Quality Upgrading and Export Performance in the Asian Growth Miracle

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Motivation and Aims

- Asian miracles represent successful development experiences that could produce useful information to other development nations.
- The expansion of exports has been a fundamental element of the success of those economies.
- A relatively neglected factor that can contribute to building comparative advantage is product quality upgrading.
- Question that we address:

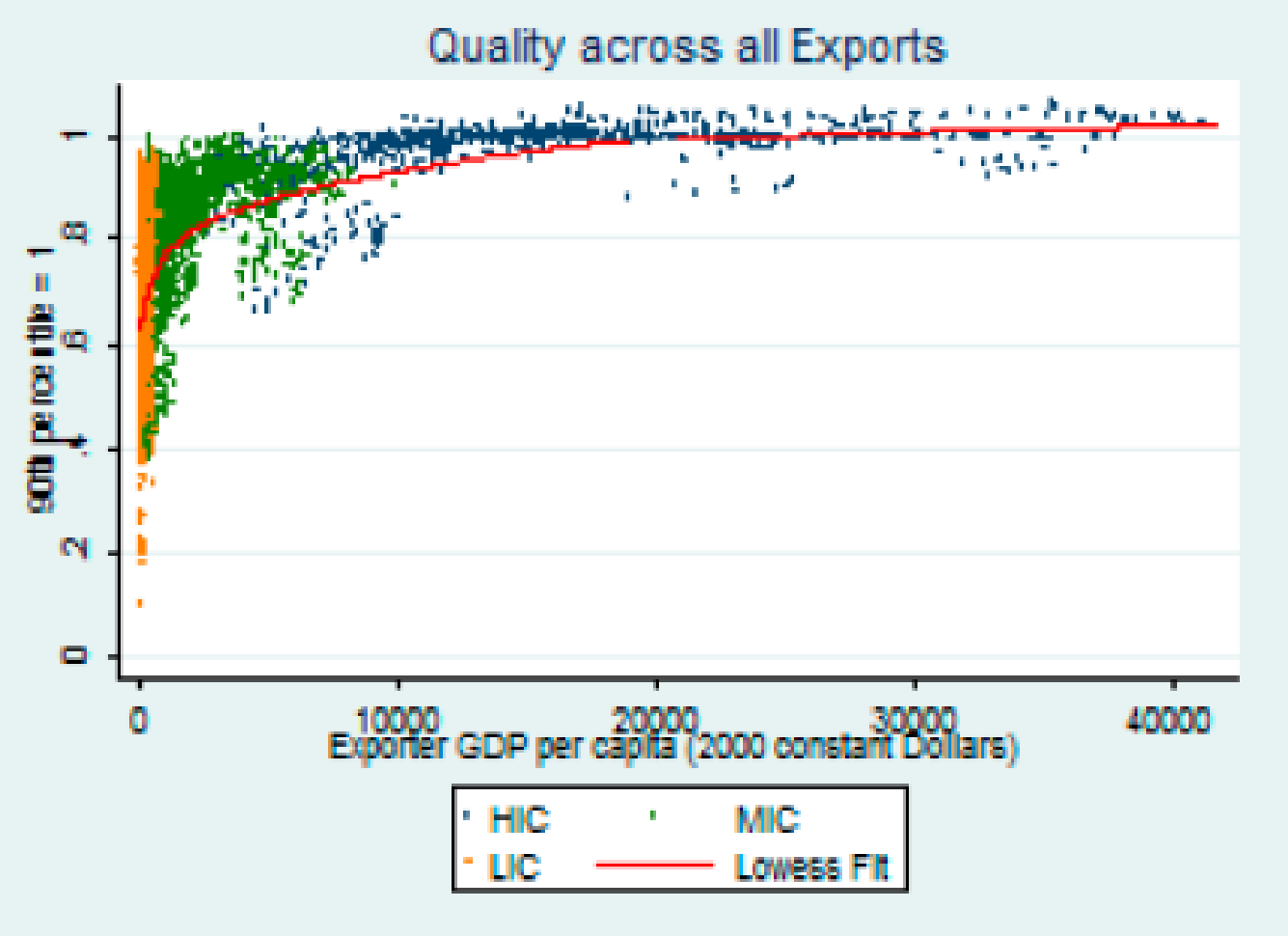
Can quality upgrading explain export expansion in Asian miracles?

Motivation and Aims

Strong positive correlation between the **quality** of exported goods and the economic development.

Convergence in export-goods quality

[Henn, Papageorgiou and Spatafora (2017)]



To answer this question….

- We first build a **Ricardian trade model** with product quality.
- It is calibrated using 2-digit SITC export data.
- We generate predictions and see the **capacity of quality upgrading to explain the evolution of exports shares**.
- We focus on a set of 6 well-known **Asian growth-miracle nations** that have benefited significantly from exports:
  - China, India, Indonesia, Malaysia, South Korea, Thailand

Contribution to the literature

- We quantitatively assess the contribution of quality upgrading to export performance.
  - Unlike, e.g., Schott (2004), Hummels and Klenow (2005) Khandelwal (2010), Baldwin and Harrigan (2011), and Gervais (2015), which focus on the composition of exports.
- We do so over a long time period (1970-2010), taking advantage of a new panel dataset on product quality, Henn et al. (2017).
  - Other data sets on product quality include Hallak (2006), Hallak and Schott (2011), and Freenstra and Romalis (2014).
- Our estimation approach does not require the use of domestic production data, a significant advantage over previous literature.
  - E.g., Costinot et al. (2012), Caliendo and Parro (2014).

The Model

Consumers

- Model is Eaton and Kortum (2002) extended with many sectors and product quality.
- There are N **economies** that trade products but not inputs.
- Each economy n is populated by L_n inhabitants.
- Individuals supply *one* unit of **labor** and receive salary w_n.
- Utility defined over **consumption** $c_{nk}(j)$, good $j \in [0,1]$, and sector $k = 1, 2, ...K.$, weighted by **quality** q_{nk}.
- Goods are sold to final consumers at **price** $p_{nk}(j)$.

The Consumer's Problem

- **Quality rises utility.** Assume $q_{nk}(j) = q_{nk}$ for all j.

- Problem is

$$\max_{\{c_{nk}(j)\}} c_n = \left(\sum_{k=1}^{K} \omega_k^{1/\varepsilon} c_{nk}^{1-1/\varepsilon} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

with

$$c_{nk} = \left\{ \int_0^1 \left[e^{\beta_k q_{nk}} c_{nk}(j) \right]^{1-\frac{1}{\eta_k}} dj \right\}^{\frac{\eta_k}{\eta_k-1}}$$

Subject to

$$w_n = \sum_{k=1}^{K} \left[\int_0^1 p_{nk}(j) c_{nk}(j) \, dj \right]$$

The Production Function

- **Product quality requires input quality** (or higher costs) as in Kugler and Verhoogen (2012) and Baldwin and Harrigan (2011).
- **Production** depends on labor (L_{nk}), efficiency (z_{nk}) and quality:

$$y_{nk}(j) = z_{nk}(j)\frac{L_{nk}(j)}{e^{\alpha_k q_{nk}}}$$

- $z_{nk}(j)$ is a random draw from a Fréchet distribution:

$$F_{nk}(z) = \Pr[z_{nk}(j) \leq z] = \exp(-\Upsilon_{nk}\, z^{-\theta_k})$$

The Importance of Quality

- **Quality has two effects**: it raises utility and production costs.
- Country n's demand for good j produced in country i depends on the **producer price** (p_{nik}) **per unit of effective quality**:

$$\frac{p_{nik}(j)}{e^{\beta_k q_{nik}}} = \frac{w_i}{z_{ik}(j)} e^{(\alpha_k - \beta_k) q_{nik}}$$

- Higher quality preferred if the utility effect dominates ($\beta_k > \alpha_k$); otherwise, exports will suffer.

