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Thailand's Quest for Economic Growth: From Factor Accumulation to Creative Destruction

กลไกสู่การเติบโตอย่างยั่งยืนของเศรษฐกิจไทย: รื้อ โละ ริเริ่ม

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Abstract

A prolonged global economic recovery and diminished global trade have highlighted the need for Thailand to rely on a new growth model—creative destruction—that focuses on sustained productivity-led growth from within. Over the past decades, the Thai economy grew from capital and labor accumulation as well as productivity. However, the gains from labor and capital accumulation are now diminishing; long-term growth will ultimately have to come from productivity. This paper empirically examines the micro-foundations of productivity growth through creative destruction—the process by which new innovations replace older technologies. Rich firm data shows two key results. First, incentives matter—competition can foster firm innovation. Second, firm dynamics also play a role: the reallocation of capital to high productivity firms away from low productivity boosts aggregate productivity growth. In addition, new firms undergo a selection process whereby innovative firms survive, grow in size and become industry leaders. However, the evidence for creative destruction is not prevalent throughout all sectors and suggests that the economy is bifurcated: a dynamic Thailand co-exists alongside a stagnant Thailand. The challenge for policymakers is therefore how to fully harness the forces of creative destruction through broad and consistent reforms in areas such as education, competition, labor, finance and the institutional environment.

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1 Introduction

The Thai economy is at a critical juncture. Growth registered 3 percent over 2007-2011, hardly stellar for an economy considered a development success. Low trend growth as well as external challenges—prolonged global economic recovery, diminished global trade—have highlighted the need for Thailand to rely on a new growth model—creative destruction—that focuses on sustained productivity-led growth from within. Over the past decades, the Thai economy grew from capital and labor accumulation as well as productivity. This growth model worked well for Thailand or indeed any nascent emerging market. However, the gains from labor and capital accumulation are now diminishing; long-term growth will ultimately have to come from productivity.

However, productivity growth following the Asian crisis has not been a major contributor to growth. It is imperative we understand the underlying process driving productivity growth in Thailand. This paper empirically examines the micro-foundations of productivity growth through creative destruction—the process by which new innovations replace older technologies. Rich firm data shows two key evidences. First, incentives matter—competition can foster firm innovation. Second, firm dynamics also play a role: the reallocation of capital to high productivity firms away from low productivity boosts aggregate productivity growth. In addition, new firms undergo a selection process whereby innovative firms survive, grow in size and become industry leaders. However, the evidence for creative destruction is not prevalent throughout all sectors and suggests that the economy is bifurcated: a dynamic Thailand co-exists alongside a stagnant Thailand. The challenge for policymakers is therefore how to fully harness the forces of creative destruction through broad and consistent reforms in areas such as education, competition, labor, finance and the institutional environment.

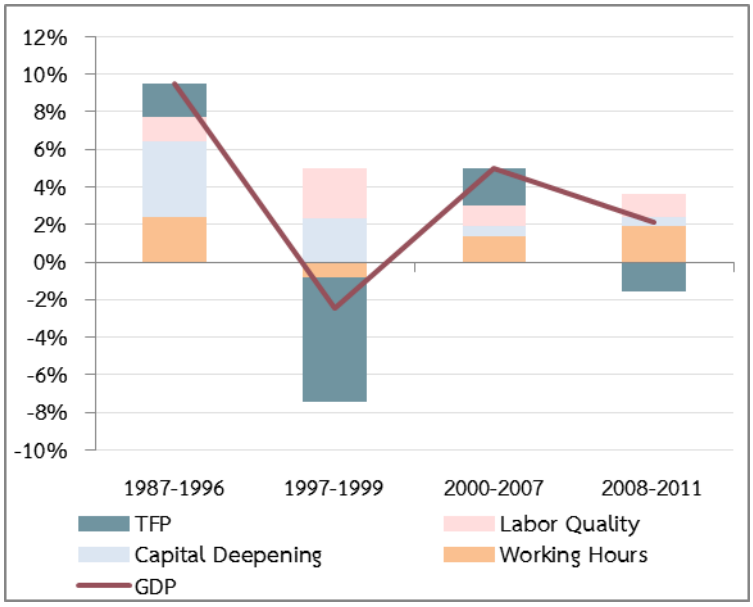
This paper first briefly discusses Thailand's past growth experience and then assesses the state of productivity growth through creative destruction in the Thai economy using firm data. The paper concludes with policy implications.

