Firm Strategies in a Modern Global Economy: FDI Diversion, Scalable Intangibles, and Export Complexity

Final Public Oral Examination

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Firm Strategies in a Modern Global Economy

Three dimensions of firm decision-making with macroeconomic and trade implications:

I. Firm location choices (FDI diversion) in response to trade policy shocks;

II. Firm investments in scalable intangibles with M&A markets;

III. Firm portfolio (evolution) of export goods along the complexity dimension.

I. "Trade Wars with FDI Diversion"

What are the impacts of trade policies on trade and welfare?

One important margin: the relocation of productive capital, as highlighted by the Trump Tariffs.

Vietnam is emerging as a winner from the era of deglobalisation

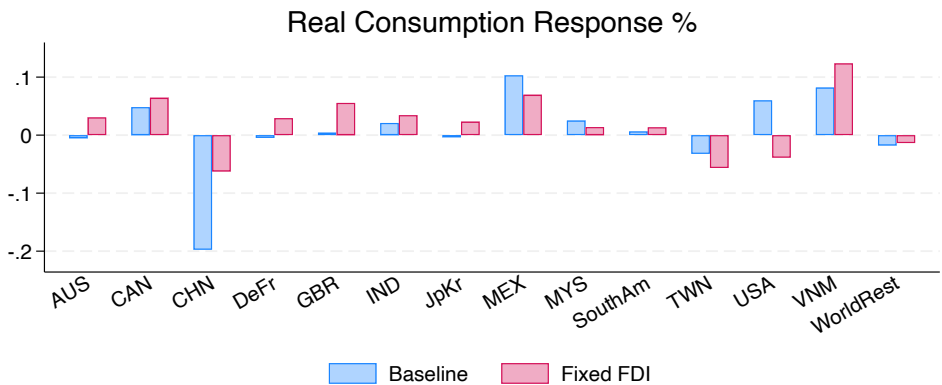
Vietnam ready for next FDI wave out of China

Accounting for the *responses* of **F**oreign **D**irect **I**nvestment & the *patterns* significantly changes the quantitative implications of the Trump Tariffs.

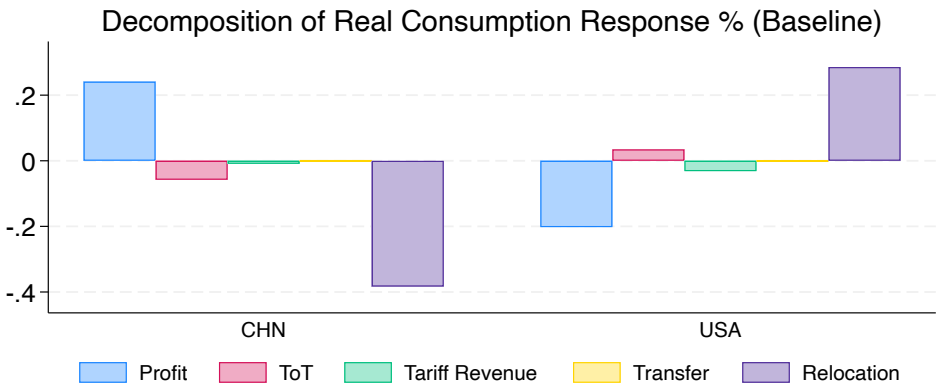
Summary of Empirical Results & Model

1. **Empirical evidence** connecting tariffs, trade and FDI;
   - Countries more exposed to trade diversion from the Trump Tariffs: higher inward FDI stocks;
   - Document country characteristics correlated with magnitude of bilateral FDI responsiveness;
2. A multi-country GE quantitative trade **model** incorporating FDI diversion;
   - FDI as producers choosing optimal export-platform locations:
     Welfare effects of tariff changes: terms-of-trade, profit-shifting, relocation effects;
   - A tractable and flexible method to generate heterogeneous bilateral FDI diversion elasticities;
3. **Calibrate** to world economy & **Quantitative** evaluations of the Trump Tariffs.

