Promoting Productivity Growth in Manufacturing Sector:

Evidence from Thailand Firm-Level Data

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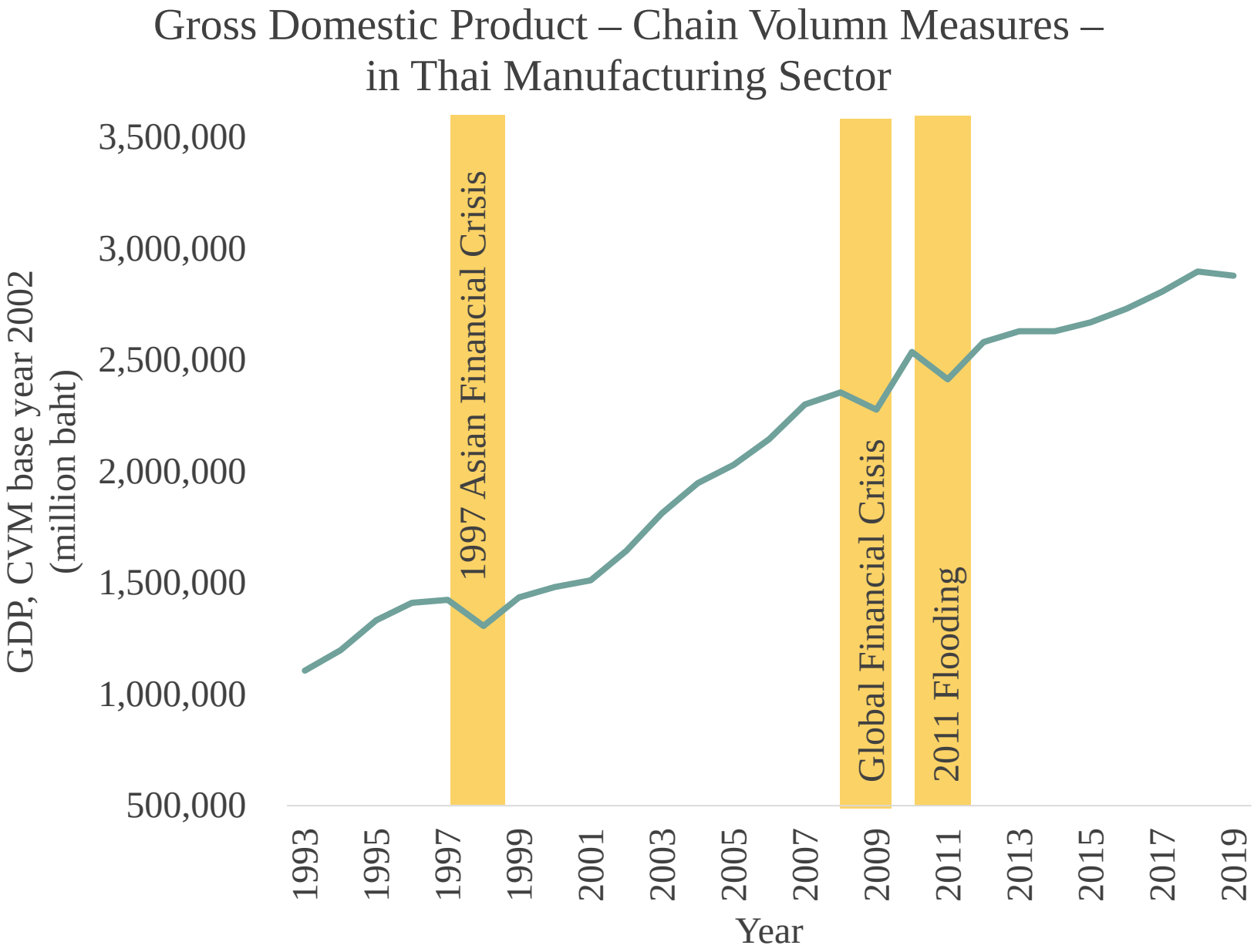
March 17, 2021

Disclaimer: The views expressed herein are those of the presenter; they do not necessarily reflect the views of the Bank of Thailand.



Source: NESDC

How to excelerate growth?

What is productivity?

How to measure it?

What explains productivity growth?

How can we promote productivity?

