A Conceptual Framework for Export Diversification and Sustainable Growth

Part I

PREM Week
Vandana Chandra and Israel Osorio Rodarte
April 27, 2010
Outline of the presentation

A. Why does a country need to diversify?

B. What should it diversify in?
Why does a country need to diversify?

• By the mid-1990s, most developing countries had implemented the macroeconomic reforms that are necessary for economic growth.

BUT

• Economic diversification which is essential for sustained and inclusive growth did not ensue in many developing countries.

• The absence of economic diversification has fueled social and political pressures.

• Some governments have announced industrial policies targeted at industries they believe can deliver faster and more inclusive growth. Most choices are motivated by pro-poor or inclusive growth considerations.

• A government’s choice of industries is frequently *ad hoc* and targets non-traditional industries in which the country may not have a comparative advantage.

• BUT, comparative advantage is a necessary condition for sustained growth in a globalized world.

• This recent shift in public policy from an industry-neutral to an industry-specific approach has created a demand for analytical tools to study the economic growth implications of active development policies.
Korea and Brazil Catching up with OECD Countries (trends in per capita income)

Source: World Development Indicators
China and India in the Catch Up Game (trends in per capita income)

Source: World Development Indicators
Per capita income trends in Sub-Saharan Africa have been stagnant for 46 years!
B. What should a poor country diversify in?

1. What does the literature say?
2. What does empirical evidence indicate?
3. What is optimal and feasible for a client country?
GNI in Burkina Faso compared to other landlocked, natural resource based comparators

![Graph showing income per capita in various countries over time](image-url)
A simple measure of economic diversification

- Production data series for developing countries is not easily available.
- Proxy: export data

- Herfindahl Index of export concentration (HI). Sum of the square of the shares of each product exported.

\[
HERFINDAHL = \sum_{i=1}^{N} s_i^2
\]

- HI lies between 0 and 1 where 1 implies complete concentration

- Common observations:
  - Nigeria and other oil exporters: between 0.9 and 1 (oil and minerals exporters)
  - Primary product and minerals exporters – often between 0.8 – 0.2
  - China/Brazil, India and countries with large domestic markets: closer to 0.02 – 0.03
  - Most of East Asia and most large countries were already very diversified in the 1980s

- **Strength**: HI is useful for understanding general direction of export diversification
- **Weakness**: HI is uninformative about the composition of exports or their income potential
The Herfindahl Index of export concentration (0-1) has remained high for Nigeria (dominance of oil exports) and increased for Burkina Faso (rising dominance of cotton) in comparison to significantly lower levels for large and highly diversified countries like China, India and Brazil.
The share of the top five exports in Burkina Faso (cotton exporter) are almost as high as in Nigeria (oil exporter).

Export shares of the top 5 products

- Burkina Faso
- Bangladesh
- Nigeria

Share of the top 5 products in total exports (%)
What should a poor country diversify in?

- Conventional theories - as economies diversify, their income grows (positive relationship).

- Imbs and Wacziarg (2003) – empirical fact. U-shaped relationship between sectoral diversification and income. Initially, negative, i.e., as diversification increases, per capita income increases. After reaching $10,000 (2000 constant USD), sectoral diversification decreases and the relationship becomes positive (employment and production data).

- Natural resources are a curse:
  - Prebisch and Singer in 50s and 60s and Sachs and Warner ‘90s;
  - “Natural Resources are Neither Curse nor Destiny” – Lederman and Maloney, 2006.
Relationship between diversification and income per capita in SSA is L-shaped

Level of development and Diversification, 2002-06

GDP per capita constant 2000 US$

Herfindahl Index of exports

note: excludes MENA and Developing countries
Why Natural Resources appear to be a Curse? (Prebisch-Singer hypothesis)
Share of cotton in total exports is negatively related with per capita income

[Graph showing the relationship between the log of GDP per capita (constant US$) and the share of cotton in total exports for various countries. The graph illustrates a negative correlation, with countries like TCD, MLI, and BFA having a high share of cotton in their exports, indicating a potential curse.]
What should a poor country diversify in?


• Technology classification (Lall, 2005)
  – Links a product to its technology content.
  – Cereals and fish are primary (PP), minerals are resource-based (RB) and manufactured products are low, medium or hi tech (LT, MT, HT)

Deterministic - In poor countries, manufactured exports are the PATH to growth
Technology classification - High and sustained growth has occurred in countries that export mostly LT, MT and HT products.

Cereals and fish are primary (PP), minerals are resource-based (RB) and manufactured products are low, medium or hi tech (LT, MT, HT).