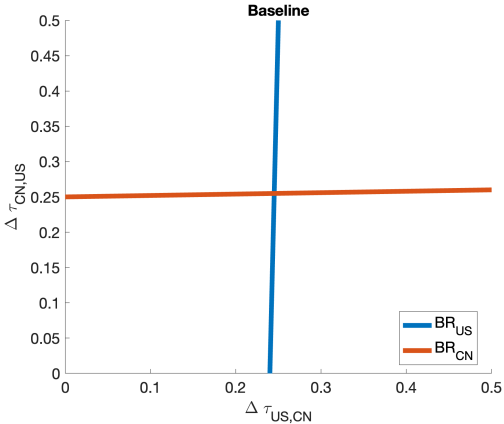
Quantitative Results: (i) Large Aggregate Welfare Implications

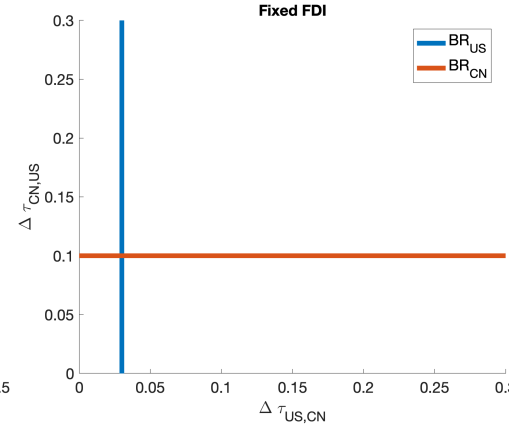


(ii) Large Distributional Welfare Implications



(iii) Large "Optimal Nash Tariffs"





II. "Scalable Intangibles: To Buy or to Build?," with Anshu Chen and Jihong Song

Intangibles have proliferated in recent years as a factor of production.

- A key feature compared to tangibles: **scalable**;
- Crucial for understanding issues like innovation.

Larger firms increasingly **buy** intangibles rather than **build** them in-house.

- Declining business dynamism? Growing monopoly power? Increasing financial frictions?

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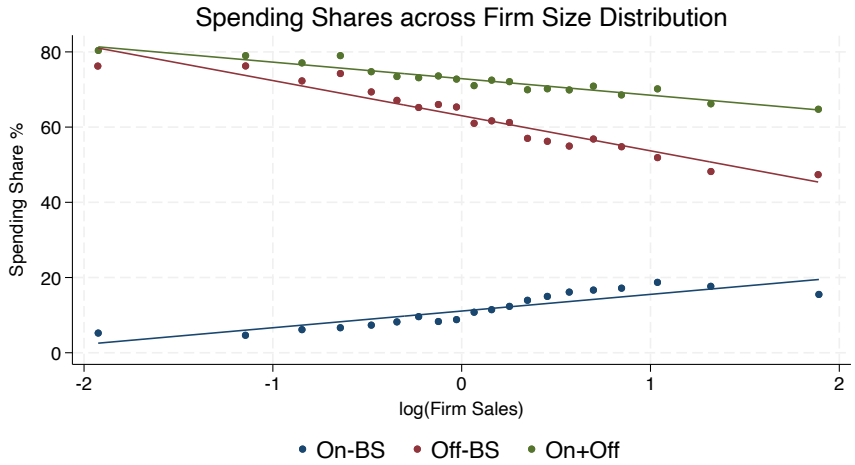
This paper: Scalability of intangibles makes buying cheaper than building for larger firms.

- Document spending patterns on buying and building intangibles across different firm sizes;
- A stylized model of scalable intangibles with the options to buy (M&A) and build (R&D);
- Test model hypotheses on spending shares and target intangible unit prices.