Unbalanced Panel

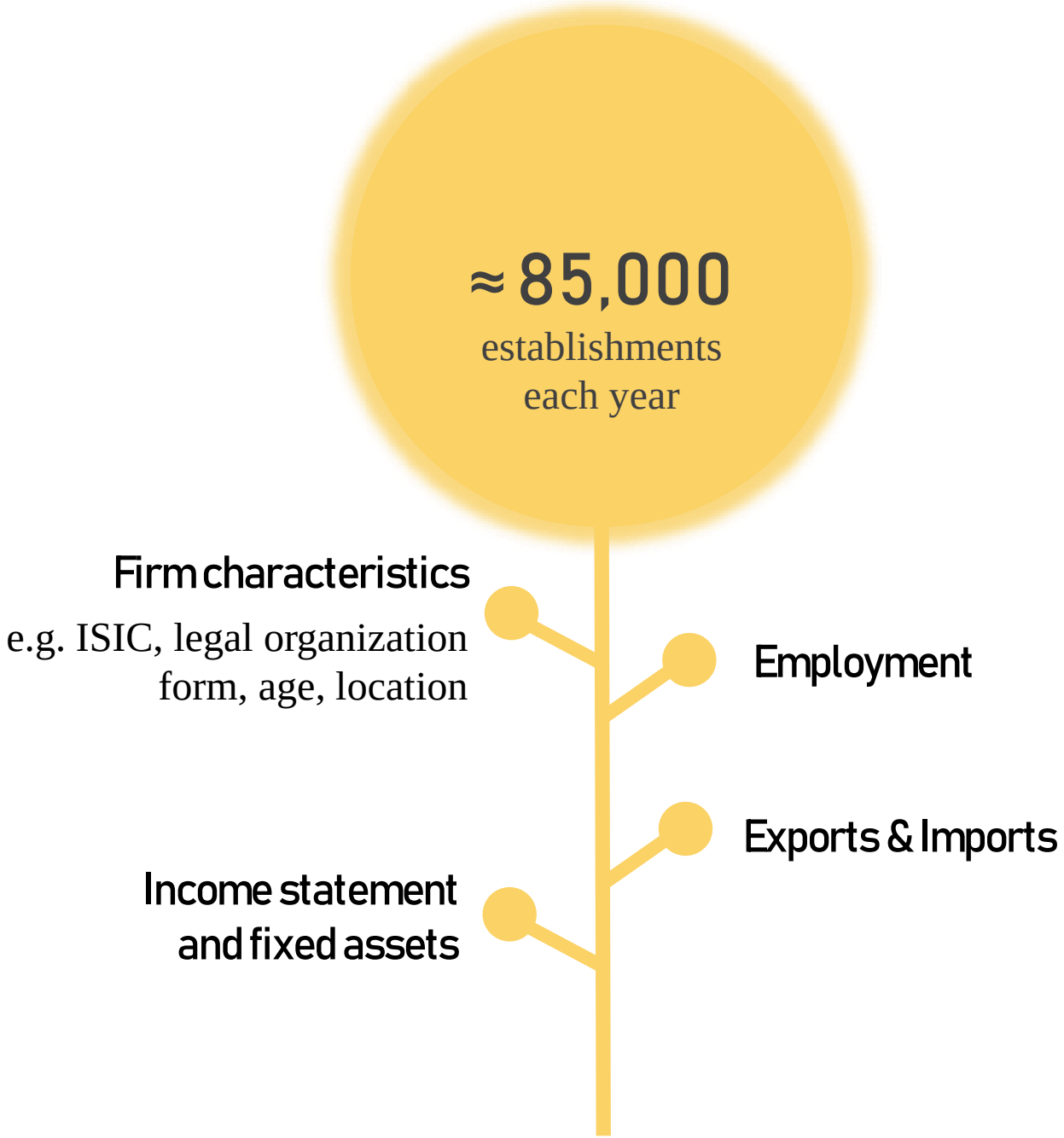
Manufacturing Industrial Census

2006-16

Data Trimming

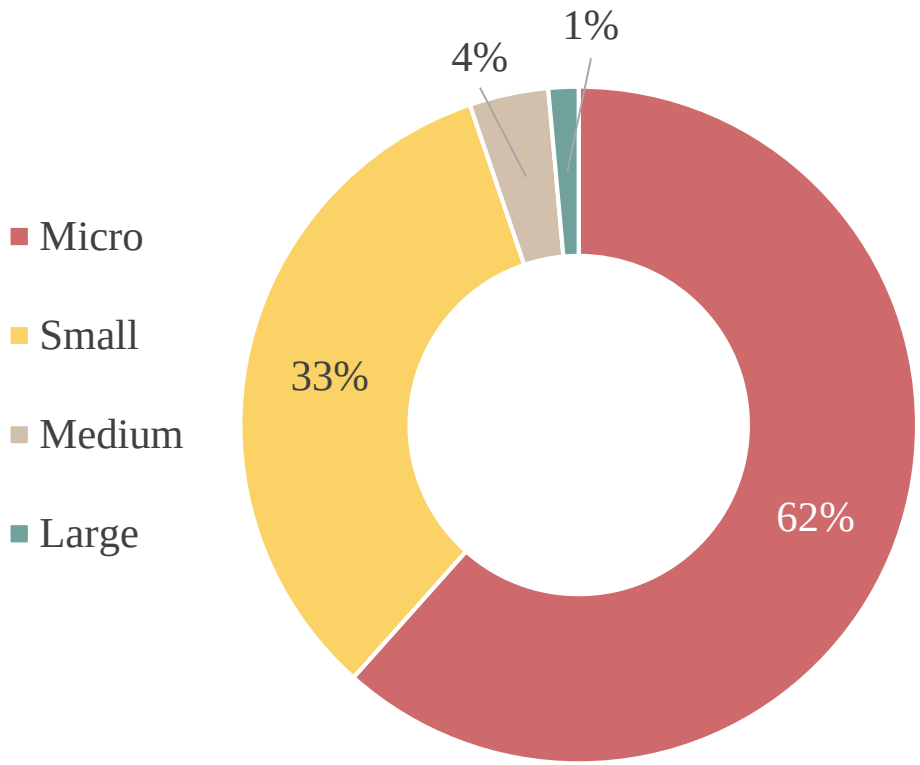
Discard observations whose deflated capital, intermediate input and number of workers are below the 5th or above 95th percentile within each 2-digit ISIC group and year surveyed