Problem: Too deterministic. Implies manufactured exports (from OECD and East Asia) are the only path to growth.
Technology classification – The technological composition of Burkina Faso’s exports changed very little in 22 years
### ‘Natural resources: neither curse not destiny’ - case of landlocked countries (per capita GNI, US$ Atlas method)

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<td>319</td>
<td>328</td>
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<td>510</td>
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<td>356</td>
<td>323</td>
<td>410</td>
<td>500</td>
<td>640</td>
<td>800</td>
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</table>

- Landlocked (LL), cotton
- LL, leather, beans
- LL, coffee, wood
- LL, cotton, gold, tobacco
- Landlocked
- LL, nuts, tobacco, cotton
- LL, wool, wood, minerals
- LL, petroleum, tin
- LL, cotton, soya beans, wood
- Sya beans, wood, rubber
- Groundnuts, seafood, minerals
- Coffee, cotton, bananas
- Tea, rubber
- Cotton, coffee, sugar
- Landlocked, cotton
- Landlocked, coffee
- Landlocked, tobacco
- Landlocked, coffee
- Landlocked, cotton, coffee
- Cotton
- Cotton
- Landlocked, copper

1. Globalization – trade patterns are not determined by only fundamentals (L,K, and institutions)
2. Indeterminate – Malaysian oleo-chemicals, electronics! Sri Lankan and Bangladeshi garments; Rwandan silk!
3. Some products are more growth enhancing than others – contrast discovery of metals, cocoa (with coffee), oil-related products relative to processed agro-products (refined palm oil, oleo-chemicals with crude).
4. Firms engage in cost discovery – but externalities, new technology, market failures, transactions costs may constrain internalization of profits and discovery of new products. Public policy can facilitate internalization of rents from the discovery of new products, innovation.
In low income countries, the relationship between HI and income is L-shaped. The HI for China and Korea is similar but it does not tell us what China must export to catch up with Korea.

Author's calculations
Data Source: UN Comtrade (SITC Rev. 2 - 4 digit) and the World Bank (World Development Indicators)
“Rich countries export rich country products.”

The productivity level associated with product $k$:

$$\text{PRODY}_k = \frac{\sum_j \left(\frac{x_{jk}}{X_j}\right)}{\sum_j \left(\frac{x_{jk}}{X_j}\right)} \times \text{GDP}_j$$

Where $x_{jk}=X_j$, is the value-share of the commodity in the country’s overall export basket. The denominator aggregates the value-shares across all countries exporting the good. The index represents a weighted average of per-capita GDPs, with weights representing the revealed comparative advantage of each country in good $k$. 
**Sophistication of a Product: PRODY**

Designed by Hausmann, Hwang and Rodrik (2005). (Lall (2005))

Reflects the per capita GDP of each country that exports the product weighted by the exporter’s revealed comparative advantage in it.

Attaches to each product a value that reflects the income potential/level of the product.

**Prody value of selected Products (by tech category)**
### Products that aided China’s Catch-up

- Leapfrogging does not require *all* exported products to be transformed into high PRODY ones.
- China’s catch up with Hong Kong and Korea occurred when it started exporting some High Prody products.

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<td>13526</td>
<td>4</td>
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<td>Fabrics woven of silk or noil or other</td>
<td>8685</td>
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<td></td>
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<td>13962</td>
<td>8</td>
<td></td>
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<td></td>
<td>Watches, watch movements and cases</td>
<td>21281</td>
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<td>Other outer garment of textile fabrics</td>
<td>5155</td>
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<td>Trousers, breeches, etc of textile fabric.</td>
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<td>Footwear</td>
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<td>Fabrics woven of continuous synth.</td>
<td>10361</td>
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<td></td>
<td>Electronic microcircuits</td>
<td>15002</td>
<td>3</td>
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<tr>
<td></td>
<td>Art. of apparel &amp; clothing accessories</td>
<td>6379</td>
<td>3</td>
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<td>Watches, watch movements and cases</td>
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<td>Passenger motos cars, for transport</td>
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<td></td>
<td>Radiotelegraphic and radiotelephonic</td>
<td>18331</td>
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<tr>
<td></td>
<td>Peripheral units, incl. control &amp; ada</td>
<td>13315</td>
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<td></td>
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## Manufactured Exports are not the only path to faster and sustainable growth

Other developing countries’ success stories are natural resource-based

<table>
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<tr>
<th>Country</th>
<th>Main exports, 1980</th>
<th>Shares</th>
<th>Prody</th>
<th>Country</th>
<th>Main exports, 2004</th>
<th>Shares</th>
<th>Prody</th>
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<td>6825</td>
<td>Chile</td>
<td>Copper alloys</td>
<td>31.2%</td>
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<td>Flours &amp; meals, of meat/fish</td>
<td>8.1%</td>
<td>10625</td>
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<td>Copper ores</td>
<td>16.7%</td>
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<td>Grapes</td>
<td>4.7%</td>
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<td>Petrol.oils &amp; crude</td>
<td>19.3%</td>
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<td>Sugars, beet and cane</td>
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<td>Cut flowers and foliage</td>
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<td>4.5%</td>
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<td>2286</td>
<td></td>
<td>Cut flowers</td>
<td>6.4%</td>
<td>2286</td>
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</table>

**Netherlands:** Cut flowers

**USA and Canada:** Fish fillet and Frozen Fish

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**Economic Policy and Debt Department**

Sound Economics for Growth and Poverty Reduction

**THE WORLD BANK**
EXPY – The income potential of a country’s export basket

Defining EXPY – summation of the PRODYs (weighted)

The productivity level associated with a country’s i’s export basket, EXPY, is in turn defined by

\[ EXPY_i = \sum_l \left( \frac{x_{il}}{X_i} \right) \text{PRODY}_l \]

This is a weighted average of the PRODY for that country, where the weights are simply the value shares of the products in the country’s total exports.