Intangible Spending Shares: Buying vs. Building Across Firm Sizes



Notes: Subsector-Year FE

A Stylized Model of Firm Investment

- Partial equilibrium OLG: each firm potentially operates for 2 periods;
- Each firm z chooses its scale and invests in both tangible and intangible assets;
  - Each product line requires tangible and intangible inputs;
  - Products are sold in a monopolistically competitive market;
  - Intangibles can be imperfectly scaled across product lines;

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  - Intangibles can be imperfectly scaled across product lines;
- A new firm in its first period acquires intangibles only through in-house R&D;
  - Before production, it might become an M&A target and be acquired;
  - If not acquired, it produces, its assets fully depreciate, and it becomes an old firm;
- An old firm has the option to buy intangibles from the new firms born one period later;
  - After the M&A and investments, the old firm produces, earns profits, and exits;
- Assumption: the new firms do not internalize the possibility of M&A.

Building Intangibles for New Firms

$$V^{new}(z) = \max_{x,K,I,\{K(s),I(s)\}} \pi(K(s), I(s), x; z) + \beta\pi(K(s), I(s), x; z),$$

$$\text{where } \pi(K(s), I(s), x; z) = \int_0^x \left[z \left(\zeta^{\frac{1}{\sigma}} K(s)^{\frac{\sigma-1}{\sigma}} + (1-\zeta)^{\frac{1}{\sigma}} I(s)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \right]^{1-\epsilon} ds - K - I - \frac{F}{\omega} x^{\omega},$$

$$\text{s.t. } \int_0^x K(s) ds \leqslant K, \quad \left(\int_0^x I(s)^{\frac{1}{1-\rho}} ds \right)^{1-\rho} \leqslant I.$$

Within-product-line and Aggregate Spending Shares

A firm's scope x and within-product-line ratio $\frac{I(s)}{K(s)}$ increase with z if (Assumption 1) $\omega > \frac{1}{\epsilon}$.

Moreover, when K and I are complements ($\sigma < 1$), the total spending $\frac{I}{K}$ decreases with z.

Price Function of Target Firms' Intangibles

- Assumptions:
  2. K is homogeneous and is bought and sold in a competitive market at a unit price.
  3. The target firm is sold at its firm value with an exogenous and constant premium $G > 1$.
- The per-unit intangible price for a target firm with productivity z is:

$$P(z) = G\frac{V^{new}(z) - K^*(z)}{I^*(z)}.$$

Price Function

Under Assumptions 1 - 3, $P(z)$ decreases with z if $\omega < \frac{1}{1-\frac{1}{1+\beta}\frac{1-\epsilon}{\epsilon}}$.

Buying Intangibles for Old Firms

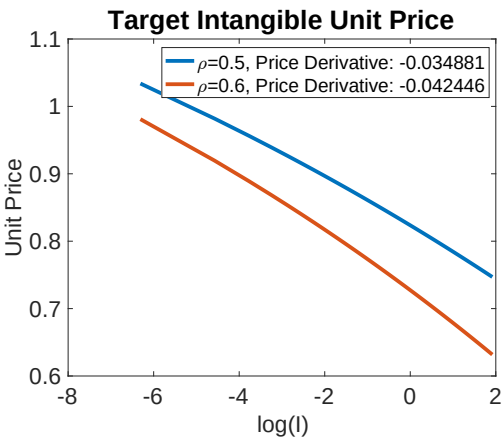
$$V^{old}(z) = \max_{x,K,I,M,\{K(s),I(s),M(s)\}} \int_0^x \left[z \left(\zeta^{\frac{1}{\sigma}} K(s)^{\frac{\sigma-1}{\sigma}} + (1-\zeta)^{\frac{1}{\sigma}} N(s)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \right]^{1-\epsilon} ds$$