223,447
observations

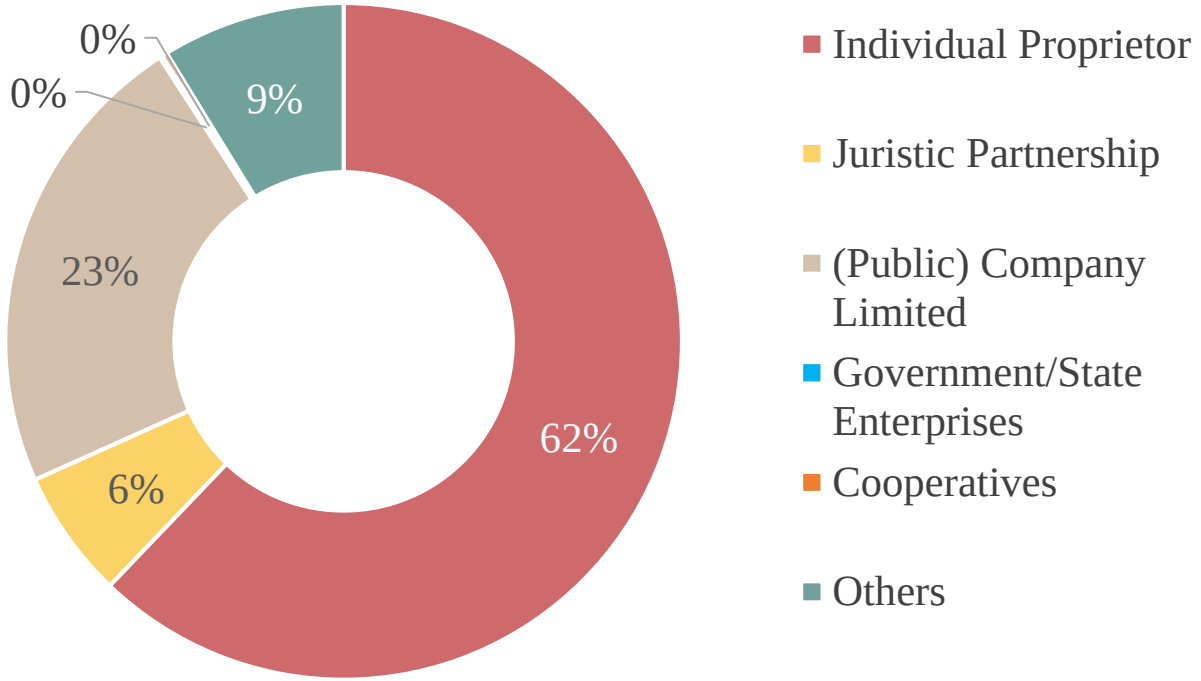


SUMMARY STATISTICS

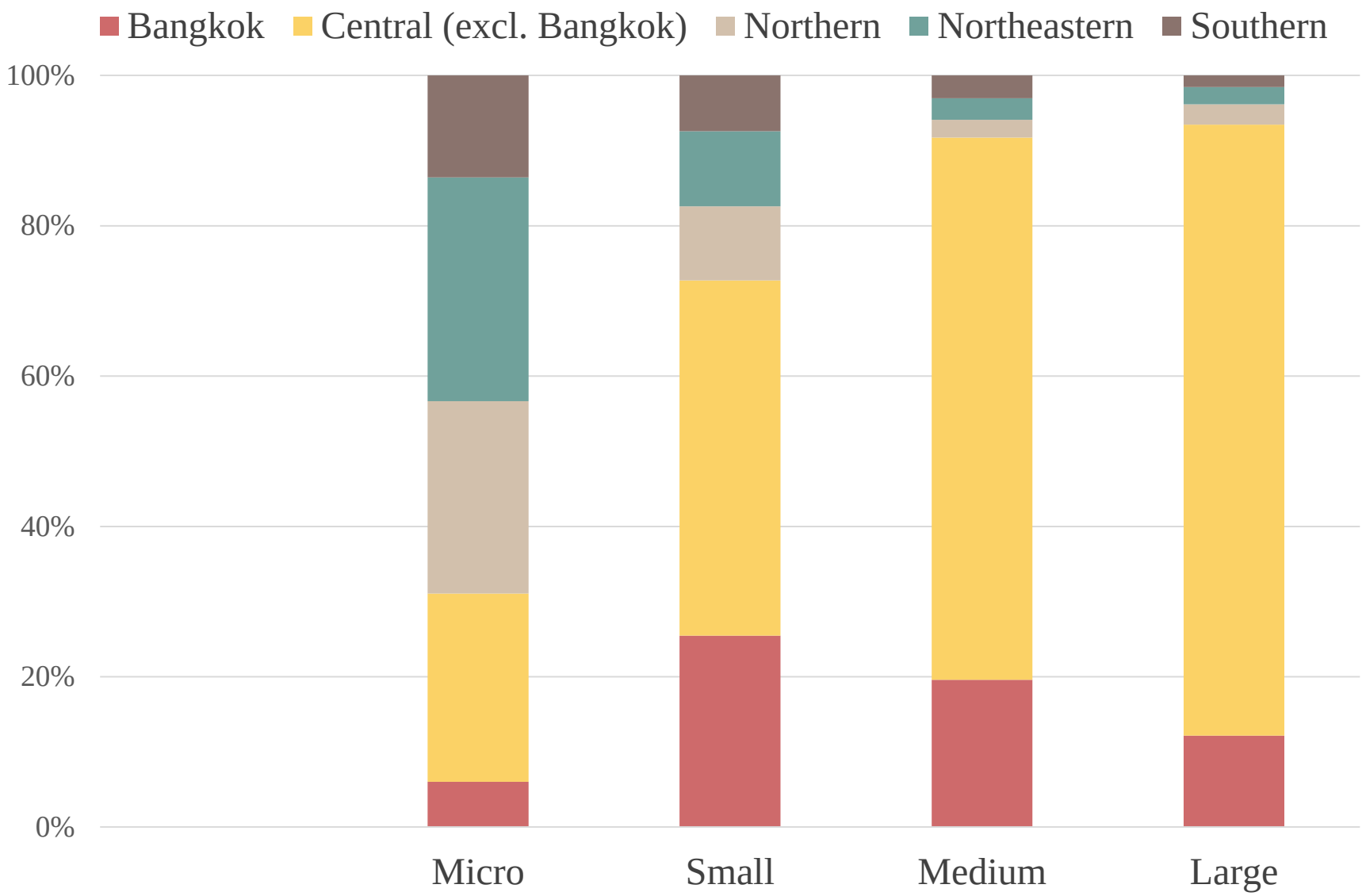
Number of Observations by Firm Size



Number of Observations by Legal Organization Type

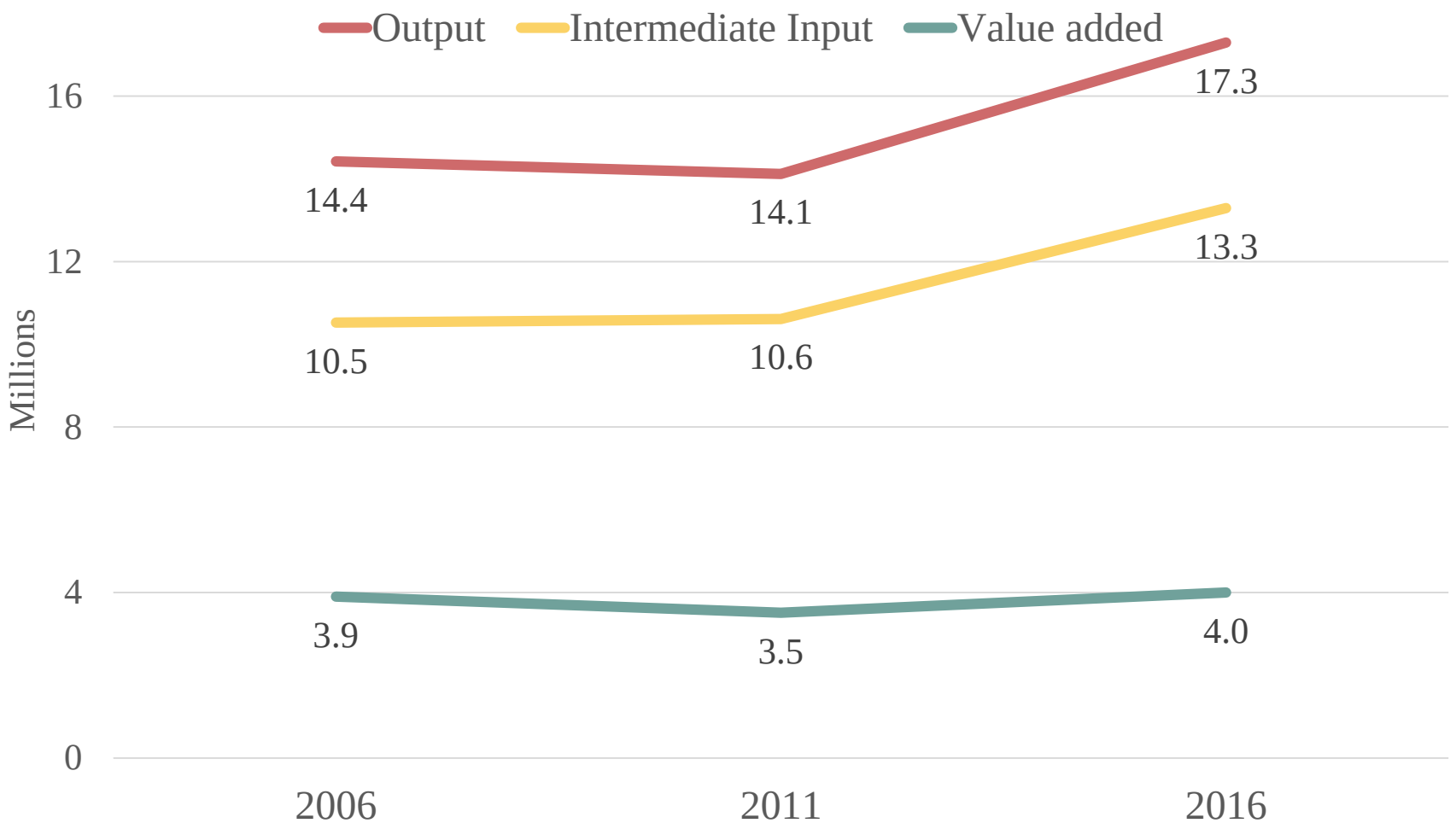


Number of Observations by Size and Region



SUMMARY STATISTICS

Weighted Average Output, Intermediate Input, and Value Added



METHODOLOGY

TFP Estimation

Levinsohn and Petrin (2003)
approach to control for the endogeneity problem: firms respond to productivity shocks by adjusting input and output levels

Feature Selection

Random forest feature importance
method to evaluate the importance/relevance of each feature on TFP level classification task

