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ENTREPRENEURSHIP, FIRM DYNAMICS, AND NEW TECHNOLOGIES

R&D Activities in Thailand: Survey of Firm-Level Data Analyses

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Main Topics

(1) The survey of Thailand's firm-level data

(2) An overview of empirical studies using firm-level data

(3) The R&D behavior of Thai firms

(4) The future studies and developments

(1) The survey of Thailand's firm-level data

(1) The survey of Thailand's firm-level data

Publisher/Owner	Frequency	Period of Coverage	No. of samples	Financial Statements	Operational Statistics	Accessibility
The Stock Exchange of Thailand (SET)	Quarterly		722	Yes	N/A	Publicly available and purchasing (for the full historical data set)
Industrial Census - National Statistics Office (NSO)	Every 10 years	1997,2007	73,931	Yes	Yes	Purchasing
Manufacturing Industry Survey - National Statistics Office (NSO) Surveys		1999, 2000, 2001, 2003	18,078	Yes	Yes	Purchasing
Industrial Survey – Ministry of Industry	Annual		1,144	Yes	Yes	Case-by-case approval
Corporate Profile Financial Statement (CPFS) database – Ministry of Commerce	Annual	2001 - Current	142,872 (2001) - 227,866 (2013)	Yes	N/A	Purchasing
Board of Investment (BOI)	Annual	2004 - Current	1,496 (2004) - 3,460 (2015)	Yes	Yes	Confidential

(2) An overview of empirical studies using firm-level data

(2) Overview of empirical studies using firm-level data

External factors

- Tax
- Credit constraint
- Trade policy / market access
- Production network / Global Value Chain

Internal factors

Individual characteristics

- Size, age, location
- Foreign ownership
- Market orientation
- Human capita

Individual behaviors

- Capital structure
- Investment (capital formation)
- Corporate governance
- R & D

Firm's performance

External factors

(1) Tax

- Gemmell (2013) used **OECD firm-level data**, showing that firms with higher corporate profits but in regimes involving **higher corporate tax rates** are expected to have **lower TFP**.
- Muthitacharoen (2016) has showed that in the case of Thailand, an **accelerated depreciation** and **investment tax allowance** are two options that **may perform better than the tax holiday** (note: the firm-level data have not been used).

(2) Credit constraint

- Limjaroenrat (2016) used the firm-level data of Corporate Profile Financial Statement (CPFS) database – Ministry of Commerce. Her work has identified that the **low investment of small firms** was caused by **limitation to access credit**.

External factors

(3) Trade Policy

- Kohpaiboon and Jongwanich (2013) used Industrial Survey of 2007. Their work has indicated that **trade policy regime** can **conditionally gain the horizontal spillovers of FDI**.

(4) Production Network / Global Value Chain

- Puttanapong (2016) used Industrial Survey of 2007 and the combination of Trade in Value Added indicators. The econometrical result has showed that **the higher degree of participation in Global Value Chain gained the productivity.**

Internal factors

(1) Individual characteristics

- Srithanpong (2016) used firm-level panel data from the Manufacturing Industry Survey between 1999 and 2003. His panel regression has indicated that the **size, human capita, foreign ownership and export orientation** have a **positive impact on TFP**, while the age of firm has the adverse effect.

(2) Individual behaviors

Capital structure

- Chancharat (2015) utilized the balanced panel data of listed companies covering the period of 2009 - 2011. Her study has identified that the **higher degree of leverage** has **a significantly negative impact** on corporate **financial performance**.