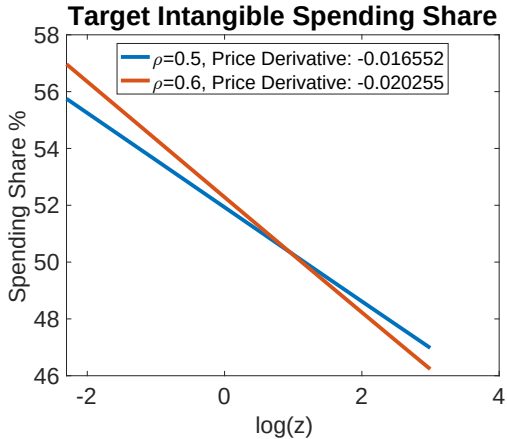
$$- K - I - P(\mathcal{Z}^{-1}(M))M - \frac{F}{\omega} x^{\omega}$$

$$\text{s.t. } N(s) = \left(\eta^{\frac{1}{\nu}} I(s)^{\frac{\nu-1}{\nu}} + (1-\eta)^{\frac{1}{\nu}} M(s)^{\frac{\nu-1}{\nu}} \right)^{\frac{\nu}{\nu-1}}, \nu > 1,$$

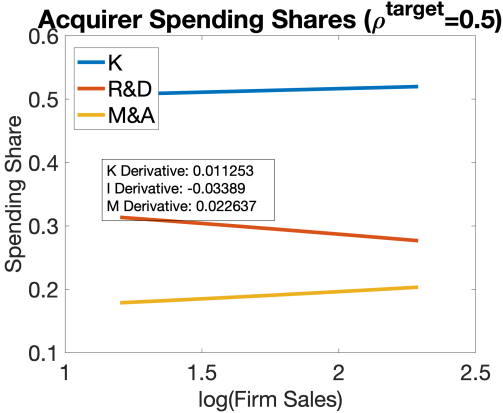
$$\int_0^x K(s)ds \leqslant K, \quad \left(\int_0^x I(s)^{\frac{1}{1-\rho}} ds \right)^{1-\rho} \leqslant I, \quad \left(\int_0^x M(s)^{\frac{1}{1-\rho}} ds \right)^{1-\rho} \leqslant M.$$

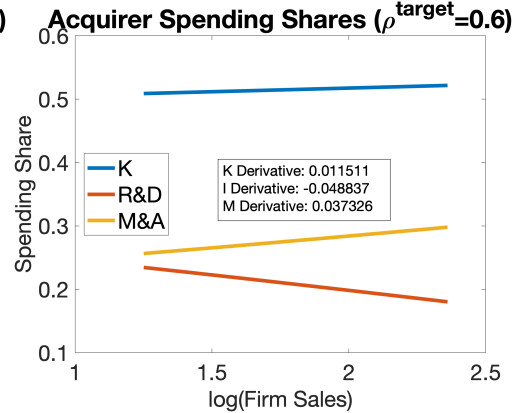
Numerical Examples: Targets





Numerical Examples: Acquirers





Hypotheses Testing: Data and Measure

- Measure of model ρ^{target}:

  Firm scope: # product markets in which firms operate from Hoberg and Phillips (2023 JF);

  $\Rightarrow$ The potential targets' average scope for each acquirer's sector s (SIC 2d), $\mathcal{S}_{s,t}$;

- Measure of model P(z):

  Target intangible unit price from M&A transactions from Refinitiv's M&A Standard.

Hypotheses Testing: Intangible Unit Price

	Baseline	Interaction
	(1)	(2)
Target Log Intan	-0.179^{+}	-0.125
	(0.0937)	(0.281)
Target SIC4d Scope		-0.0833
		(0.0686)
Target Log Intan X Target SIC4d Scope		-0.0401^{+}
		(0.0229)
Controls	✓	✓
Subsector-Year FE	✓	✓
Within R^2	.453	.483
# Years	32	31
Dep. Var. Mean	.81	.64
Observations	1275	1003