Empirical Relation

OLS
to estimate the parameters of variables selected based on the result of the previous stage

TFP Estimation

Levinsohn and Petrin (2003) approach to control for the endogeneity problem: firms respond to productivity shocks by adjusting input and output levels

Cobb-Douglas production function for firm *i* in industry *d* at time *t*:

productivity shocks

$$y_{it} = \beta_0^d + \beta_l^d l_{it} + \beta_k^d k_{it} + \omega_{it} + \xi_{it}$$

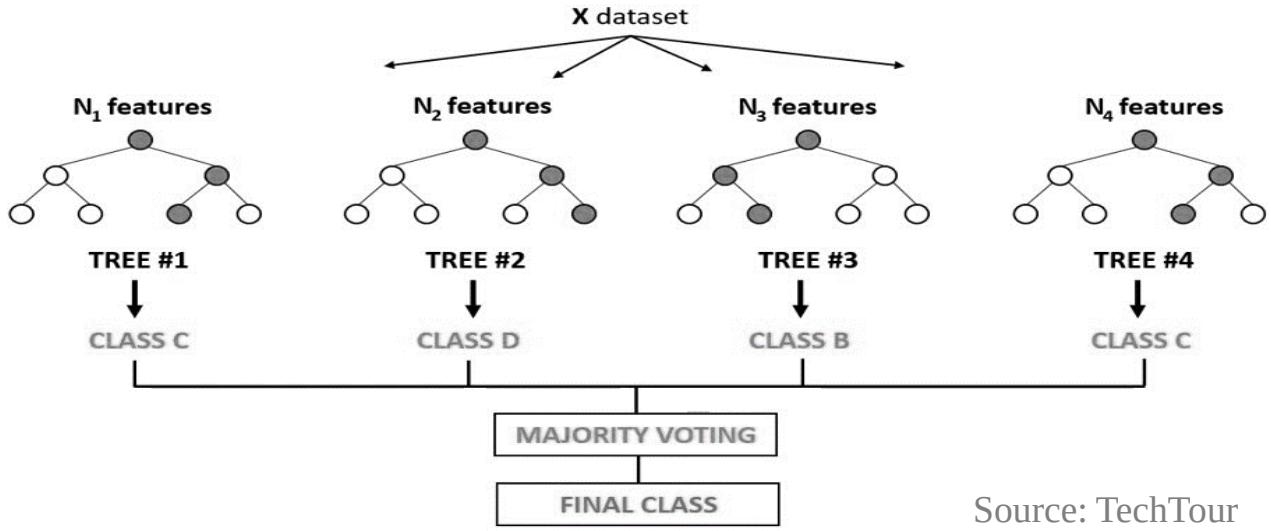
- y_{it}: value added
- l_{it}: number of workers
- k_{it}: capital
- ω_{it}: unobservable, has impact on decision rules
- ξ_{it}: i.i.d., does not affect firm decisions

Key Assumption

Firm adjusts an optimal level of intermediate inputs according to $m_{it} = m_{it}(\omega_{it}, k_{it})$ where m_{it} is monotonically increasing in ω_{it}.

Feature Selection

Random forest feature importance method to evaluate the importance/relevance of each feature on TFP level classification task



Source: TechTour

Task is to predict which quartile each firm's TFP falls into.

Compute feature importance from the random forest using 2 methods:

01 MDI
Mean Decrease in Impurity

Total decline in node Gini impurity, weighted by the probability of reaching that node, averaged over all trees of the ensemble where $Gini = 1 - \sum_c (p_c)^2$

02 MDA
Mean Decrease in Accuracy

The decrease in prediction accuracy, averaged over all trees, as a result of the values for the feature of interest being randomly permuted in the out-of-bag samples

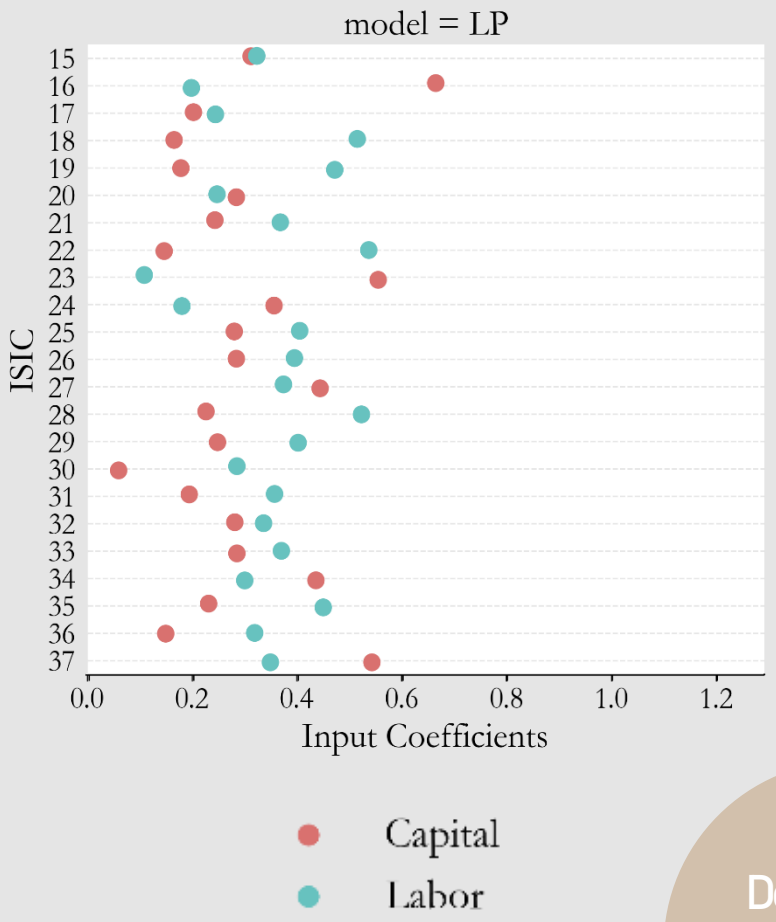
Empirical Relation

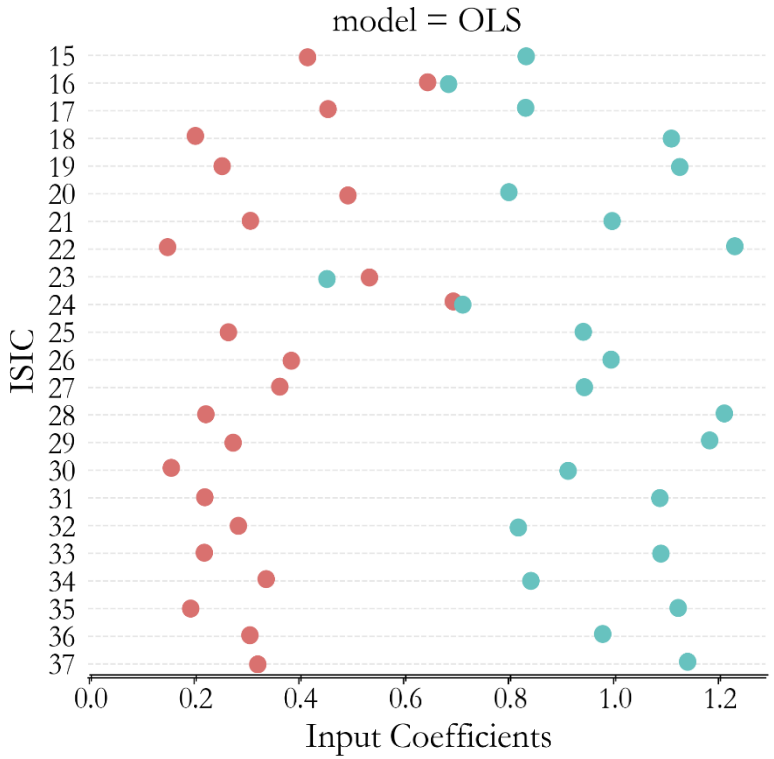
OLS
to estimate the parameters of variables selected based on the result of the previous stage