Internal factors

(2) Individual behaviors

Corporate Governance

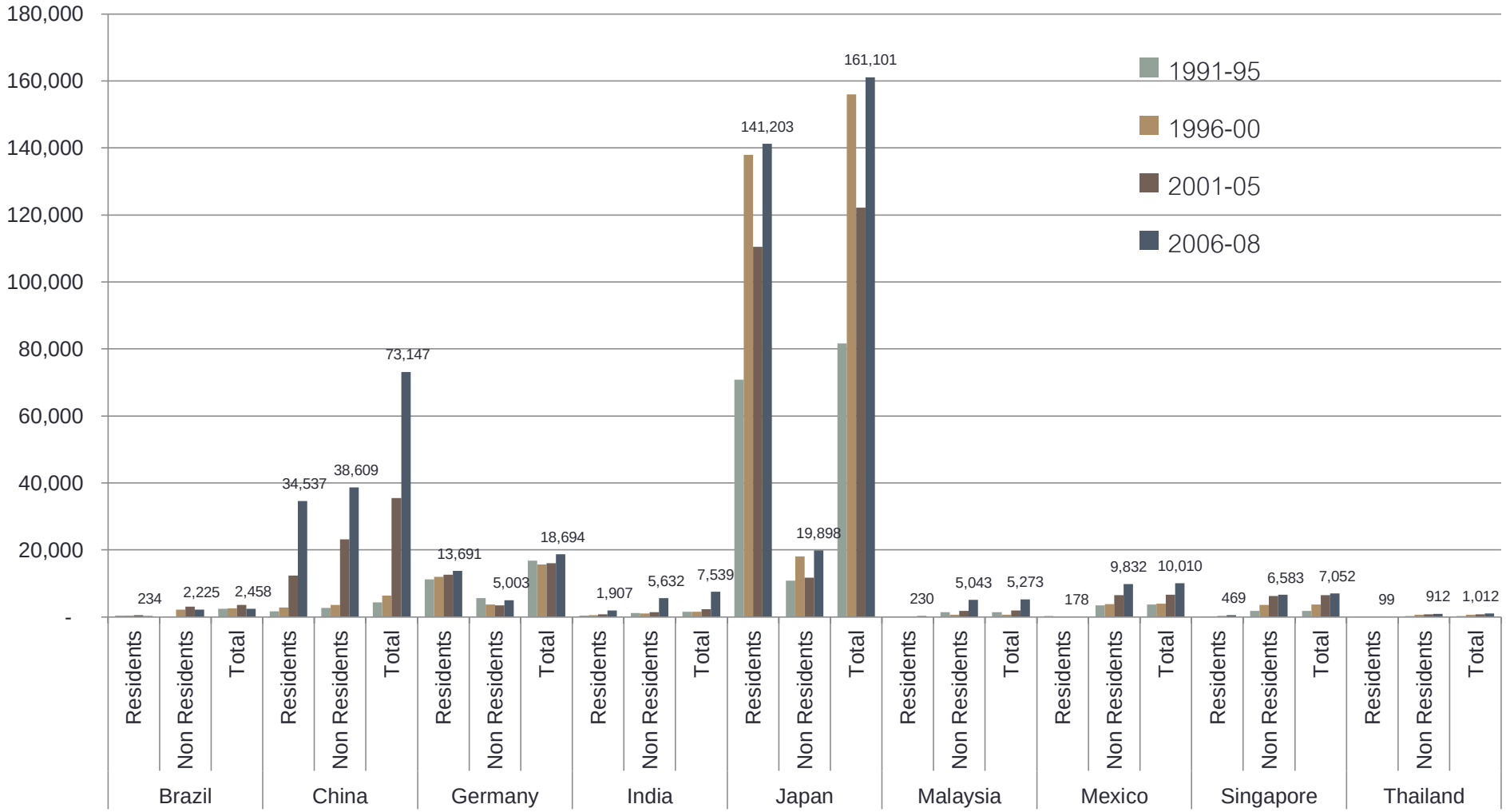
- Connelly et al. (2012) has showed that the **quality of corporate governance** practices, as based on the measure introduced in this study, are **positively correlated to the firm value**.

R&D

- Berger (2010), Jongwanich and Kohpaiboon (2011), Srithanpong (2013), Suvanvihok (2015) applied the similar econometrical techniques to the firm-level data in order to examine conditions that influenced firms to conduct R&D, and also identified factors determining their R&D budgets. These studies have found that the **size**, the **industrial sector** and the **affiliation with other innovation-driven companies** are **key determinants**.

(3) The R&D behavior of Thai firms

Patent grants by patent office, broken down by resident and non-resident



Source: Jongwanich and Kohpaiboon (2015)

Low R&D investment in Thailand

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Public R&D (million baht)	8,202	8,138	9,571	10,548	9,988	11,550	10,015	11,887	12,737
Private R&D (million baht)	5,284	5,164	5,928	6,023	6,679	7,998	8,210	7,278	8,174
Total R&D (million baht)	13,486	13,302	15,499	16,571	16,667	19,548	18,225	19,165	20,911
R&D/GDP (%)	**0.25**	**0.24**	**0.26**	**0.25**	**0.24**	**0.25**	**0.21**	**0.21**	**0.23**

Source: Srithanpong (2015) and Thailand's Ministry of Science and Technology

R&D behavior of Thai firms

- Jongwanich and Kohpaiboon (2015), Srithanpong (2013), and Suvanvihok (2015) applied **the CDM (Crépon, Duguet, and Mairesse) model**, originally introduced in Crépon et al. (1998), to the firm-level data.
- Griffith et al. (2006) applied the CDM to OECD's data to examine R&D behavior in France, Germany, Spain, and the United Kingdom.
- Lee (2008) and Crespi and Zuniga (2012) utilized the CDM model to study the behavior in the cases of Malaysia and Latin American countries, respectively.

Empirical model

The CDM (Crépon, Duguet, and Mairesse) model was developed to examine **two main questions** regarding R&D activities (Crépon et al. (1998)), and this method has been widely used in this field.

What makes the firm to conduct R&D?

Probit model

What determines the size of R&D expenditure?