2 Thailand's growth experience

Thailand is one of the world's great economic development success stories. Market reforms and integration into the global economy laid the foundations for growth from factor accumulation and mobilization as well as productivity. A growing labor force in terms of both quantity and quality as well as capital deepening consistently contributed to growth

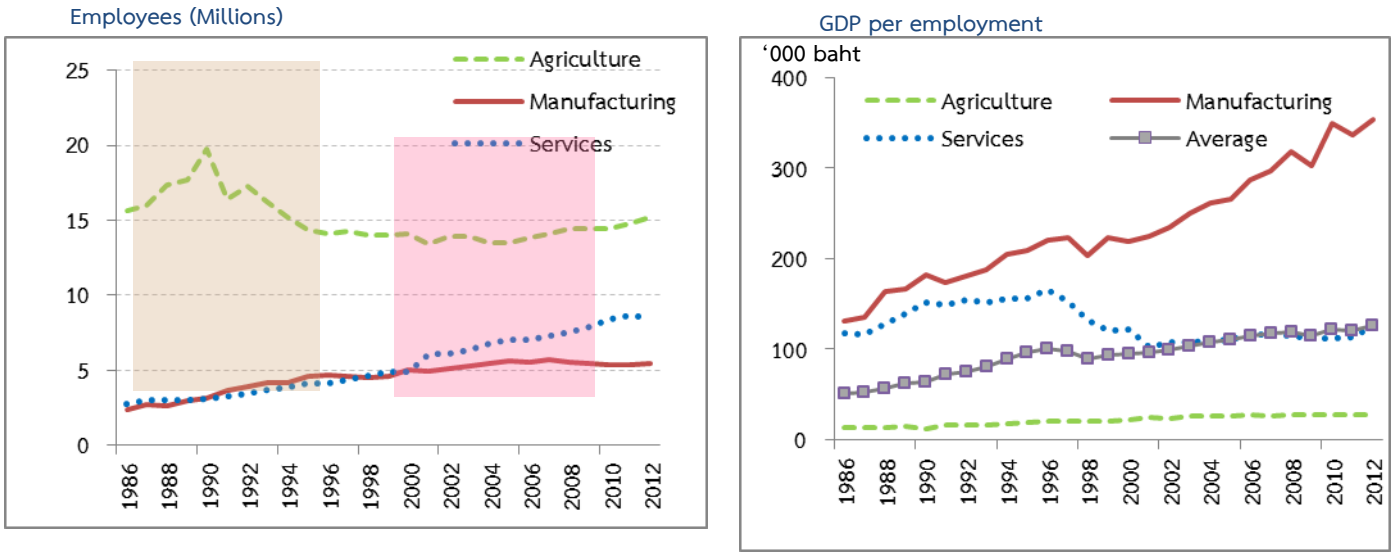
from 1987 until 2011. Productivity growth contributed to overall growth during 1987-1996 and 2000-2007 but turned negative following the Asian and global financial crises.