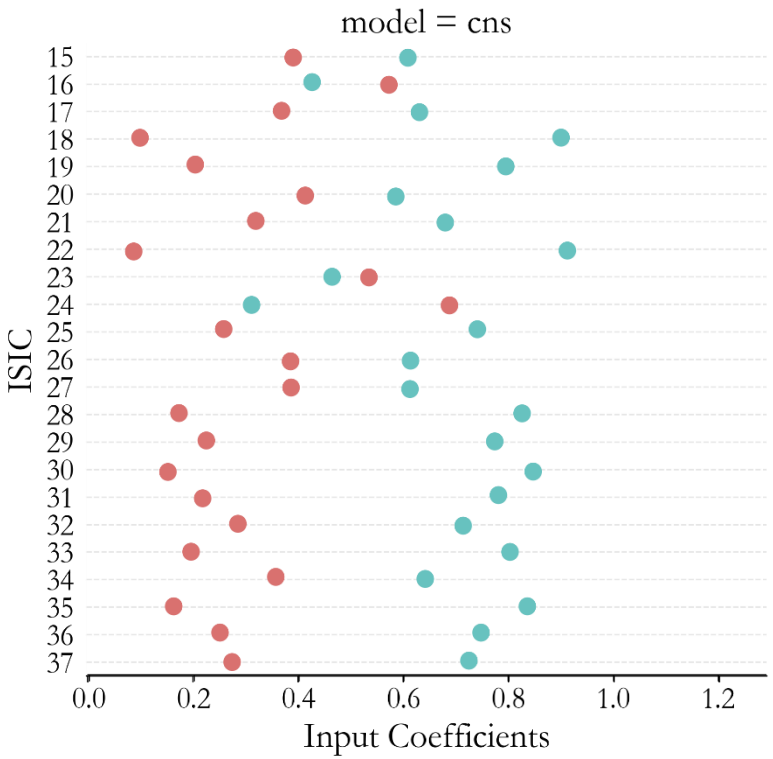
$$TFP_{it} = \alpha + \Theta X_{it} + \Psi H_i + \lambda t + u_{it}$$

where TFP_{it} is of firm *i* at time *t*, X is a vector of variables of interest, and H and t are to control for firm characteristics and year surveyed, respectively.