OLS or IV Regression

Paper #1: Multinational Enterprises, Exporting and R&D Activities in the South

Jongwanich and Kohpaiboon (2015)

Source: Jongwanich J. and A. Kohpaiboon (2015) 'Multinational Enterprises, Exporting and R&D Activities in the South', *Thammasat Economic Journal*, 33: 2, 1-54

Paper #1: Empirical model

There are **three alternatives of R&D investment**, i.e. the dependent variable, in this study, namely R&D leading to improved production technology (RDTech), R&D leading to product development (product innovation) (RDProduct) and R&D leading to improved wasting management system (process innovation) (RDProcess).

$$RDTech_{ij} = f\left(\begin{matrix} MNE_{ij},\ Ex_{ij},\ Size_{ij},\ Size_{ij}^2,\ Age_{ij},\ Age_{ij}^2,\ PROD_{ij},\ KL_{ij},\ BOI_{ij},\ region_{ij},\ Network_j, \\ D_j,\ MNE \times D_j \end{matrix}\right) \quad (1.1)$$

$$RDTechEx_{ij} = f\left(\begin{matrix} MNE_{ij},\ Ex_{ij},\ Size_{ij},\ Size_{ij}^2,\ Age_{ij},\ Age_{ij}^2,\ PROD_{ij},\ KL_{ij},\ region_{ij},\ Network_j, \\ D_j,\ MNE \times D_j \end{matrix}\right) \quad (1.2)$$

$$RDProduct_{ij} = f\left(\begin{matrix} MNE_{ij},\ Ex_{ij},\ Size_{ij},\ Size_{ij}^2,\ Age_{ij},\ Age_{ij}^2,\ PROD_{ij},\ KL_{ij},\ BOI_{ij},\ region_{ij},\ Network_j, \\ D_j,\ MNE \times D_j \end{matrix}\right) \quad (2.1)$$

$$RDProductEx_{ij} = f\left(\begin{matrix} MNE_{ij},\ Ex_{ij},\ Size_{ij},\ Size_{ij}^2,\ Age_{ij},\ Age_{ij}^2,\ PROD_{ij},\ KL_{ij},\ region_{ij},\ Network_j, \\ D_j,\ MNE \times D_j \end{matrix}\right) \quad (2.2)$$

$$RDProcess_{ij} = f\left(\begin{matrix} MNE_{ij},\ Ex_{ij},\ Size_{ij},\ Size_{ij}^2,\ Age_{ij},\ Age_{ij}^2,\ PROD_{ij},\ KL_{ij},\ BOI_{ij},\ region_{ij},\ Network_j, \\ D_j,\ MNE \times D_j \end{matrix}\right) \quad (3.1)$$

$$RDProcessEx_{ij} = f\left(\begin{matrix} MNE_{ij},\ Ex_{ij},\ Size_{ij},\ Size_{ij}^2,\ Age_{ij},\ Age_{ij}^2,\ PROD_{ij},\ KL_{ij},\ region_{ij},\ Network_j, \\ D_j,\ MNE \times D_j \end{matrix}\right) \quad (3.2)$$

Source: Jongwanich and Kohpaiboon (2015)

Paper #1: Empirical model

- To estimate a firm's R&D expenditure (equation 1.2; 2.2; 3.2) , the sample selection model is applied since the dependent variable (i.e. R&D expenditure) is observed only a firm makes a decision to invest in R&D (i.e. this could be observed only for a restricted, nonrandom sample).
- There are **two key equations** in the model. The first equation (equation (4)) explains whether an observation is in the sample or not (i.e. **in order to statistically examine factors that influence firms to do R&D**).

$$Z_i^* = w_i^* \alpha + e_i \qquad (4)$$

$$\left.\begin{aligned} Z_i = 0 \quad if \quad Z_i^* \le 0 \\ Z_i = 1 \quad if \quad Z_i^* > 0 \end{aligned}\right\}$$

Source: Jongwanich and Kohpaiboon (2015)

Paper #1: Empirical model (continued)

The second equation (equation (5)) determines the value of Y. Note that Y is the outcome variable, which is only observed when a variable Z is positive (i.e. **in order to quantify the equation explaining the size of R&D budget**).

$$Y_i^* = x_i'\beta + \mu_i \qquad (5)$$

$$\left.\begin{array}{l} Y_i = Y_i^* \quad if \quad Z_i = 1 \\ Y_i \text{ not observed} \quad if \quad Z_i = 0 \end{array}\right\}$$

Source: Jongwanich and Kohpaiboon (2015)

Paper #1: Empirical model (continued)

$RDTech_{ij}$ = Decision of firm i in industry j to invest in R&D improved technology

$RDTechEx_{ij}$ = R&D expenditure of firm i in industry j in improving production technology (% of total sales)

$RDProduct_{ij}$ = Decision of firm i in industry j to invest in R&D product development

$RDProductEx_{ij}$ = R&D expenditure of firm i in industry j in product development (% of total sales)

$RDProcess_{ij}$ = Decision of firm i in industry j to invest in R&D (process innovation)

$RDProcessEx_{ij}$ = R&D expenditure of firm i in industry j in process innovation (% of total sales)

MNE_{ij} = Proportion of foreign share holding of firm i in industry j

Ex_{ij} = Propensity to exports of firm i in industry j

$Size_{ij}$ = Size of firm i in industry j

Age_{ij} = years ofoperation of firm i in industry j

$PROD_{ij}$ = Productivity of firm i in industry j

KL_{ij} = Capital-labor ratio of firm i in industry j

BOI_{ij} = Investment (R&D) promotion from Board of Investment (BOI) of firm i in industry j