Trade

- **Iceberg cost**: country i ships 1 unit to nation n, $1/d_{nik}$ units arrive (e.g.: transportation costs, insurance and tariffs).
- Notice $p_{nk} \neq p_{nik}$ and $q_{nk} \neq q_{nik}$.
- **You buy from the best price-to-quality offer**:

$$\frac{p_{nk}(j)}{e^{\beta_k q_{nk}}} = \min \left\{ \frac{d_{nik} w_i}{z_{ik}(j) e^{(\beta_k - \alpha_k) q_{nik}}} \, , \; i = 1, \ldots, N \right\}$$

The Volume of Exports

- Eaton and Kortum (2002) prove that the value of sector-k **exports** from i to n equals

$$X_{nik} = \left\{ \frac{Y_{ik} \left[\frac{d_{nik} w_i}{e^{(\beta_k - \alpha_k) q_{nik}}} \right]^{-\theta_k}}{\sum_{v=1}^{N} Y_{vk} \left[\frac{d_{nvk} w_v}{e^{(\beta_k - \alpha_k) q_{nvk}}} \right]^{-\theta_k}} \right\} P_{nk} c_{nk} L_n$$

- *Main point:* **relative quality, efficiency, input prices, trade costs, and trade partners' consumption expenditure matter.**

Data and Methodology

Exports and Quality Across Asian Miracles

- We generate predictions for **sectoral export shares** in China (CHN), Indonesia (IDN), India (IND), Malaysia (MYS), South Korea (KOR) and Thailand (THA).
- Our rich dataset allows focusing on export shares and abstract from country-specific unobservables.
- We assess the capacity to explain the observed **average changes** with respect to the previous period.
  - Help because the sum of the changes is relatively close to zero.
  - Address mismeasurement error and business cycle issues.

Data and Methodology

- Assume n is the **rest of the world**. We focus on two economies: an Asian nation i, and Germany as the **reference economy** o.
- For each sector k, the **model implies**:

$$\frac{X_{nik}}{X_{nok}} = \frac{Y_{ik}}{Y_{ok}} \left[\frac{d_{nik}}{d_{nok}} \frac{w_i}{w_o} e^{(\alpha_k - \beta_k)(q_{nik} - q_{nok})} \right]^{-\theta_k}$$

- It makes sense to assume: $d_{nik} = d_{nok}$.
- Sample comprises 2-digit SITC exports (*Comtrade*) and quality numbers (Henn et al. (2017)) for 60 products, 1970-2010.
- Wages are proxied using the economy-wide marginal product of labor calculated from *PWT 8.0*. divided by average quality.

Data and Methodology

- Product-specific **parameter values** obtained from the following regression for each 2-digit SITC product k:

$$\ln \frac{X_{nik,t}}{X_{nok,t}} = \gamma_{k0} + \gamma_{k1i}\, E_i + \gamma_{k3i}\, t + \gamma_{k4} \ln \frac{w_{it}}{w_{ot}} + \gamma_{k5} \left(q_{nik,t} - q_{nok,t}\right) + \varepsilon_{ikt}$$

- Country FE dummies E_i and time trends control for relative efficiency levels Y_{ik}/Y_{ok} and other omitted variables.

- γ_{k5} is the coefficient of interest. It measures the effect of relative product quality.

Data and Methodology

- How much of the export shares variation can quality explain?
- We first generate **predictions** about export-shares ($\hat{S}_{nik,t}$):

$$\hat{S}_{nik,t+1} = \frac{e^{\hat{\gamma}_{k5}[(q_{nik,t+1}-q_{nik,t})-(q_{nok,t+1}-q_{nok,t})]} X_{nik,t}}{\sum_{v\in\{00,\ldots,96\}} e^{\hat{\gamma}_{v5}[(q_{niv,t+1}-q_{niv,t})-(q_{nov,t+1}-q_{nov,t})]} X_{niv,t}}.$$

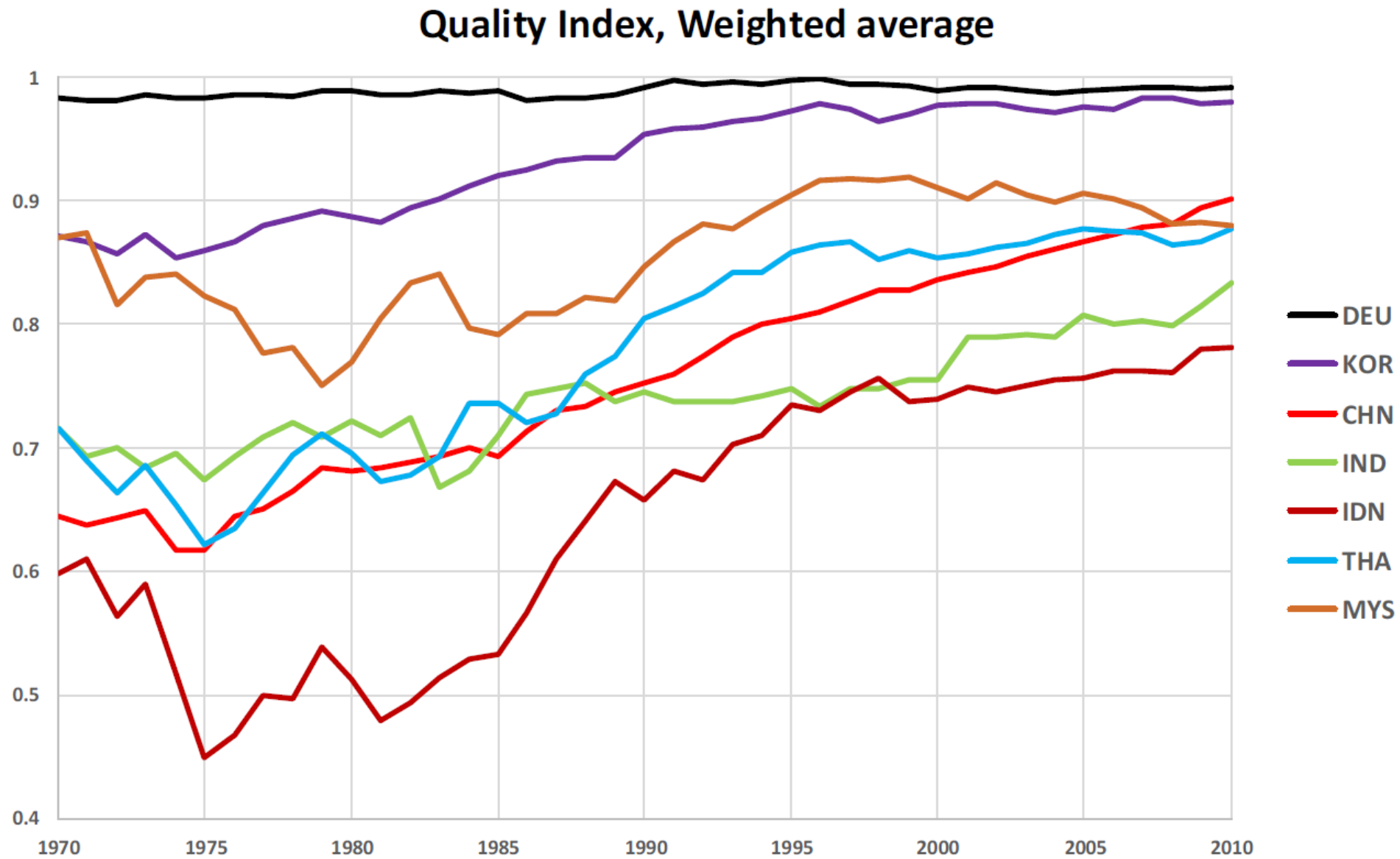
- The goodness of fit between predictions and data is assessed for different sets of periods (Ψ) by a **Pseudo-R^2**:

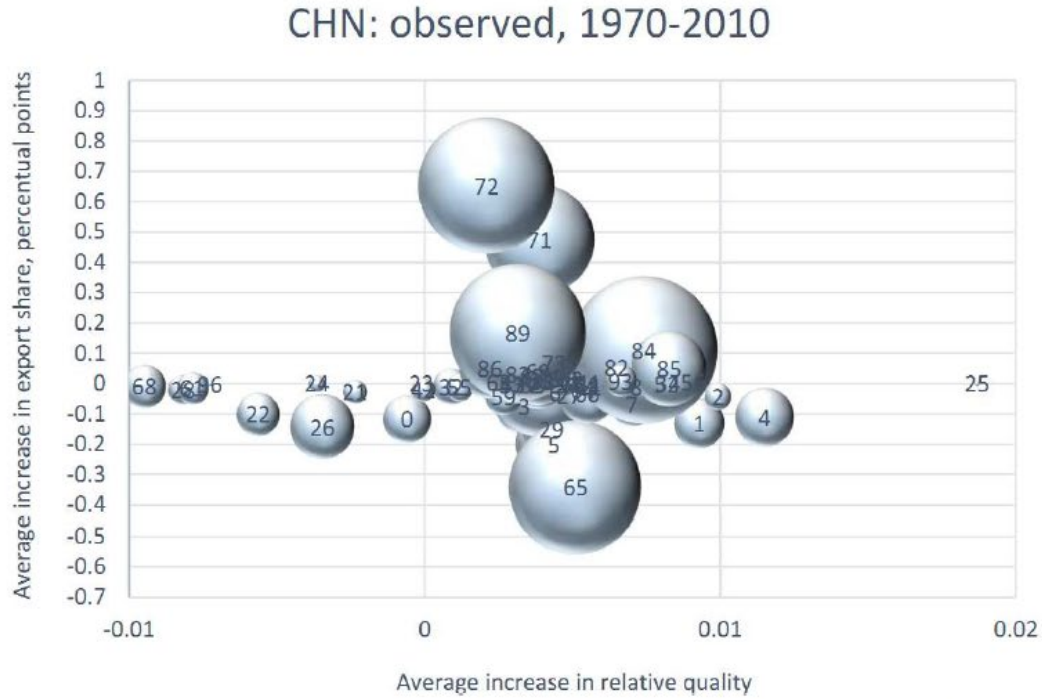
$$pseudo\text{-}R^2 = 1 - \frac{\sum_{k\in K}\sum_{\tau\in\Psi}\left[I^*_{nik}(\tau) - \hat{I}^*_{nik}(\tau)\right]^2}{\sum_{k\in K}\sum_{\tau\in\Psi}\left[I^*_{nik}(\tau)\right]^2};$$

where $\hat{I}_{nik,t+1} = \hat{S}_{nik,t+1} - S_{nik,t}$; $I_{nik,t+1} = S_{nik,t+1} - S_{nik,t}$; and $I^*_{nik}(\tau)$ is the average for $I_{nik,t}$, and $\hat{I}^*_{nik}(\tau)$ for $\hat{I}_{nik,t}$.