Output Elasticities by Industry



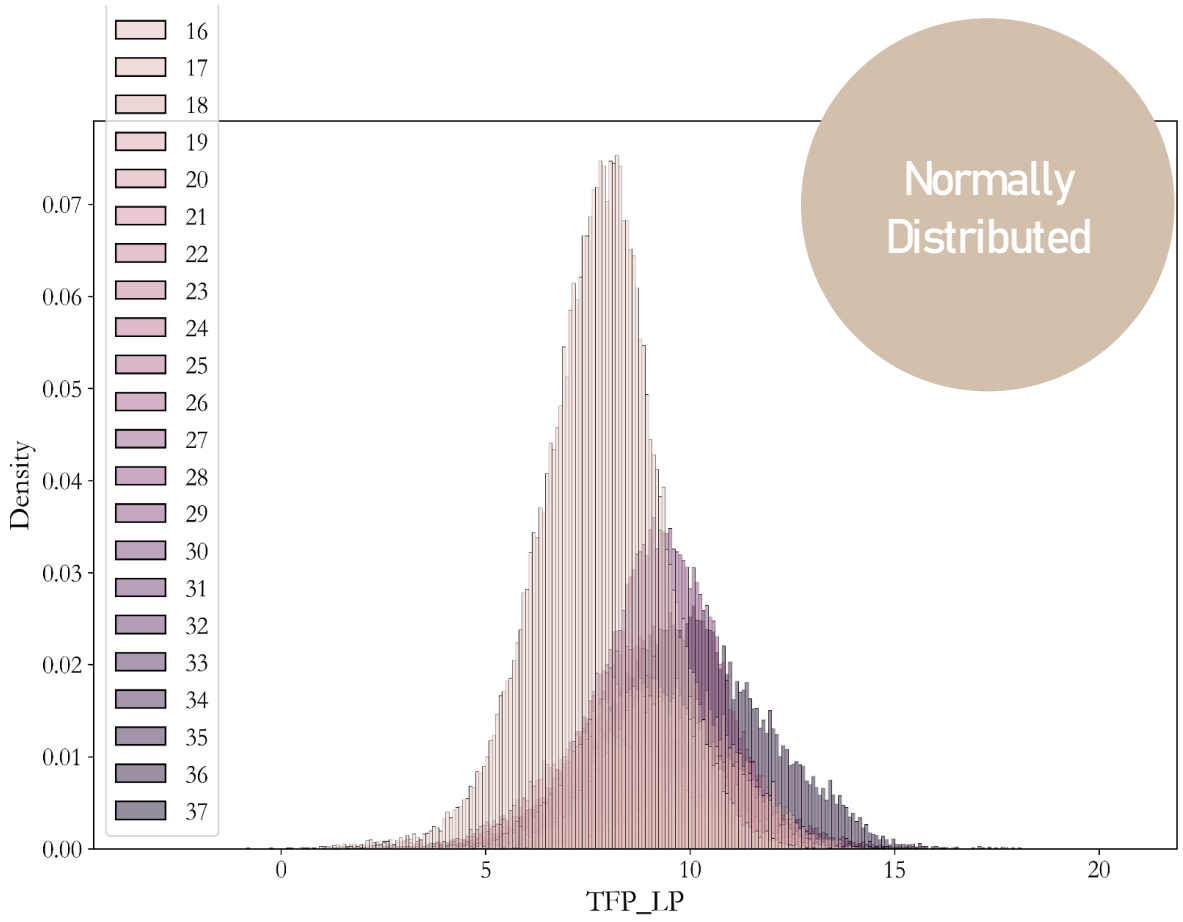




Decreasing returns to scale

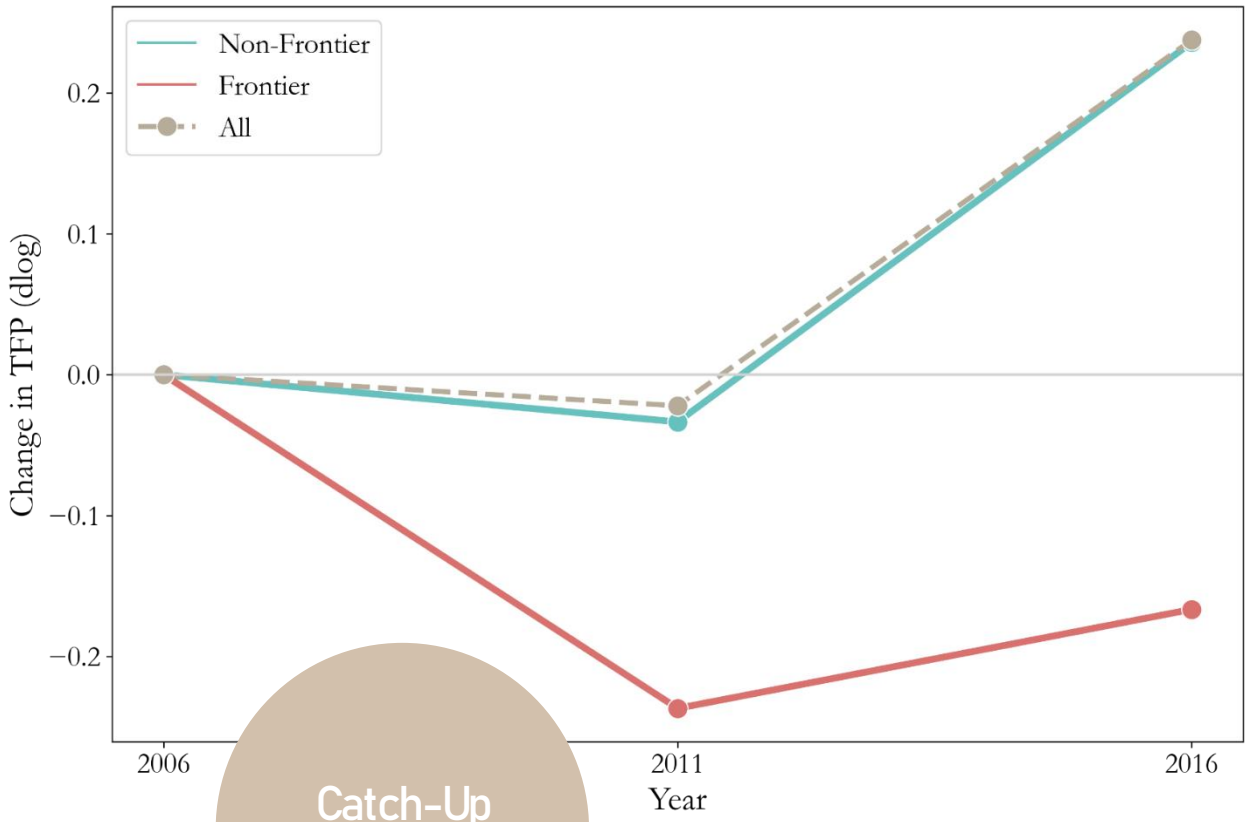
RESULTS

Estimated TFP Distribution by Industry



Normally Distributed

Change in TFP during 2006-16 (base year 2006)