$region_{ij}$ = Location of plant of firm i in industry j

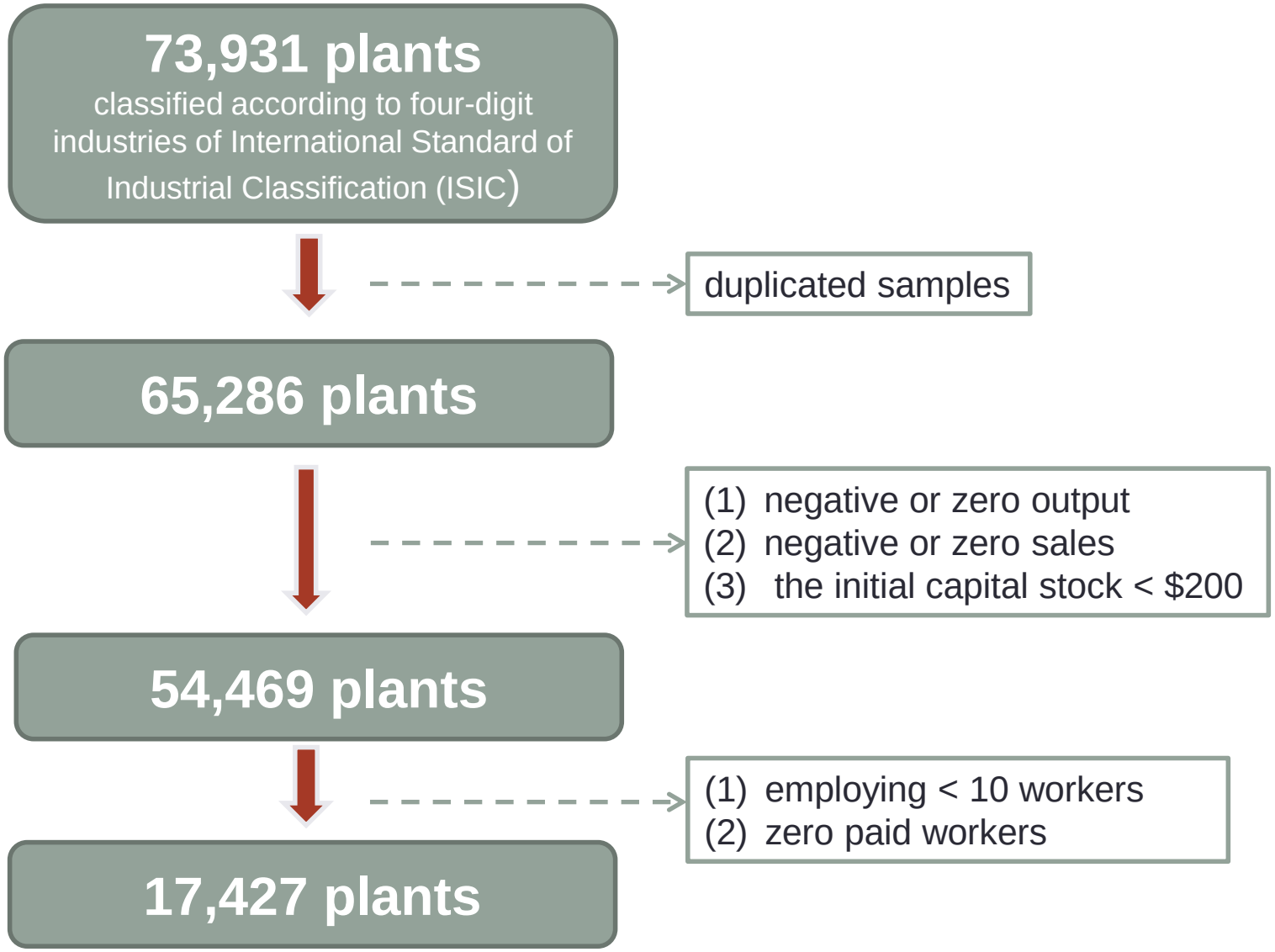
$Network_j$ = Proportion of parts and components exports in industry j

D_j = Duummy variable for industry j

$MNE_{ij} \times D_j$ = Interaction term between MNE and industry dummy variable

Source: Jongwanich and Kohpaiboon (2015)

Paper #1: Data cleaning process



Source: Jongwanich and Kohpaiboon (2015)

Estimation results: (1) R&D leading to improved production technology

	Column A **(eq. 1.1)** A firm's decision to invest in R&D		Column B **(eq. 1.2)** R&D intensity (% of sales)	
	Coefficient	T-statistics	Coefficient	T-statistics
Intercept	-12.37	-9.80*	-3.16	-1.32
MNE_{ij}	-11.13	-1.60**	-4.15	-0.24
Ex_{ij}	0.90	1.36	0.08	0.10
Age_{ij}	0.07	2.72*	0.07	1.14
$Age_{ij}^{\wedge 2}$	-	-	-	-
$PROD_{ij}$	-0.08	-3.53*	0.003	0.07
$Size_{ij}$	0.99	7.51*	0.43	1.79**
$Size_{ij}^{\wedge 2}$	-0.02	-5.90*	-0.01	-1.99*
KL_{ij}	0.07	4.67*	-0.006	-0.12
BOI_{ii}	-0.09	-0.31	-	-
$region_{ij}$	0.02	0.41	0.14	1.62**
$Network_{j}$	0.43	2.30*	1.14	2.78*
MNE_{ij}×Auto dummy	12.76	0.80	31.09	1.60**
MNE_{ij}×Hard disk dummy	1.96	0.09	92.38	2.63*
Inversed mill ratio	-	-	-0.40	-0.30
D_j	Included		Included	
No. of obs	17,427		1018	