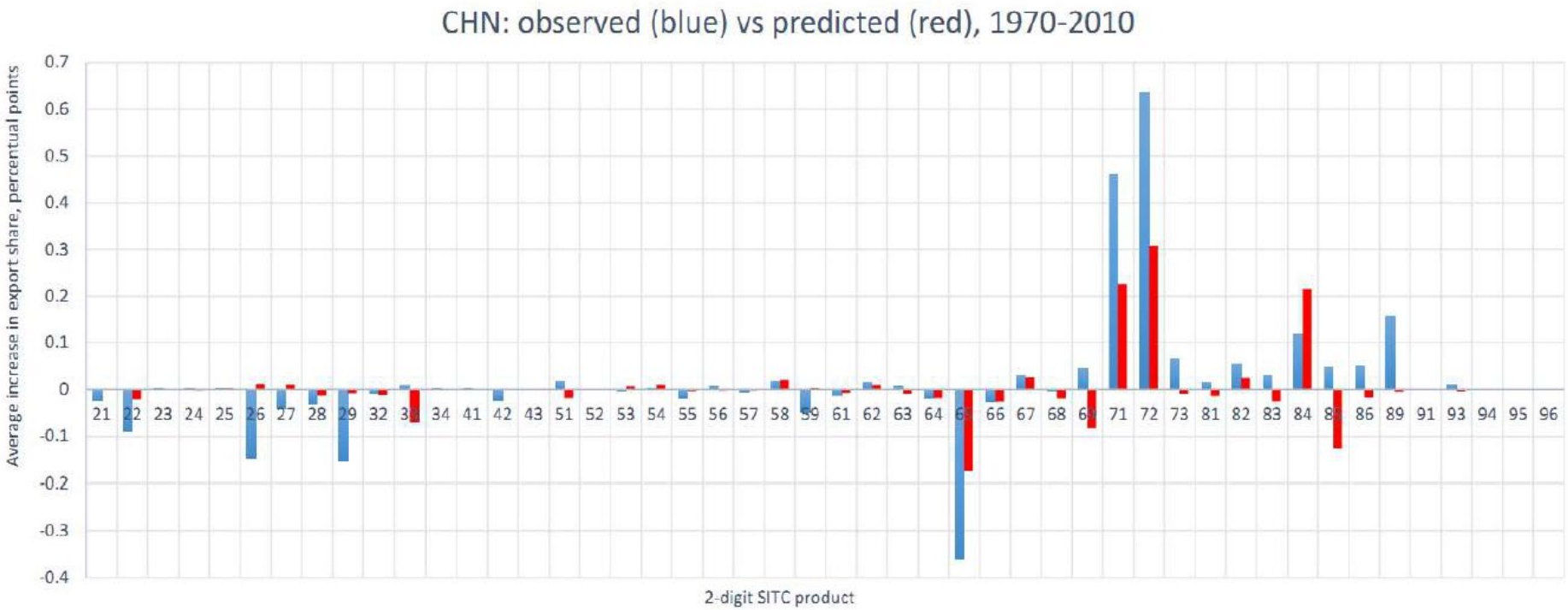
Results

Data: Evolution of Quality

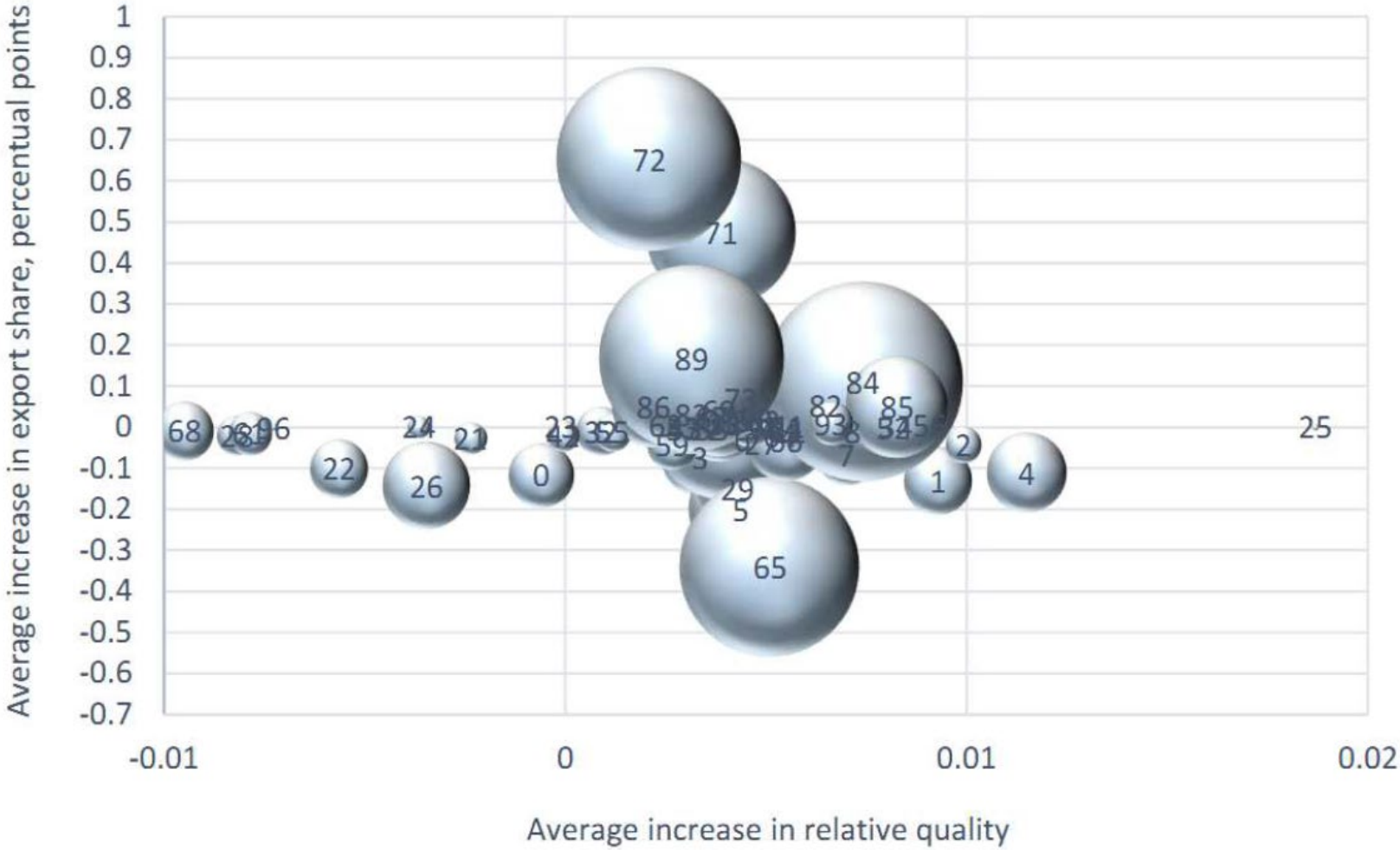




CHN	$Pseudo$ R^2	$Weighted$ R^2
1970-2010	0.534	0.649
1990 split	0.316	0.416
Decades	0.166	0.244
1970-1979	-0.015	-0.022
1980-1989	0.141	0.151
1990-1999	0.203	0.128
2000-2010	0.504	0.660



CHN: observed, 1970-2010

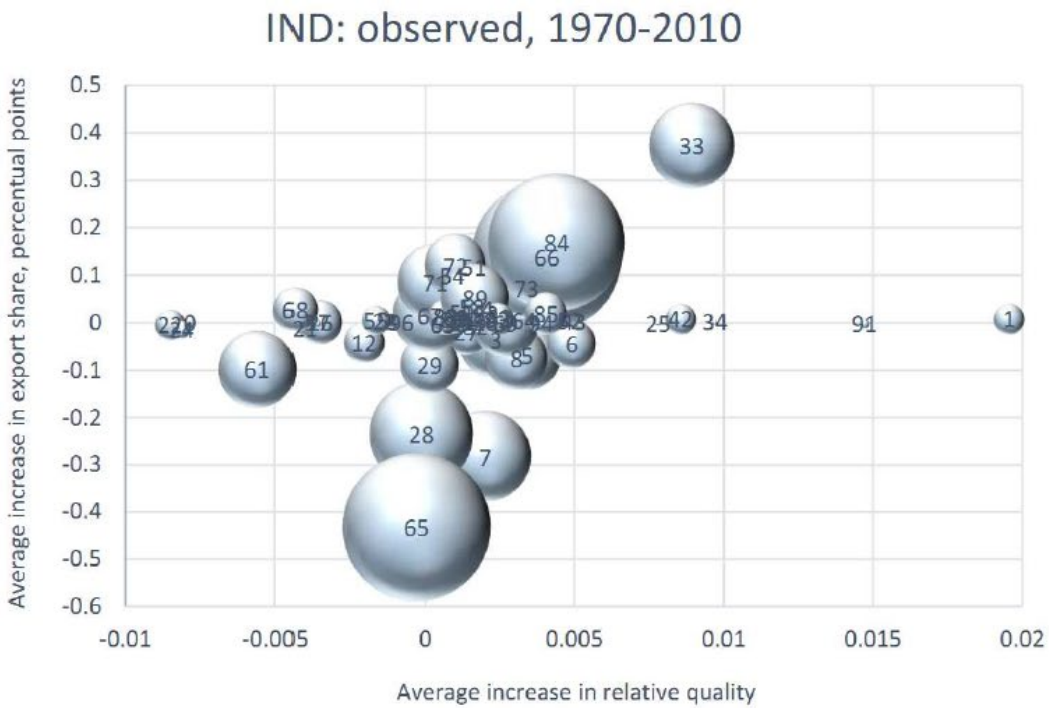


- Few sectors increase their export shares. Then concentration!
- Sectors that see their share increase, also see their quality rise.
- Sectors that see their quality increased and their share reduced are most of them commodity related.

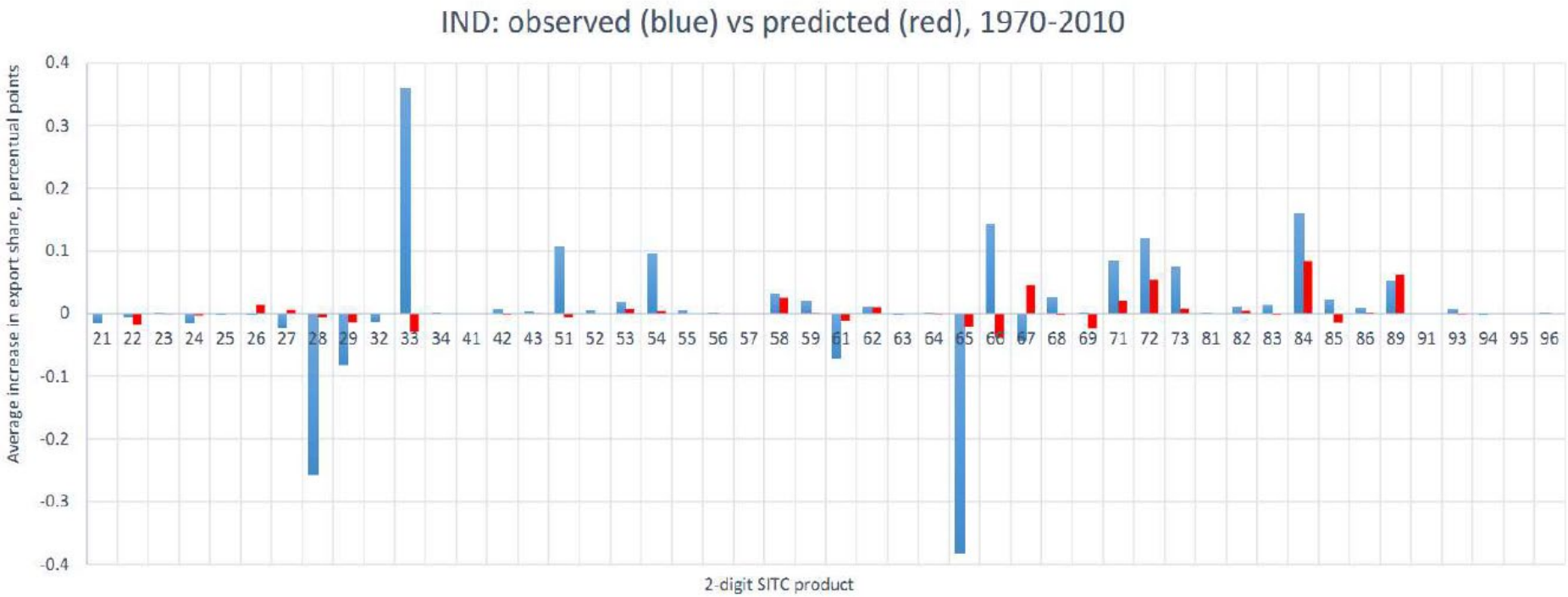
Results for China

CHN	*Pseudo* R^2	*Weighted* R^2
1970-2010	0.534	0.649
1990 split	0.316	0.416
Decades	0.166	0.244
1970-1979	-0.015	-0.022
1980-1989	0.141	0.151
1990-1999	0.203	0.128
2000-2010	0.504	0.660