Catch-Up Effect

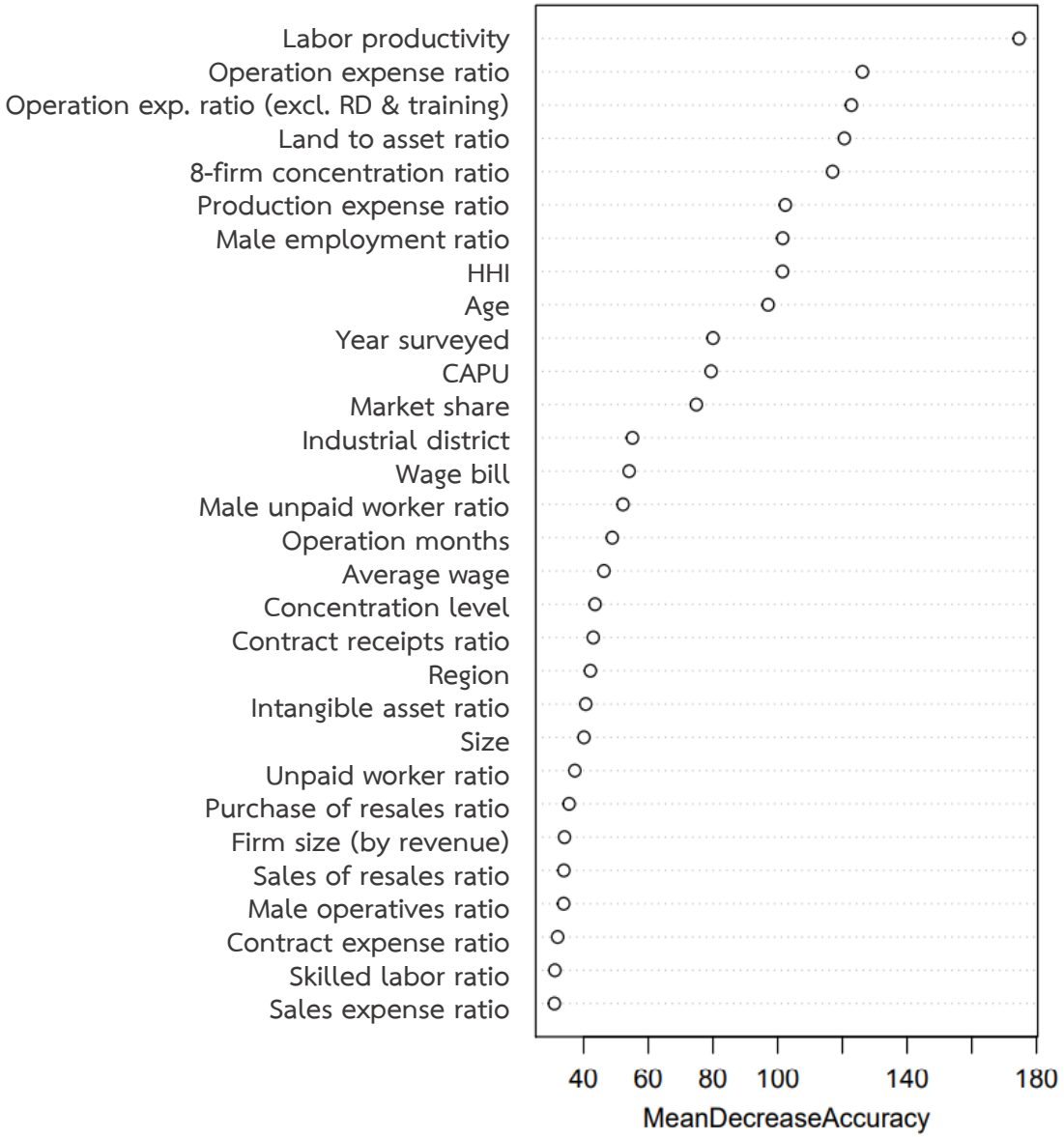
BOTTOM 5 least productive industries

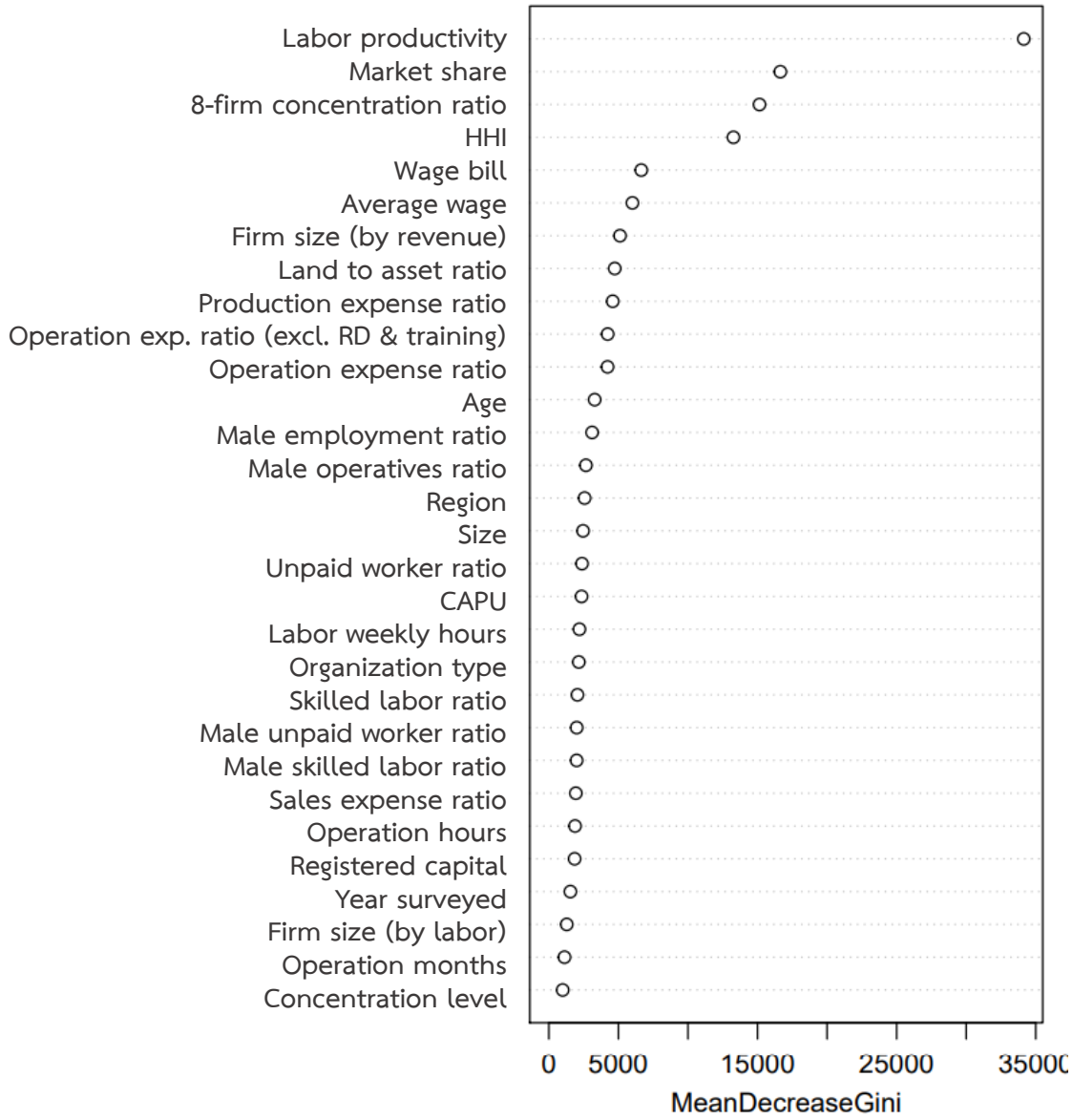
- 01 Tobacco Products (ISIC 16)
- 02 Recycling (ISIC 37)
- 03 Petroleum & Coal (ISIC 23)
- 04 Primary Metal (ISIC 27)
- 05 Food & Kindred Products (ISIC 15)

TOP 5 most productive industries

- 01 Office, Accounting, and Computing Machinery (ISIC 30)
- 02 Electronics (ISIC 31)
- 03 Printing & Publishing (ISIC 22)
- 04 TV & Communication Equipment (ISIC 32)
- 05 Furniture (ISIC 36)

Feature Importance From Random Forest





What is associated with firm productivity level ?

Industry Competition

measured as market shares, 8-firm concentration ratio, HHI, and concentration level

Workforce Demographics

such as proportion of male employees and labor quality (e.g. average wage, proportion of skilled workers)

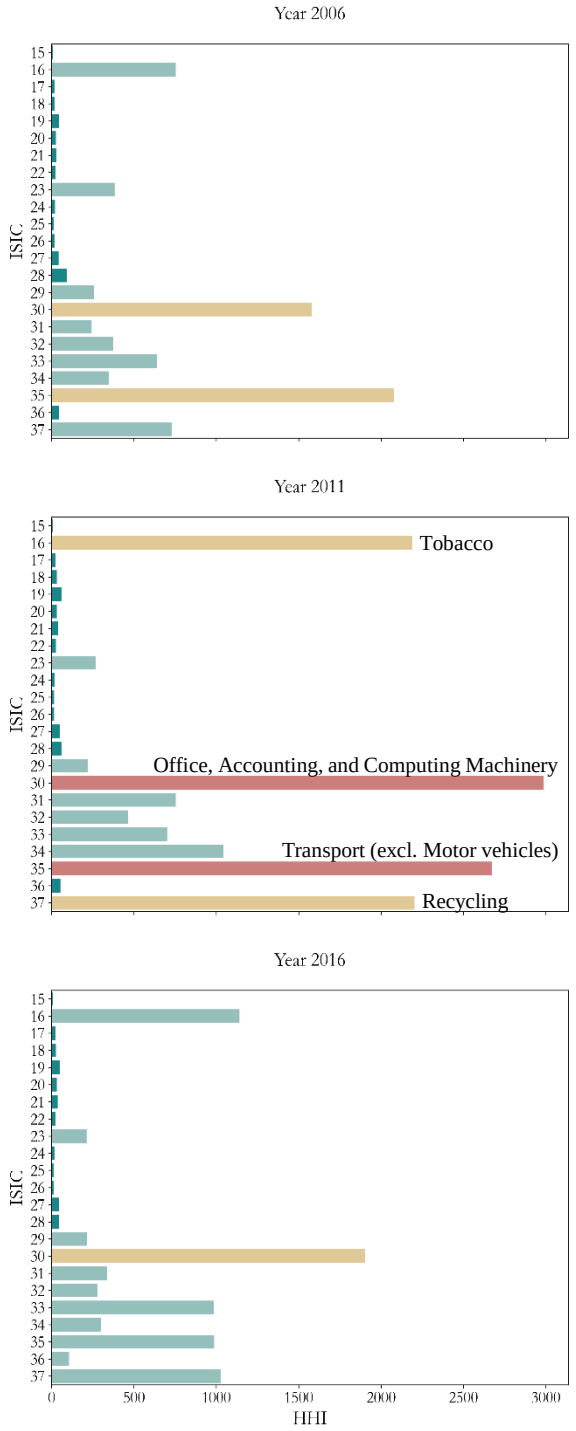
Financial & Asset Management

proxies: proportion of expenditures on production, administration, and operation; land to total fixed asset ratio