Source: Jongwanich and Kohpaiboon (2015)

Note:

(1) Column A is estimated by IVProbit model using concentration ratio as the instrument for exports and Column B is estimated by 2SLS and sample-selection model. Logarithm is used for Age; Size; KL while the ratio is applied for MNE (the share of foreign firms); EX (the share of exports to total sales); and Network (the share of trade in parts and components to total trade).

(2) *, **, and *** indicate the significant level at 5, 10 and 15%, respectively

(3) Industrial dummy variables are included (according to ISIC) in included in the estimation.

Estimation results: (2) R&D leading to product development (product innovation)

	Column A (eq. 2.1) A firm's decision to invest in R&D		Column B (eq. 2.2) R&D intensity (% of sales)	
	Coefficient	T-statistics	Coefficient	T-statistics
Intercept	-11.53	-9.34*	-2.43	-1.12
MNE_{ij}	-16.44	-2.57*	7.44	0.52
Ex_{ij}	1.90	3.35*	-0.55	-0.79
Age_{ij}	0.12	4.87*	-0.02	-0.33
$Age_{ij}^{\wedge 2}$	-	-	-	-
$PROD_{ij}$	-0.09	-4.10*	0.08	2.11*
$Size_{ij}$	0.99	7.89*	0.39	1.64**
$Size_{ij}^{\wedge 2}$	-0.02	-6.37	-0.01	-1.88**
KL_{ij}	0.04	3.21*	0.05	2.01*
BOI_{ij}	-0.60	-2.29*	-	-
$region_{ij}$	0.26	5.22	0.41	3.50*
$Network_j$	0.52	2.92*	0.52	1.54***
MNE_{ij}×Auto dummy	-8.84	-0.53	53.59	2.12*
MNE_{ij}×Hard disk dummy	9.96	0.49	94.67	2.40*
Inversed mill ratio	-	-	0.14	0.52
D_j	Included		Included	
No. of obs	17,427		1191	

Note:
(1) Column A is estimated by IVProbit model using concentration ratio as the instrument for exports and Column B is estimated by 2SLS and sample-selection model. Logarithm is used for Age; Size; KL while the ratio is applied for MNE (the share of foreign firms); EX (the share of exports to total sales); and Network (the share of trade in parts and components to total trade).

(2) *, **, and *** indicate the significant level at 5, 10 and 15%, respectively.

(3) Industrial dummy variables are included (according to ISIC) in included in the estimation.

Source: Jongwanich and Kohpaiboon (2015)

Estimation results: (2) R&D leading to improved wasting management system (process innovation)

	Column A (eq. 3.1) A firm's decision to invest in R&D		Column B (eq. 3.2) R&D intensity (% of sales)	
	Coefficient	T-statistics	Coefficient	T-statistics
Intercept	-11.54	-8.35*	-0.30	-0.11
MNE_{ij}	-9.69	-1.25	11.89	0.83
Ex_{ij}	0.34	0.47	-0.56	-1.00
Age_{ij}	0.35	2.47*	0.10	0.37
$Age_{ij}^{\wedge 2}$	-0.04	-1.52***	-0.03	-0.52
$PROD_{ij}$	-0.12	-4.40*	0.07	1.46***
$Size_{ij}$	0.88	6.03*	0.12	0.43
$Size_{ij}^{\wedge 2}$	-0.02	-4.38*	-0.008	-1.01
KL_{ij}	0.05	3.04*	-0.04	-1.14
BOI_{ij}	-0.009	-0.03	-	-
$region_{ij}$	0.13	2.25*	0.26	2.05*
$Network_j$	0.04	0.17	0.63	1.77**
MNE_{ij}×Auto dummy	16.65	0.96	57.39	2.52*
MNE_{ij}×Hard disk dummy	-36.99	-1.29	-1.00	-0.02
Inversed mill ratio	-	-	1.82	2.20*
D_j	Included		Included	
No. of obs	17,473		748	

Note:

(1) Column A is estimated by IVProbit model using concentration ratio as the instrument for exports and Column B is estimated by 2SLS and sample-selection model. Logarithm is used for Age; Size; KL while the ratio is applied for MNE (the share of foreign firms); EX (the share of exports to total sales); and Network (the share of trade in parts and components to total trade).

(2) *, **, and *** indicate the significant level at 5, 10 and 15%, respectively.

(3) Industrial dummy variables are included (according to ISIC) in included in the estimation.