Notes: Controls include acquirer's and target's scope, cash flow divided by asset, log leverage ratio, age, log sales, Tobin's Q, intangible asset share, and the acquirer's intangibles. Column (2) also include all interaction terms using the target's SIC 4d sector average intangible shares. The dependent variable is winsorized at 2.5th and 97.5th percentiles. SE clustered at the year level. Acquirer-Subsector-Target-Subsector-Year FE included. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Hypotheses Testing: Spending Shares

	M&A	R&D+Org	Intangible
	(1)	(2)	(3)
Log Sale (STD)	5.085*	-4.332	0.293
	(2.210)	(3.298)	(2.067)
Log(Sale) $\times$ $\mathcal{S}_{s(i),t}$	0.522^{+}	-1.147*	-0.510^{+}
	(0.274)	(0.423)	(0.260)
$\mathcal{S}_{s(i),t}$	0.00466	-4.209*	-4.343**
	(1.131)	(1.720)	(1.155)
Controls	✓	✓	✓
Subsector-Year FE	✓	✓	✓
Within R^2	.023	.034	.015
# Years	31	31	31
Dep. Var. Mean	10.48	62.18	72.66
Observations	27403	28355	28317

Notes: Controls include scope, log leverage ratio, cash flow to asset, firm age, log adjusted asset, and Tobin's Q. Samples are constraint to those whose ratio of On-BS intangibles to total adjusted asset is larger than 0.05. Dependent variables winsorized at 2.5th and 97.5th percentiles. SE doubly clustered at firm and year level. Subsector-Year FE included. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

III. "The Evolution of Firm Export Complexity," with Mingzhi (Jimmy) Xu

Economic growth involves not only producing more goods but also **different** goods.

- "Made in China 2025" targets key industries like information technology, robotics, etc.;
- A sign of country's capability? Further enhance economic growth?
- Important for understanding the evolution of a country's comparative advantages;

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- Important for understanding the evolution of a country's comparative advantages;

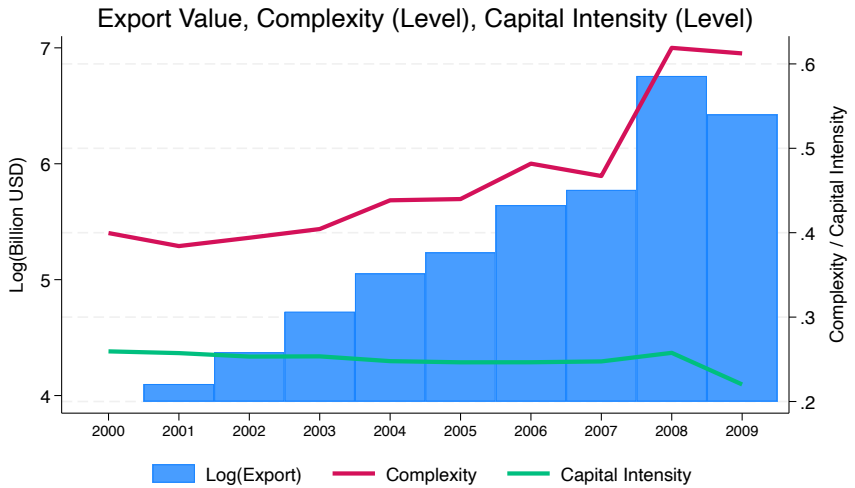
Little is known about how a country advances in goods complexity at the **firm level**.

- A measure of goods complexity based on the **number of inputs** involved in production;
- In China, **large firms** are crucial for aggregate export complexity growth;
  By exporting in **more & complex** sectors rather than by exporting more within a sector;
- Large firms in 11 other developing countries show much less capability in this regard.