RESULTS

Industry Competition

highly competitive
unconcentrated
moderately concentrated
highly concentrated



average wage
skilled workers
male employees
unpaid workers

Workforce Demographics

2006

฿ 22,542	51.9%
♂ 48.8%	16.9%

2011

฿ 24,572	51.4%
♂ 49.6%	16.6%

2016

฿ 28,237	51.2%
♂ 50.3%	16.9%

RESULTS

Dependent variable: TFP

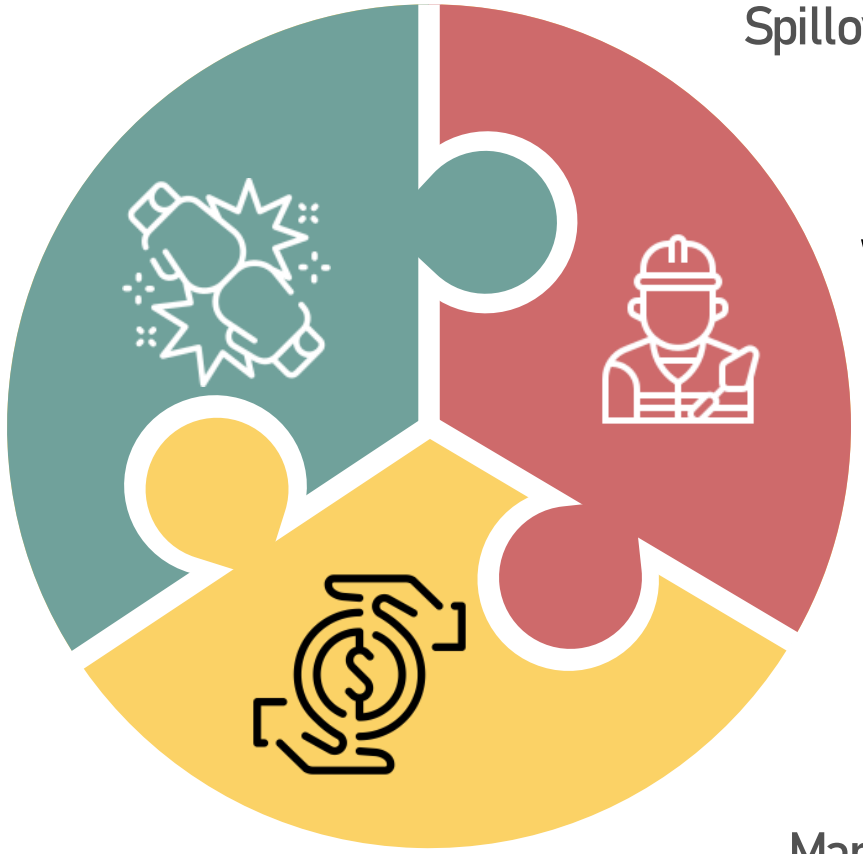
Base

Category	Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry Competition	CR8	-0.294***	-0.285***	-0.293***	-0.294***	-0.733***	-0.277***	-0.281***
	Industry Leader	1.037***	1.046***	1.038***	1.036***	1.366***	1.033***	1.040***
	CR8 x Industry Leader	0.007	-0.023	0.003	0.006	-0.438	0.010	-0.003
	Exporter		0.121***					
	FDI recipient			0.023				
	R&D spending				0.007*			
Workforce Demographics	Average wage (log)	0.556***	0.553***	0.556***	0.556***		0.557***	0.555***
	Expenditure on training					-0.040***		
	L5 expenditure on training					0.041***		
	Proportion of skilled workers						-0.001***	
Management	Land to fixed asset ratio	-0.004***	-0.004***	-0.004***	-0.004***	-0.005***	-0.004***	-0.004***
	OPEX to intermed input ratio	-0.001***	-0.001***	-0.001***	-0.001***	-0.003***	-0.001***	-0.001***
	BOI beneficiary							0.067***
	Observations	150,645	150,645	150,645	150,645	32,766	150,645	150,645
	Adjusted R-Squared	0.741	0.741	0.741	0.741	0.704	0.741	0.741

*** p<0.01, ** p<0.05, * p<0.1

Control for regions, ISIC, firm size, and census year

POLICY IMPLICATIONS



Knowledge Spillovers[4]

Skills Shortages[5]

Skills Mismatch[7]

Product-Market Reforms[1]

Industry Competition

Concentration[3]

Market Size[2]

Workforce Demographics

Upskill & Reskill

Labor Market Institutions[6]

Exposure to International Markets[3]

Labor Mobility

Human Capital

Innovation

Management Techniques[8]

Financial & Asset Management

No "One Size Fits All"[10]

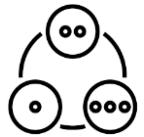
Management Consulting[9]

[1] Ospina and Schiffbauer (2010)
[2] Ding (2019)
[3] Rodriguez-Castelan et al. (2020)
[4] Kirker and Sanderson (2018)
[5] Morris et al. (2019) and Vandeplas and Thum-Thysen (2019)
[6] Henrekson (2020)
[7] Adalet and Andrews(2015a) and Vandeplas and Thum-Thysen (2019)
[8] Bloom et al. (2019), van Reenen (2018), Scur (2019), and McKinsey (2006)
[9] Bloom et al. (2013)
[10] Wall and Wood (2005)

FUTURE WORK

Explore other potential proxies for managerial quality

Continue an extensive work on the effects of managerial practices on productivity



Study the dynamics between the 3 key factors and identify a robust causal relationship

Conduct further research on knowledge spillovers and productivity

THANK YOU

Appendix

List of International Standard Industrial Classication (ISIC) Codes in Manufacturing Division

ISIC Code	Abbreviation	Industry Full Title
15	Food	Food and Kindred Products
16	Tobacco	Tobacco Products
17	Textile Mill	Textile Mill Products
18	Apparel	Apparel and Other Textile Products
19	Leather	Leather and Leather Products
20	Wood & Straw	Lumber and Wood Products, Except Furniture; Articles of Straw and Plaiting Materials
21	Paper	Paper and Allied Products
22	Print. & Publish.	Printing and Publishing
23	Petroleum & Coal	Refined Petroleum and Coal Products
24	Chemicals	Chemicals and Allied Products
25	Rubber & Plastics	Rubber and Miscellaneous Plastics Products
26	SCG	Stone, Clay, and Glass products
27	Primary Metal	Primary Metal Industries
28	Fabric. Metal	Fabricated Metal Products, except machinery and transport equipment
29	Industrial Mach.	Industrial Machinery and Equipment
30	OAC Mach.	Office, Accounting and Computing machinery
31	Electronics	Electronic and Other Electric Equipment n.e.c.
32	TV & Comm. Eqpt.	Radio, Television and Communication Equipment and Apparatus
33	MPO Inst.	Medical, Precision and Optical Instruments; Watches and Clocks
34	Motor Vehicles	Motor Vehicles, Trailers and Semi-Trailers
35	Other Trans. Eqpt.	Other Transportation Equipment
36	Furniture	Furniture and Fixtures
37	Recycling	Recycling