Source: Jongwanich and Kohpaiboon (2015)

Paper #2: Technological Investment of Thai Industries and Government Supports

Suvanvihok (2015)

Source: Suvanvihok V.(2015) 'Technological Investment of Thai Industries and Government Supports', *NIDA Economic Review*, 9:1, 74-98

Paper #2: Data

- This study investigates the behavior of Thai industries' R&D and innovation (RDI) activities, the technological investment, using the institutional framework in analyses.
- The econometrical analysis uses **the firm-level data from Thailand R&D and Innovation activities survey** in Industrial sector **2009**, carried out by the **National Science Technology and Innovation Policy Office** (STI, 2009).
- The survey, using standard definitions of the R&D activities referring to Frascati Manual (OECD, 2002) and Innovation activities referring to Oslo Manual (OECD, 1997), had statistically sampling selected a total of 8,174 firms from 27,022 firms of 23 manufacturing sectors and 6 services sectors, whose revenues were greater than 12 million baht in 2008 (or 342,759 USD).
- From 8,174 samples, a total of **3,230 completed questionnaires** or **approximately 40%** are **used for analyses**.

Source: Suvanvihok (2015)

Paper #2: Empirical results

Table 1: Estimation of R&D Activities in Thailand(Skewed Logistic Regression) (N = 2,609)

rdlocal	Odds Ratio	Std. Err.	P-value
isic1			
2 : (201 - 293)	1.1333	0.3819	0.7100
3 : (300 - 372)	0.5946	0.2259	0.1710
Owner			
71-99% locally owned	2.4968	1.8423	0.2150
51-70% locally owned	1.9978	1.1411	0.2260
1-50% locally owned	0.2518**	0.1438	0.0160
Wholly foreign-owned	0.2368***	0.1163	0.0030
employee	1.0006*	0.0003	0.0650
techact	5.7386**	3.8955	0.0100
experience	1.0902***	0.0258	0.0000
total_sale (in log)	1.4842***	0.1781	0.0010
salese	1.0094**	0.0043	0.0280
sparent	1.013	0.0084	0.1200
soem	0.9888	0.0075	0.1390
sodm	1.0155*	0.0083	0.0600
sobm	1.0196**	0.0084	0.0190
Constant	0.0001***	0.0001	0.0000
/lnalpha	-2.3684***	0.3770	0.0000
alpha	0.0936	0.0353	-

Notes : 1.) * significant at 10% ; ** significant at 5% ; ***significant at 1%

Source: Suvanvihok (2015)

Paper #2: Empirical results (continued)

- The variables ***total_sale (in log)*** and ***wholly foreign-owned***, significance at 1%.
- The variable ***techact*** (having other technological activities in Thailand) *and* ***1-50% locally owned***, significant at 5%, affect the odds of firms decided to carry out R&D versus not to carry out.
- Five other variables which significantly increases the odds, but with lower effect or less than 10%, are the following.
  - ***employee***: the total number of employees
  - ***experience***: experiences of firms
  - ***salese***: export portion of firms' revenue
  - ***sodm***: sales as ODM
  - ***sobm***: sales as OBM

Source: Suvanvihok (2015)

Paper #2: Empirical results (continued)

Table 2: Estimation of R&D expenditures (Instrumental variables (2SLS) regression)(N=369)

lnrdexp	Coefficient	t-ratio	P-value
total sale (in log)	0.3450***	3.9300	0.0000
experience	-0.0032	-0.6300	0.5300
salese	-0.0029	-1.4800	0.1390
rdfund1	-0.0055	-1.6300	0.1040
rdstaff	0.0212***	6.4500	0.0000
info1	0.0383	0.2900	0.7710
info2	-0.0686	-0.4300	0.6660
info3	-0.2134	-1.4400	0.1500
info4	1.3728	1.2900	0.1990
exco1	0.2404*	1.6800	0.0940
exco2	0.2462*	1.6600	0.0980
exco3	0.0312	0.2300	0.8170
urco	-0.0462	-0.3300	0.7390
Constant	6.7759***	3.5800	0.0000

Notes : 1.) * significant at 10% ; ** significant at 5% ; ***significant at 1%

Source: Suvanvihok (2015)

Paper #2: Empirical results (continued)

- The percentage difference of R&D expenditures among the firms can be significantly explained by four variables, which are:
  - ***total_sale (in log)***: firms' total sales
  - ***rdstaff***: R&D staffs
  - ***exco1***: cooperate intensely with business partners doing R&D
  - ***exco2***: universities or public research institutes in carrying out R&D or innovation activities

Source: Suvanvihok (2015)

(4) Future studies and developments

(4.1) Potential research question

(4.2) Improvement of data compilation

(4.3) Extension of research methodology

(4.1) Potential research question

- The government has formulated the **Thailand's 20-Year National Strategy** and **Thailand 4.0 Policy**, aiming at the long-term sustainable growth.
- Specifically, the current administration aims the country **to become the high-income nation in 2026**, based on the projection of **5 per cent annual GDP growth** and 10 per cent annual export expansion.
- However, Thailand's GDP growth has been lowered during the past decade and the country is facing three main challenging issues.