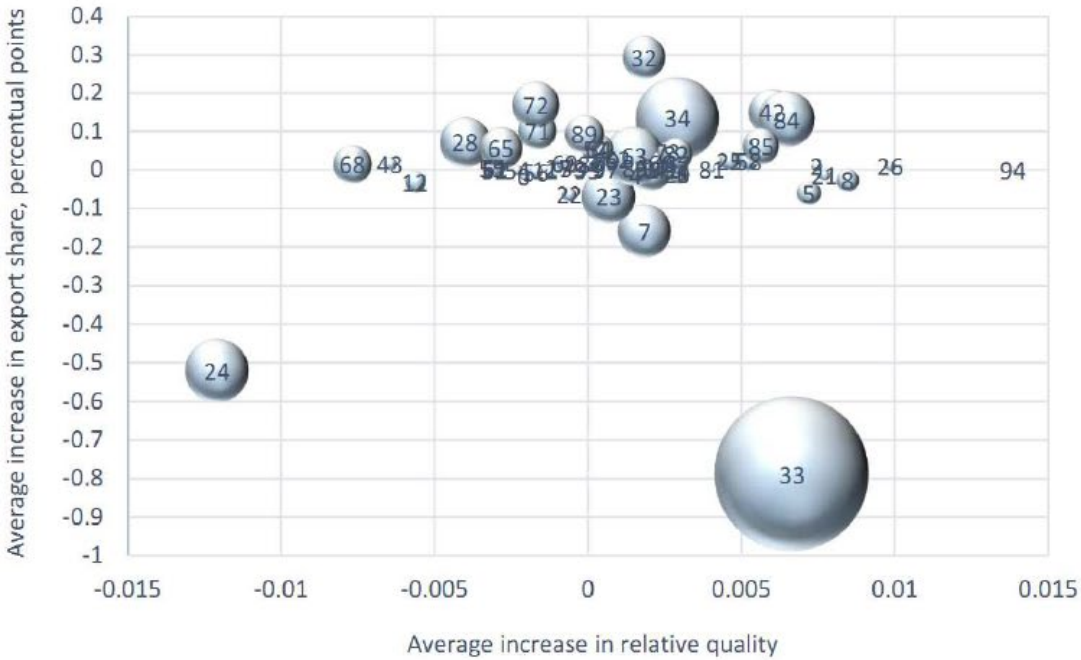
- The R^2s are large for *40-year cross-section* (row 1).
- For shorter periods (rows 2 and 3 *panels*), fit falls.
- This suggests strategies of quality upgrading should adopt a long view.
- In the *ten-year cross-sections* (rows 4 to 7):
  1. goodness of fit increases over time,
  2. is already sizable in the 1980s,
  3. becomes largest in 2000s, after China joint the WTO.



IND	$Pseudo$ R^2	$Weighted$ R^2
1970-2010	0.026	0.048
1990 split	0.058	0.065
Decades	0.032	0.040
1970-1979	0.157	0.172
1980-1989	-0.059	-0.052
1990-1999	0.162	0.240
2000-2010	-0.068	-0.085