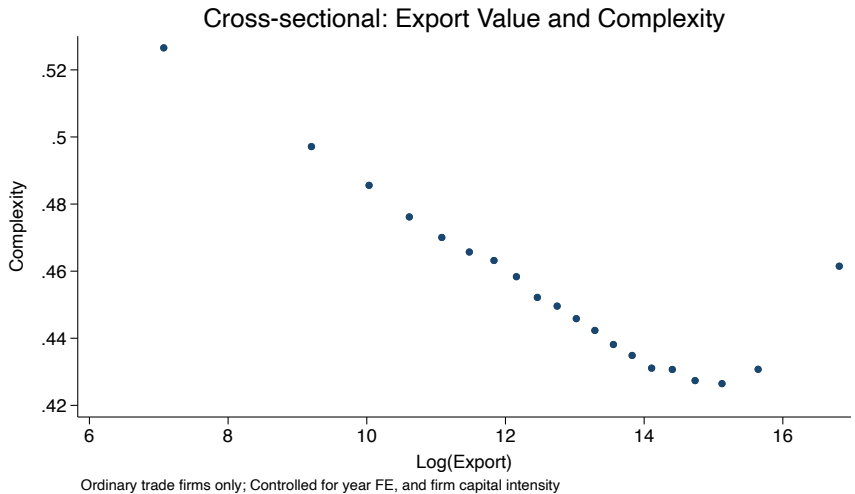
Measure of Goods Complexity

- Data: Chinese trade transactions from 2000-2011;
  - F.o.b. value of firm exports and imports by product;
  - Firm IDs linked over years;
- Construct the HS-4d goods complexity measure:
  - If an input good **i** is imported (and thus potentially used) by more than a certain fraction of firms who export good **p**, we consider good **p** to potentially require good **i**;
  - The complexity of each good p is measured by the number of potentially required input goods;
- Robustness:
  - Control for goods capital intensity;
  - Constrain the data to "ordinary" trade.

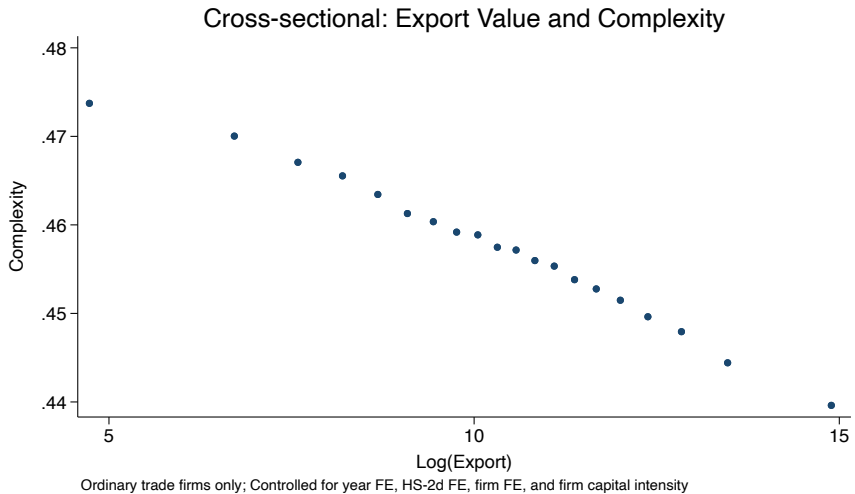
Aggregate Chinese Export Complexity Evolution



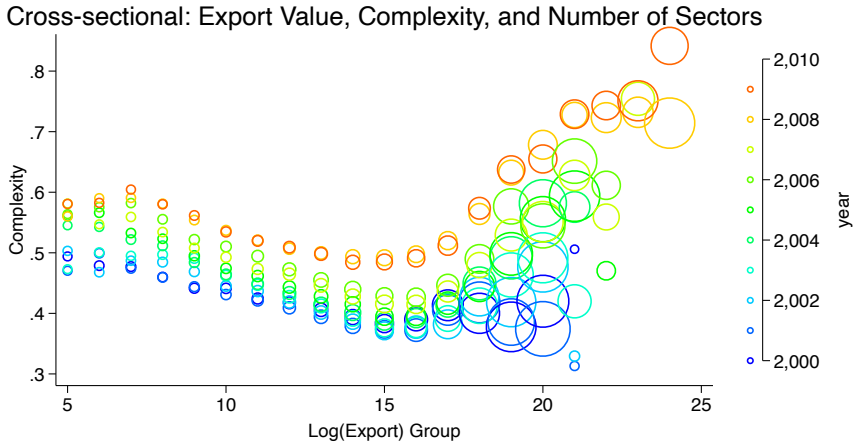
Cross-section: Complexity and Export Value, Firm Level