(1) The slowdown of global trade

(2) Ageing society

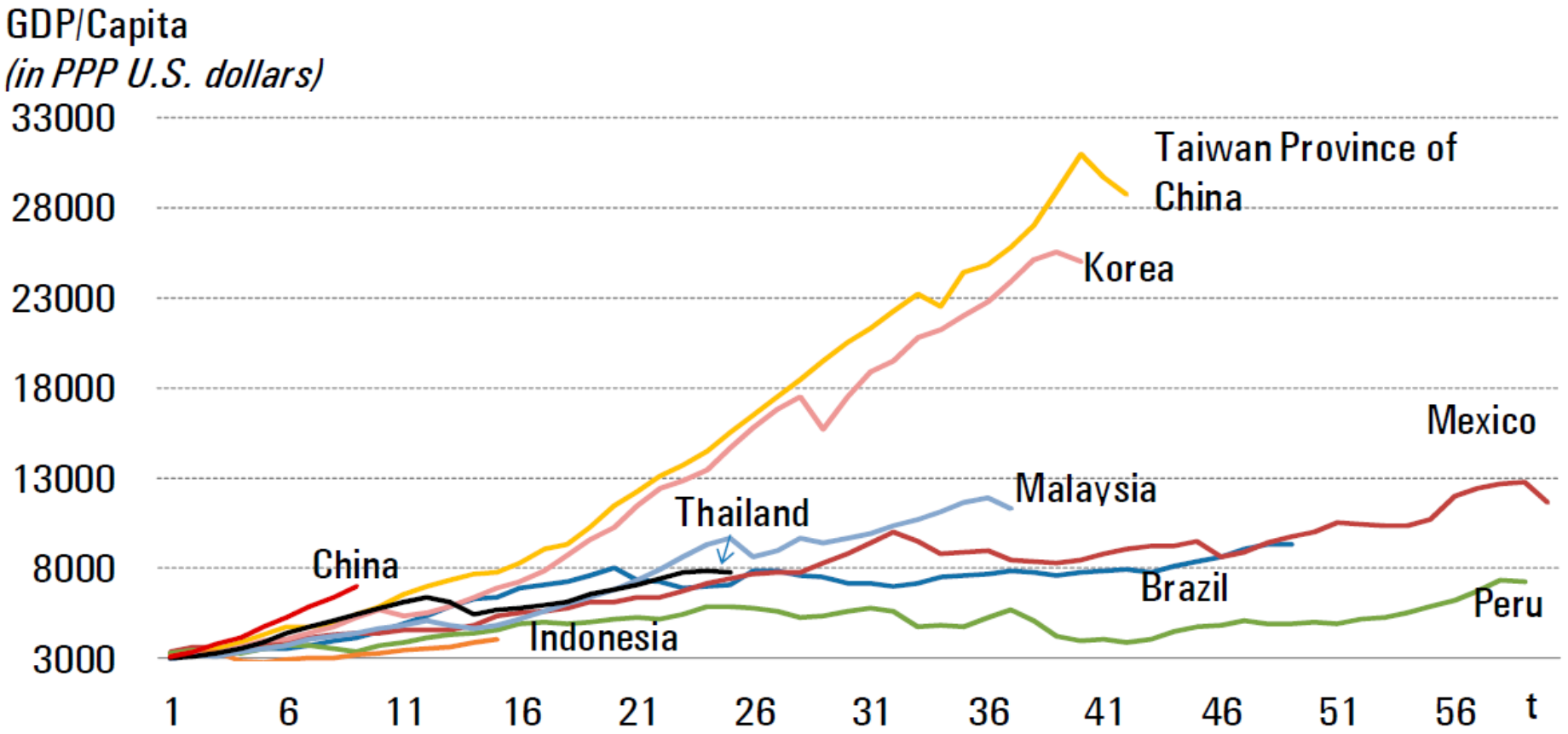
(3) Low investment in R&D

WE2-1 Years of Asian Economies Shifting to High-Income or Upper Middle-Income Countries

Item / Country	Grouping	Per Capita Nominal GNI (2012)	Per Capita Nominal GNI (1995)	The year of entering into a group		
				High-Income	Upper Middle-Income	Lower Middle-Income
Japan	High-Income	47,870	41,350	1967	Before 1962	・・・
Singapore	High-Income	47,210	22,420	1981	Before 1962	・・・
Hong Kong	High-Income	36,560	22,619	1978	Before 1962	・・・
Taiwan	High-Income	20,083	12,648	1988	1973	Before 1962
Korea, Republic	High-Income	22,670	10,770	1993	1978	Before 1962
Malaysia	Upper Middle	9,820	4,010	—	1979-86、1991	Before 1962、1987-90
China	Upper Middle	5,720	530	—	2010	1998
Thailand	**Upper Middle**	**5,210**	**2,720**	**—**	**2010**	**1966**
Indonesia	Lower Middle	3,420	980	—	—	1979
Philippines	Lower Middle	2,500	1,030	—	—	Before 1962
India	Lower Middle	1,550	370	—	—	2007
Vietnam	Lower Middle	1,550	288	—	—	2008
Laos	Lower Middle	1,270	360	—	—	2010

Source: Suehiro (2014), Studies on Emerging Asian Economies: Beyond the Catch-up Industrialization, Iwanami Publisher, p.128 (in Japanese). Up-dating the figure of per capita GNI in 2012.

Cross-country comparison



Source: IMF staff calculations.

* t=0 is defined as the year when the GDP per capita for a particular country reached 3000 U.S. dollars in PPP terms.