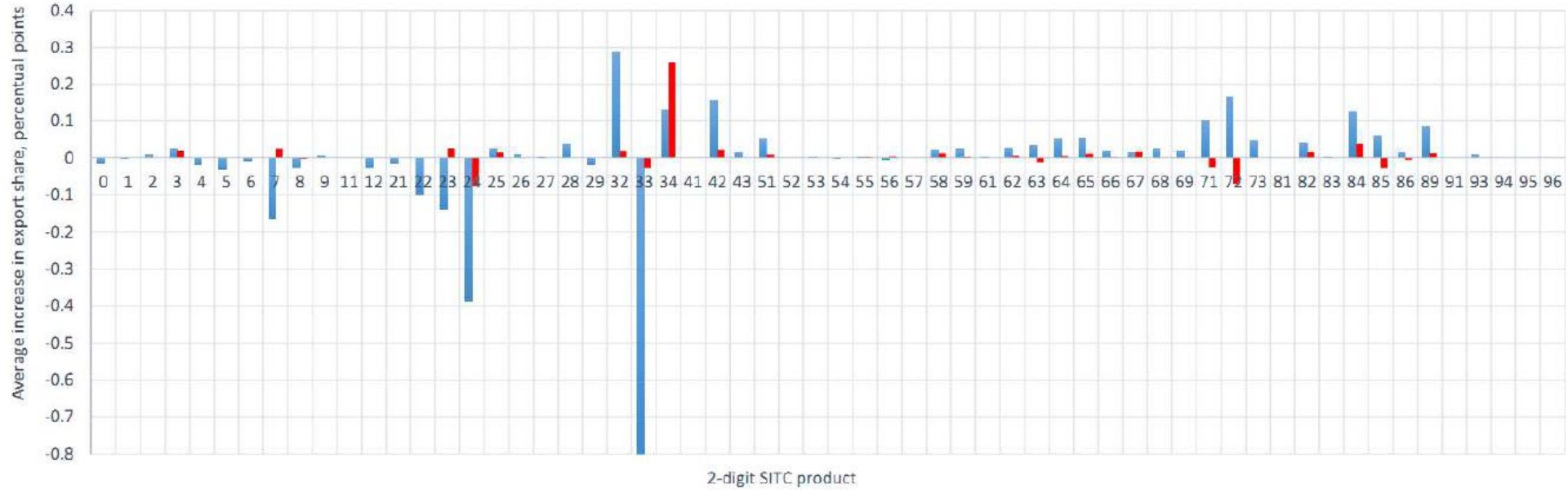


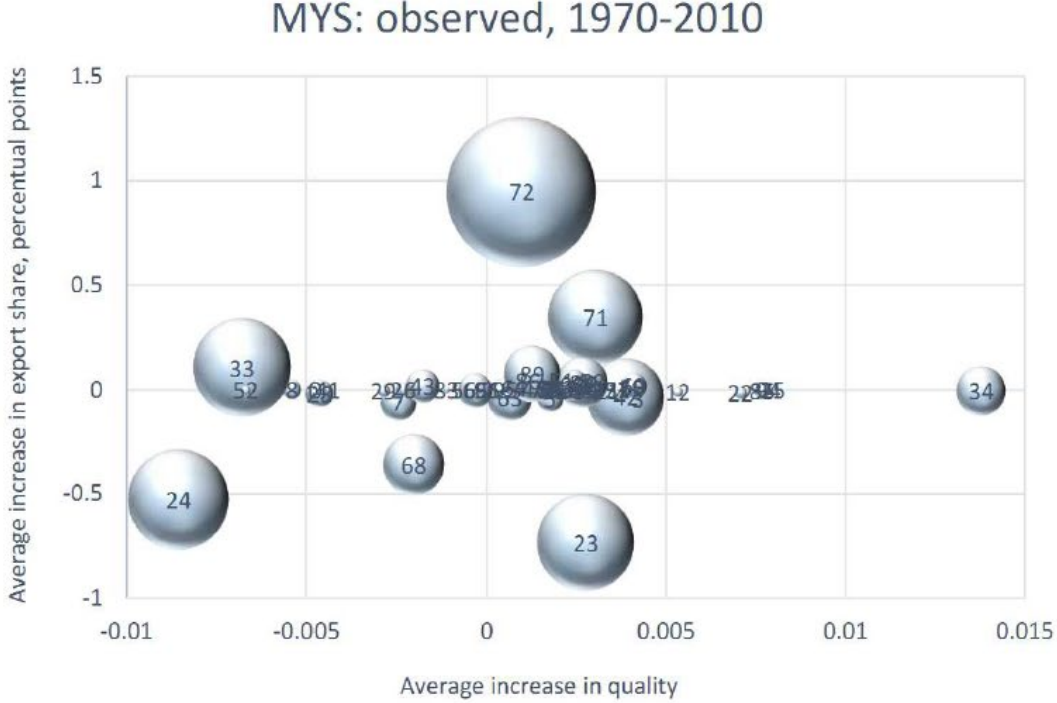
IDN: observed, 1970-2010



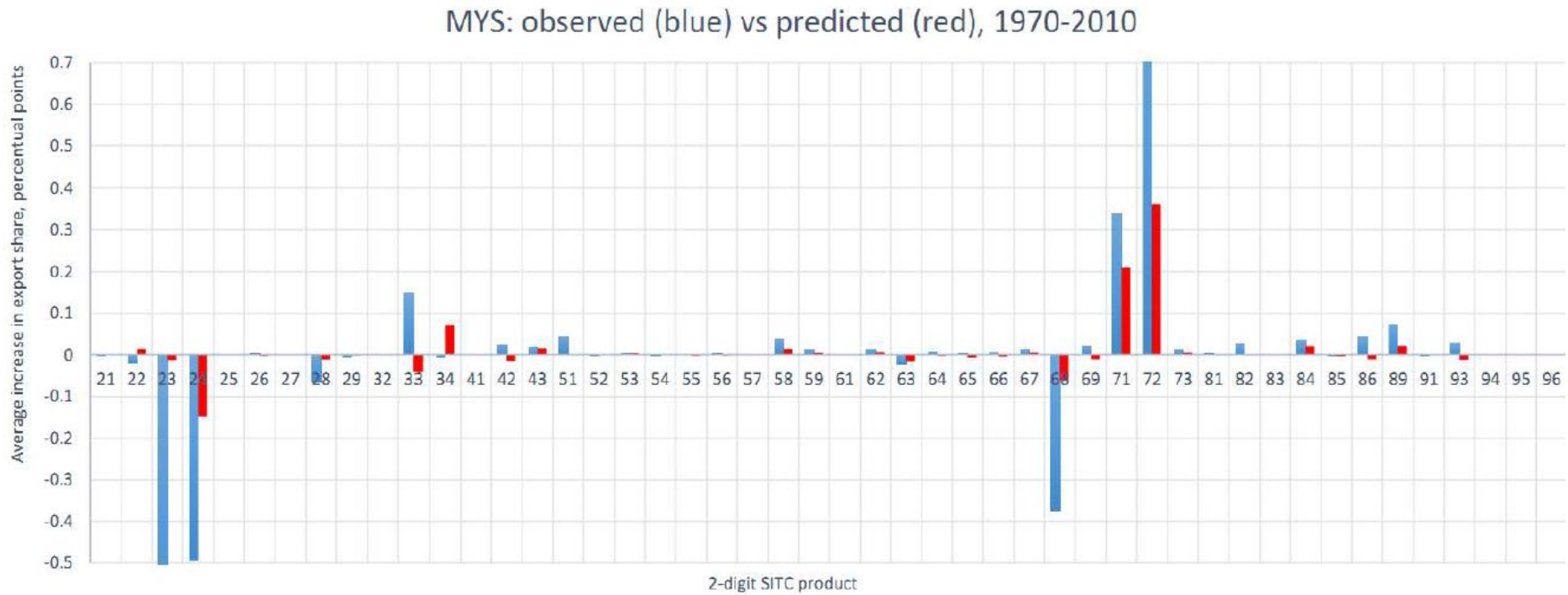
IDN	$Pseudo$ R^2	$Pseudo$ R^2
1970-2010	0.070	0.069
1990 split	0.097	0.208
Decades	0.069	0.178
1970-1979	-0.041	0.123
1980-1989	0.208	0.240
1990-1999	-0.125	-0.105
2000-2010	-0.087	-0.117

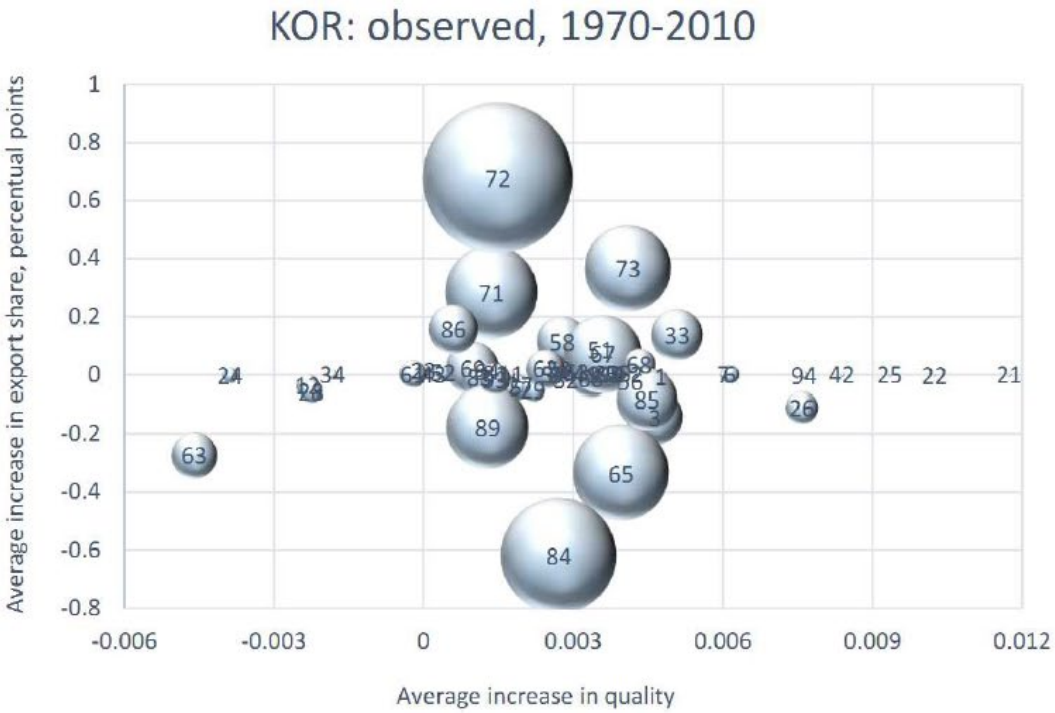
IDN: observed (blue) vs predicted (red), 1970-2010