Source: Hausmann, Hwang and Rodrik (2005)
EXPY is a good measure of the export sophistication of a country’s exports. EXPY & GDP per capita are highly correlated.

Source: Hausmann, Hwang and Rodrik (2005)
In general, they are good indicators of income-enhancing diversification for low income countries or countries that export mostly primary or resource-based commodities.

They are not suitable for large countries such as China and India – both outliers on the EXPY chart.

* Across-Product versus Within Product Specialization in International Trade, Peter K. Schott, The Quarterly Journal of Economics, May 2004
* The Relative Sophistication of Chinese Exports, Peter K. Schott, Yale School of Management & NBER, March 2007

Draw upon empirical evidence but cannot explain it.

Caution – should not be used as lone indicators to guide production patterns.
Towards Export Diversification – Path and export possibilities in the Product Space

- R. Hausmann and Klinger (2007): “Product space is used to describe the network of relatedness between products.”

- Relatedness is based on the observed similarity in inputs required to produce products, and includes everything from natural factors, skills, institutional and infrastructural requirements, to technological capabilities etc..

- Distance measures the conditional probability of exporting a new product if you already have a revealed comparative advantage in one. The distance between textiles and garments is shorter than the (a) distance between textiles and cotton; or (b) the distance between textiles and coffee.
Distance between a pair of products

The first step is to identify the products on which each country experiences a *revealed comparative advantage (RCA)*. For this, we have calculated the Balassa-RCA Index for each country, commodity and year in our sample. In a given year \((t)\), a country \((c)\) has a revealed comparative advantage in a certain product \((i)\) if the RCA Index is greater than 1. For example, Ghana has a revealed comparative advantage in cocoa because Ghana’s cocoa share in world cocoa exports is greater than Ghana’s share in total world exports.
Simplifying RCA for product classification

The second step is quite simple, and it consists in the creation of a categorical variable that identifies those products that have a revealed comparative advantage in each country’s export basket.

\[ x_{i,c,t} = \begin{cases} 
1 & \text{if } RCA_{i,c,t} > 1 \\
0 & \text{otherwise} 
\end{cases} \]
In the third step, we construct a measure that can identify revealed distance between products that can avoid any priors we might have as to the root cause of that similarity. Hausmann and Klinger (2006) call it product distance. Product distances \((\phi)\) for each pair of products \((i,j)\) are calculated using the minimum of two conditional probabilities: the probability of having RCA in product \(j\), given that countries experience RCA in product \(i\); and the probability of having RCA in product \(i\), given that countries experience RCA in product \(j\).

\[
\varphi_{i,j,t} = \min\{P(x_{i,t} \mid x_{j,t}), P(x_{j,t} \mid x_{i,t})\}
\]

With these calculations we can construct a matrix with all the minimum conditional probabilities for each pair of products. This matrix is a representation of the product space. It contains a numerical measure of revealed distance between each pair of products in the classification.
Distances between products reflect similarity in inputs of production

Structural transformation - the process of how firms move from the poor to the rich part of the forest. It is easier for firms to jump short distance to products that use similar pre-existing factors.
The Product Space Can Be Understood as a Network of Products

The Product Space - a Forest or Network of Products
Density – a country’s capability to export a product – *country-specific* concept

we develop the concept of product density. It is obtained using previously calculated product distances and categorical variables.

\[
density_{i,c,t} = \left( \frac{\sum_k \varphi_{i,k,t} x_{c,k,t}}{\sum_k \varphi_{i,k,t}} \right)
\]

The concept of density recognizes that the more one pair of exporting products are related, the stronger the force to create RCA in one, given that the other had already attained it.
Density is a country’s capability to jump to new products e.g. to jump to fish fillet from the current export basket (higher is better)

India’s Density in Cotton seed oil = 0.35

Benin’s Density in Cotton seed oil = 0.08

USA and South Africa have the Highest Density in cotton seed oil: 0.46 and 0.36 respectively
KOREA: Developed strong capabilities (density) to grow richer 1980-84 – Korea had weak capabilities in high-Prody emerging champions. By 2000-04, Korea’s strongest capabilities were in high-Prody emerging champions.
MALAYSIA: Developed strong capabilities (density) to grow richer
1980-84 – Malaysia had weak capabilities in high-Prody emerging champions.
By 2000-04, Malaysia’s strongest capabilities were in high-Prody electronics
Making progress but still along way to go........

In 1980-84 – Uganda’s capabilities (density) supported low-Prody classics & emerging champions

By 2000-04 – Uganda’s had stronger capabilities but they still supported mostly low-Prody products;  a few fishery products were the exception
Government of Uganda’s vision: industrial policy (STRATEX)

UGANDA: Product Space, 2000-04

- Emerging champions
- Marginals
- Classics
- Dissaparance
- STRATEX