(4.1) Potential research question (continued)

- With those factors, the long-term goal may not be easily achieved.
- Endogenous growth driven by R&D would be one of main elements for the long-term achievement.
- Hence, key future research questions are related to the economy-wide expansion of R&D.
  - What are main factors supporting firms to do R&D?
  - What would be the role of government to influence R&D?
  - How does R&D influence the firm productivity?
  - How do firms' productivities increase the national Total Factor Productivity (TFP)?

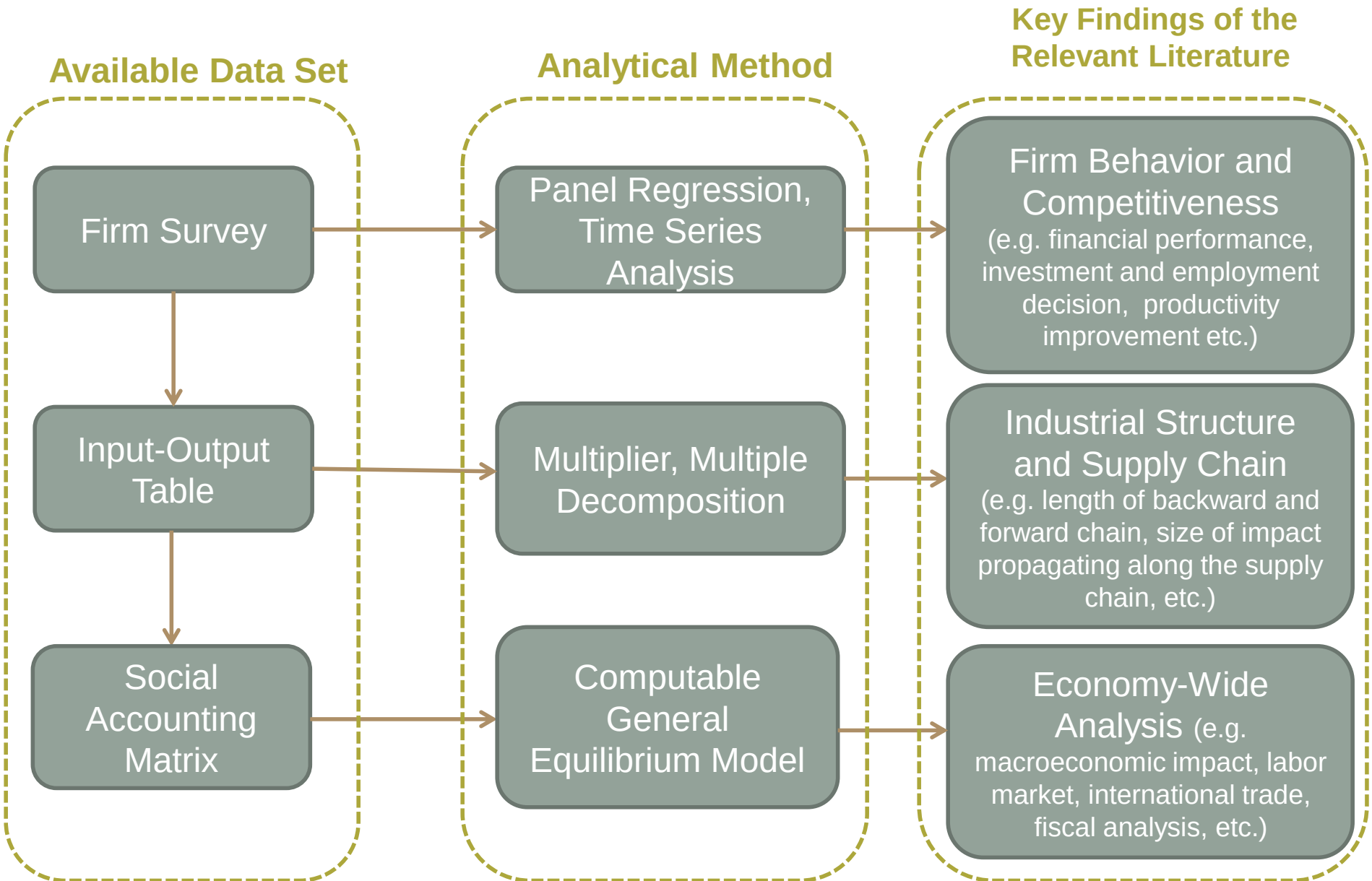
(4.2) Improvement of data compilation

(4.2.1) Completeness: the industrial survey should be conducted annually in order to develop the balanced panel data.

(4.2.2) Validation: data cleaning should be undertake to avoid duplication and error.

(4.2.3) Accessibility: the data set should be publicly accessible.

(4.3) Extension of research methodology (continued)



(4.3) Extension of research methodology

- The research methodology, as well as dataset, should be extended to cover the linkage between firm-level to industrial level, and that of industrial level and the macroeconomic condition.
- The development of quantitative techniques should be supported in order to identify two-way effects, which are:

  (1) the impact of macro factors on firm-level influences to conduct R&D.

  (2) the effect of firm's improvement of productivity on macroeconomic performances.

Thank you

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