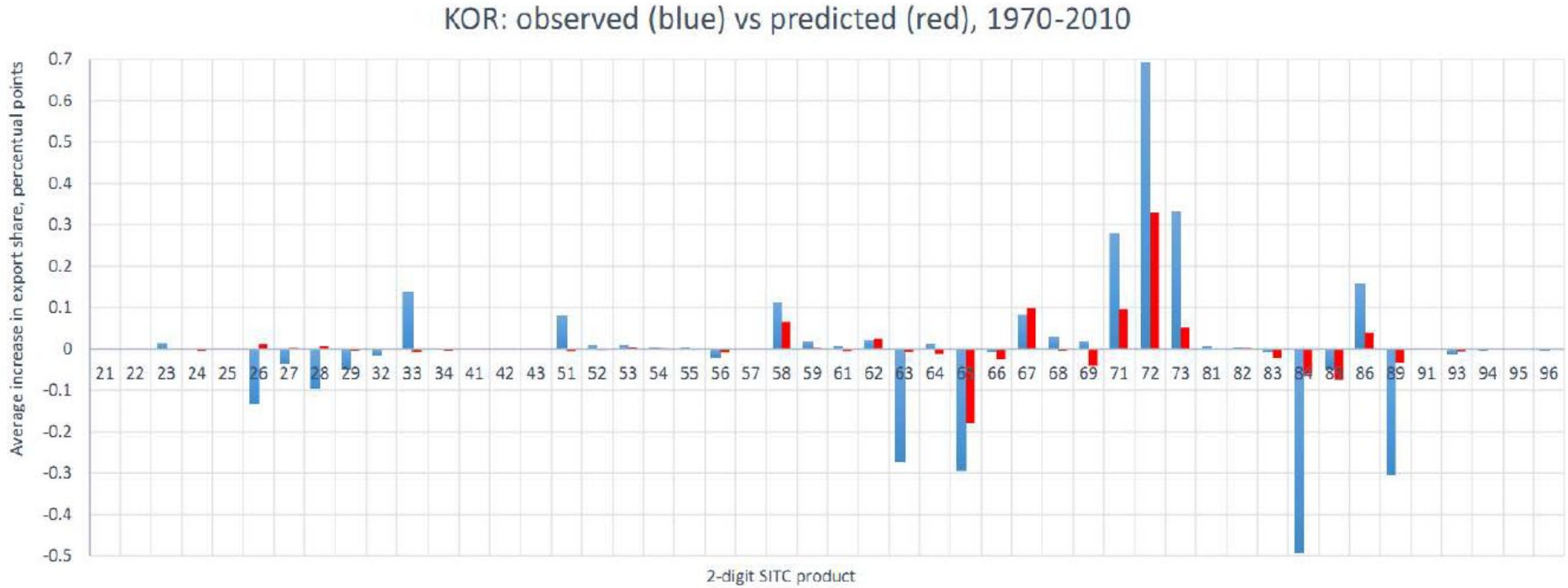


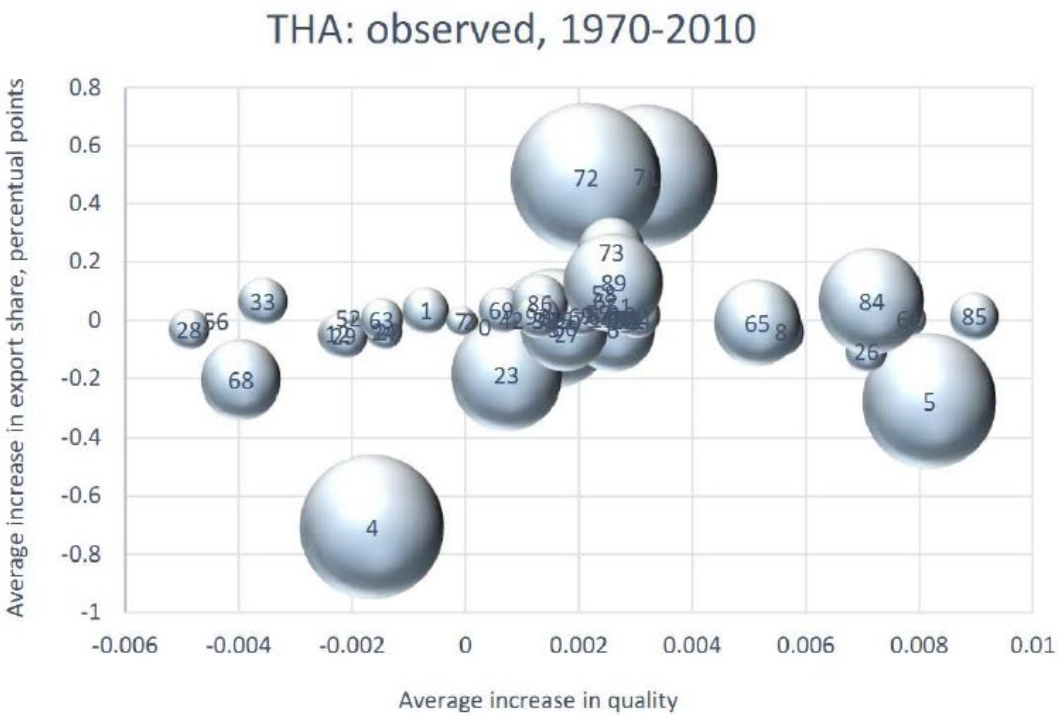
MYS	$Pseudo$ R^2	$Weighted$ R^2
1970-2010	0.389	0.486
1990 split	0.196	0.268
Decades	0.086	0.029
1970-1979	0.162	0.038
1980-1989	-0.599	-0.712
1990-1999	0.502	0.581
2000-2010	-0.141	-0.504



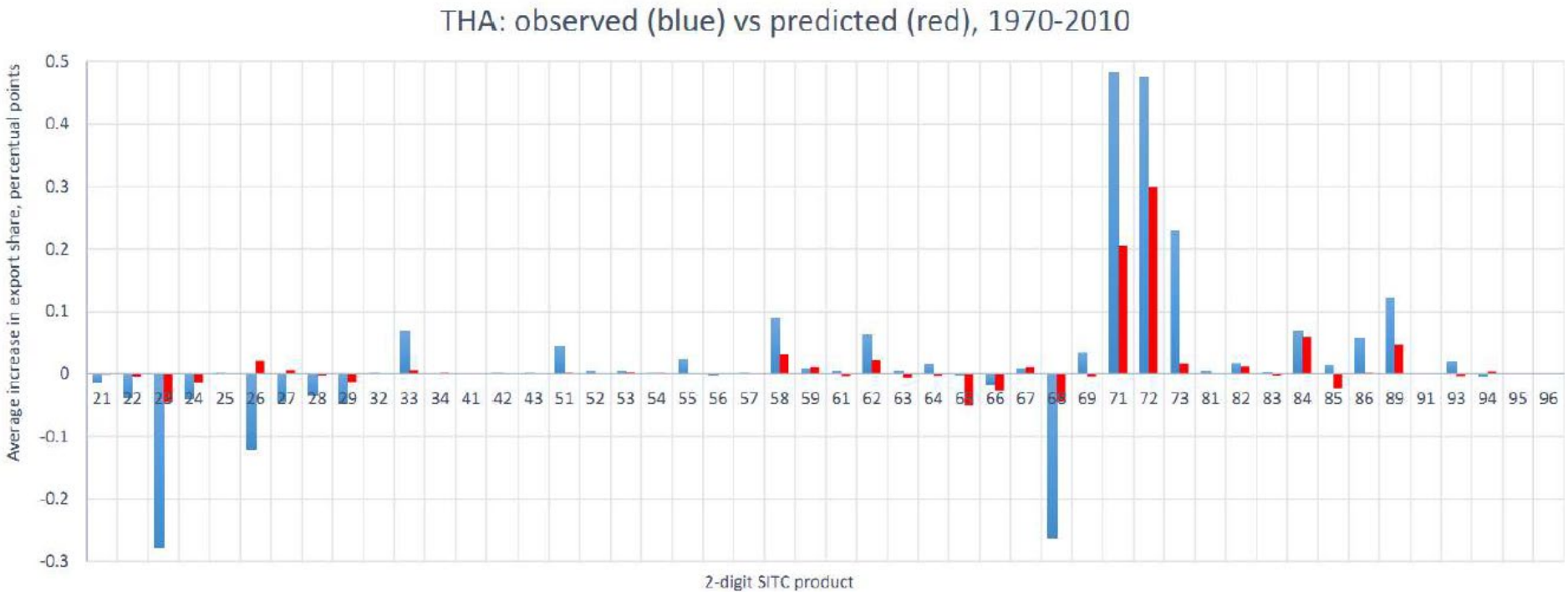


KOR	$Pseudo$ R^2	$Weighted$ R^2
1970-2010	0.464	0.583
1990 split	0.319	0.455
Decades	0.134	0.171
1970-1979	0.114	0.203
1980-1989	0.079	0.081
1990-1999	0.120	0.058
2000-2010	0.336	0.560