... Firm-Sector (HS-2d) Level

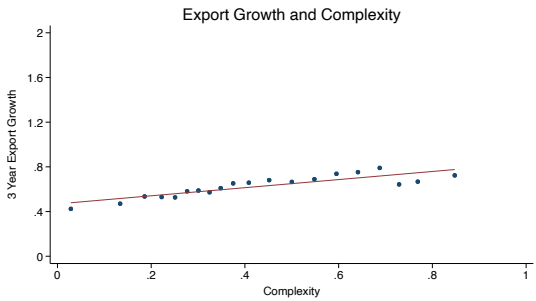


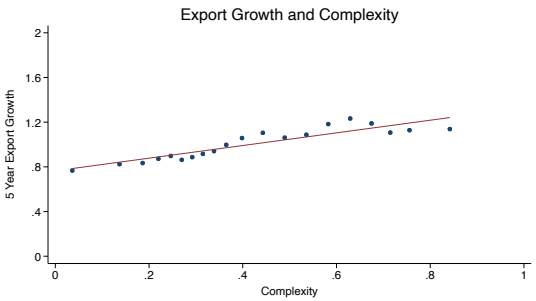
Firm Size, Complexity, Number of Sectors



Ordinary trade firms only;
Size of circle is weighted average of number of HS2d sectors for each year-group;
The min is 1.07, max is 57, median is 3.17, mean is 7.39

Export Value Growth, Firm Level





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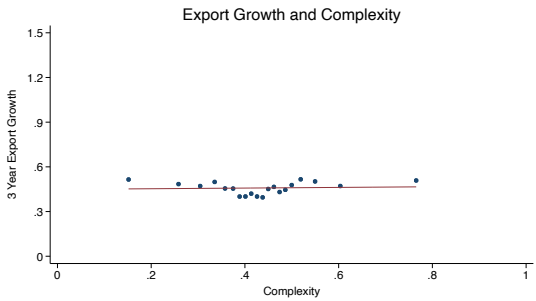
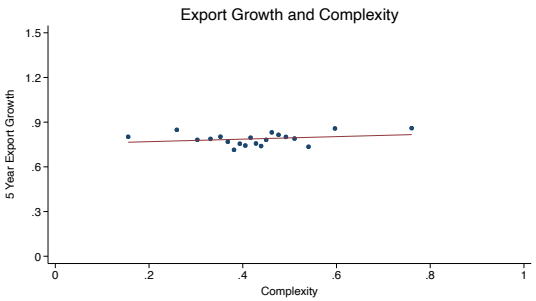
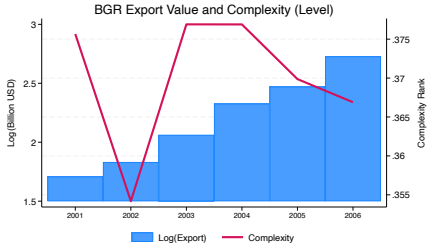
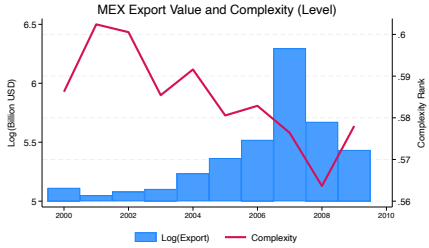
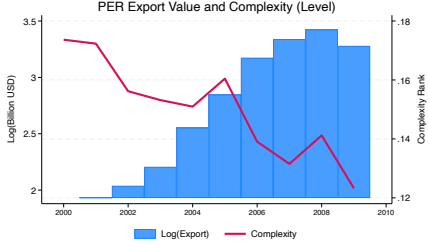


