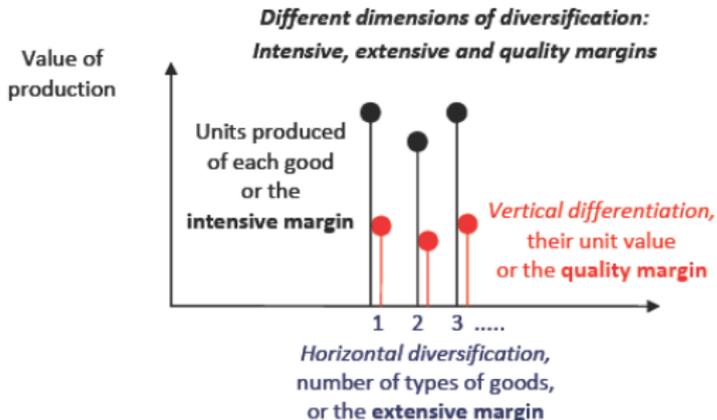
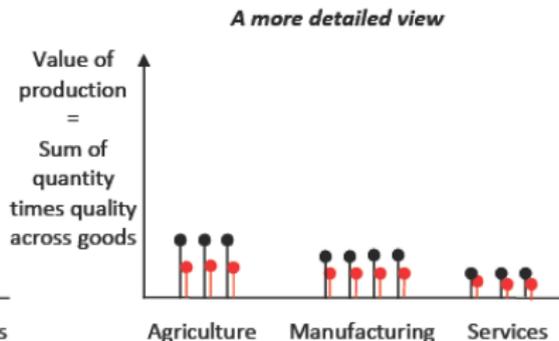
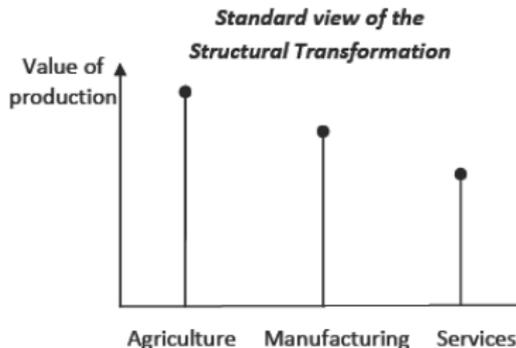
Agricultural exports



Main Goals

- To build a conceptual framework that encompasses structural transformation along with the different dimensions of diversification, and answer the following questions:
 1. What is the relationship between the structural transformation and the path of diversification?
 2. Why does diversification increases with income at first?
- Subsequently:
 3. Take the model to the data using calibration exercises to examine the heterogeneous performance of countries and regions
 4. Use the calibrated model to inform the policy debate on horizontal and vertical diversification along the process of structural transformation

The Intensive, Extensive and Quality Margins



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

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

- Consumption within sectors

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

The Family Problem: Constraints

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

$$[f_{at} + (f_{mt} + f_{st}) \exp(\xi e_t)] w_t + b_t(1 + r_t) = \sum_{z=a,m,s} \sum_{x=1}^{N_{zt}} p_{zxt} c_{zxt} + b_{t+1}(1 + n)$$

- The term $\exp(\xi e_t)$ represents a Mincerian approach to human capital
- Accumulation of education:

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

The Intensive Margin

- Production function in sector z :

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

- i_z is *zero* for agriculture; *one* for manufacturing and services
- k and l denote capital and labor adjusted for quality

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

- d_{zxt} is an input quality index: improvements in goods quality require additional (or more sophisticated) units of inputs

The Quality Margin

- Q_{zx} – fixed cost needed to produce higher quality
- With the upgrade, firm obtains monopoly power for one period
- Product quality, input quality, and Q_{zx} :

$$q_{zxt} = \min \left\{ \eta_z \exp(\zeta e_t) d_{zxt}^\epsilon Q_{zxt}^\varphi, d_{zxt}^\beta \right\} \quad \text{if } e_t \geq \bar{e}_z$$
$$= 1 \quad \text{otherwise}$$

- Schooling and intertemporal spillovers save on the fixed cost
- $\beta > 1$ to guaranty that p_{zxt}/q_{zxt} falls with d_{zxt} , and consumers prefer newer versions

The Extensive Margin

- F_z – fixed cost needed to produce a new good in sector z
- Again, monopoly power just for one period
- The number of different types of goods in sector z evolves according to

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

- 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

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

Growth

- The economy approaches an asymptotic balanced-growth path (ABGP)
- Along the ABGP, the interest rate is constant, and

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

Which also gives the growth of GDP per capita

- The number of goods increase at rate

$$G_{N_z} = (1+n)^{\frac{\phi}{1-\lambda-\phi/(1-\alpha)}}$$

- And prices grow with input quality, at rate

$$G_{p_z} = G_{d_z} = \left[G_{N_z}^{\alpha/(1-\alpha)} (1+n) \right]^{\varphi/(\beta-\varepsilon)}$$

Main Forces

Sectoral shares in consumption expenditure move because of

1. *Income effect* – due to consumption endowments
2. *Quality effect* – due to better versions of existing products
3. *Variety effect* – caused by diversification through utility
4. *Price effect* – impact of diversification on TFP

Within Sector Impact

No intra-sector effects

$$\frac{p_{zxt}c_{zxt}}{P_{zt}c_{zt}} = \left(\frac{p_{zxt}/q_{zxt}}{P_{zt}} \right)^{1-\sigma_z}$$

- Share of product x on sector- z consumption expenditure rises with p_{zxt}/q_{zxt} if $\sigma_z \in (0, 1)$
- However, a symmetric equilibrium exists in which $p_{zxt}/q_{zxt} = p_{zt}/q_{zt} \forall x$ in z

Impact Across Sectors

Sectoral shares can change

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

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. *Quality effect*, given by q_{zt} , is negative ($\beta > 1$)
3. *Variety effect*, caused by N_{zt} , is negative
4. *Price effect*, because of N_{at}/N_{zt} , 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 $\frac{F_{zt}}{Q_{zxt}} = N_{zt+1} - N_{zt}$

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

- *Main message:* The structural transformation crucially involves the process of economic diversification (or the other way round)
- *Implications with a policy angle*
 1. Diversification, through cross-product synergies, can accelerate the structural transformation
 2. In turn, the structural transformation, through an increasing importance of human-capital intensive activities, favors diversification (the quality margin in our model)
- *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

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