THA	$Pseudo$ R^2	$Weighted$ R^2
1970-2010	0.455	0.504
1990 split	0.280	0.333
Decades	0.176	0.192
1970-1979	0.087	0.088
1980-1989	0.257	0.275
1990-1999	0.254	0.306
2000-2010	-0.328	-0.838



Robustness

- Perhaps previous results informs about the correlation between quality and exports but not about causality.
- We address this concern redoing the analysis employing a quality lag $q_{nik,t-1} - q_{nok,t-1}$ to estimate the coefficient γ_{k5}.
- The pseudo-R^2 and the weighted-R^2 fall slightly.
- Results significantly deteriorate only for Indonesia.
- However, main findings for the rest of countries are robust.

Conclusion

- This paper represents a first attempt to estimate the contribution of product quality upgrading to the evolution of sectoral export shares in a set of Asian growth miracles.
- We have developed an EK model with many sectors and product quality.
- Our estimation approach, unlike previous literature, does not require domestic production data.
- We have shown that quality upgrading is key in China, Malaysia, South Korea, and Thailand.
- In India and Indonesia, the role of quality upgrading has been less critical (at least in goods exports).

Thank You

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MACRO RESEARCH FOR DEVELOPMENT: AN IMF-DFID COLLABORATION

The Export Diversification and Quality Databases (Spring 2014)

Last Updated: May 23, 2014

About the databases

Covering 187 countries including most low-income countries, the toolkit provides indicators on export product diversification and export product quality from 1962-2010. The measures in this toolkit are based on an updated version of the UN–NBER dataset, which harmonizes COMTRADE bilateral trade flow data at the 4-digit SITC (Rev. 1) level. The export diversification and quality database was developed by IMF staff under an IMF-DFID research collaboration.

The Export Diversification Database has three main indicators: the Export Diversification Index, the Extensive Margin, and the Intensive Margin. Higher values for the all three indices indicate lower diversification. The Export Quality Database contains export quality measures across different aggregation levels of export products. Higher values for the quality indices indicate higher quality levels.

Download the entire databases (Excel/CSV format)

1. Export Diversification Database

Size: 265 Kb

2. Export Quality Database

- Quality Index: Overall and 1 digit level

  Size: 858 Kb
- Quality Index: 2 digit level

  Size: 4 MB

Export Quality

- **Quality Index** is calculated as the unit value adjusted for differences in production costs and for the selection bias stemming from relative distance:

$$Quality\ estimate_{mxt} = \delta \ln \theta_{mxt} = \zeta_1{}' \ln p_{mxt} + \zeta_2{}' \ln y_{xt} + \zeta_3{}' \ln Dist_{mx}$$

where the subscripts m, x, and t denote, respectively, importer, exporter, and time period.

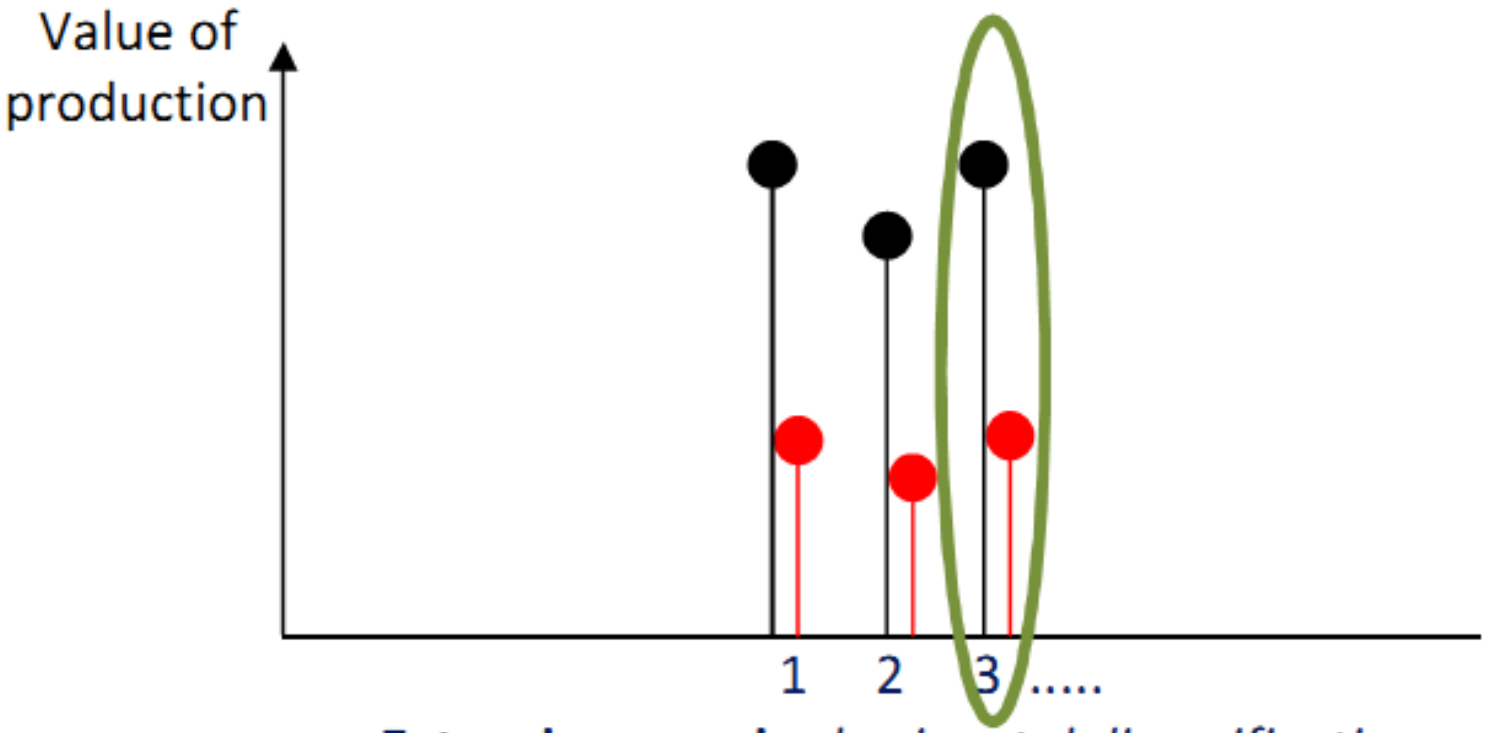
Prices reflect three factors.

- First, unobservable quality θ_{mxt}
- Second, exporter income per capita y_{xt}
- Third, the distance between importer and exporter, $Dist_{mx}$

For further reference on construction of index and applications see:
"Export Quality in Developing Countries". IMF Working Paper by Henn, Papageorgiou, and Spatafora (2013)

How to Increase the Export Value: Extensive, Intensive and Quality Margins

Intensive margin: *vertical diversification,*
unit value (**quality margin**) *times* **quantity**



Extensive margin: *horizontal diversification,*
number of types of goods exported.