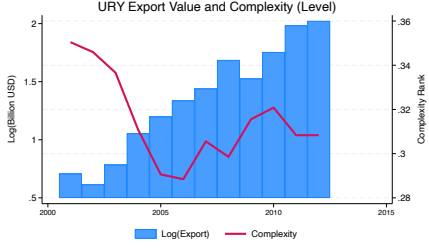


Other Developing Countries: From the Exporter Dynamics Database

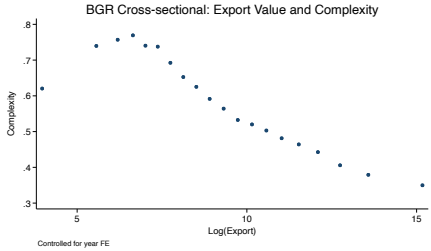


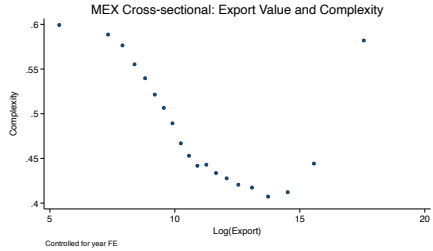


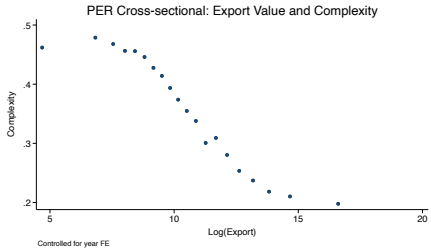


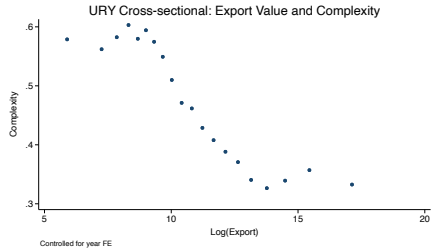


... Cross-section, Firm Level









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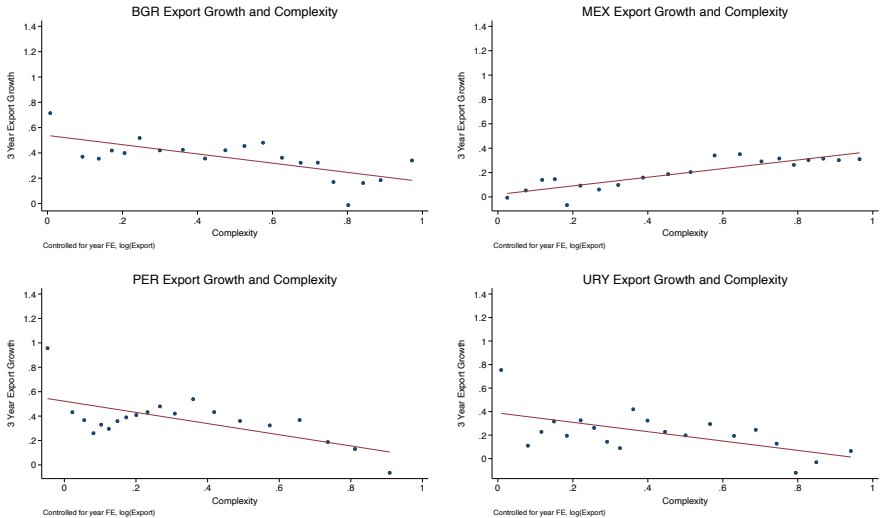

Thank You for This Wonderful Journey

- Six years have flown by surprisingly fast;
- I am truly grateful to Ezra, Mark, Gene, Richard, to Steve and Eduardo;
  And many other faculties members and colleagues for their unwavering support and guidance;
- I feel increadibly lucky to have the supports of my family, partner, friends, and roommates;
- See you in the future!