Figure 1: GDP Growth from Factor Accumulation



Source: LFS, NESDB, Chuenchoksan & Nakornthab 2008 and calculated by BOT staff

Figure 2: Labor Reallocation from Agriculture



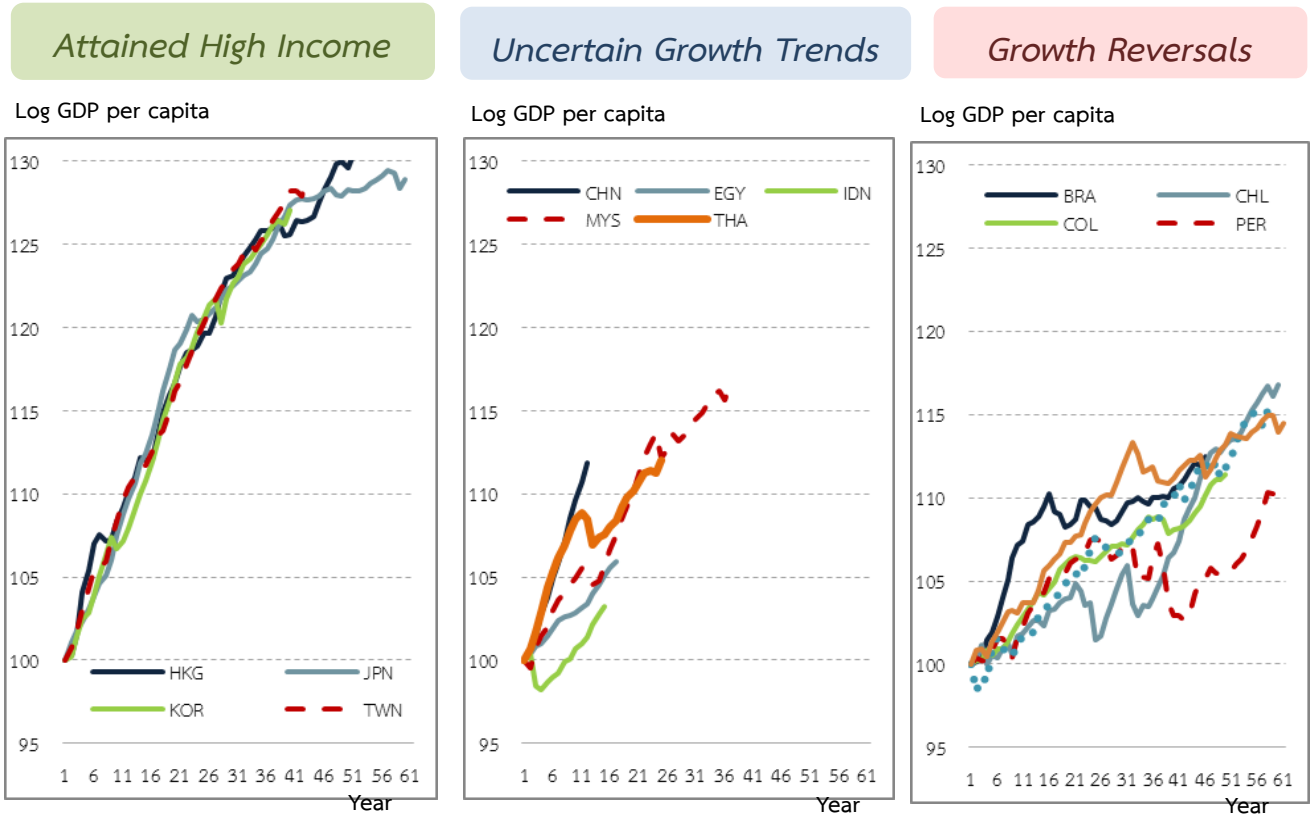
Source: LFS, NESDB, Chuenchoksan & Nakornthab 2008 and calculated by BOT staff

Another important source of growth proved to be structural change. As part of its growth story, Thailand also experienced significant structural change – the large movement of resources across sectors. Indeed, for Thailand, as well as other emerging markets, economic growth has been synonymous with structural change. In the mid-1980s, economic

liberalization prompted labor to reallocate from agriculture to more productive sectors—mostly manufacturing and, to some extent, services. As a result, the manufacturing sector's share of total output rose substantially. Without structural change, the productivity gains in high productivity sectors would not have been realized.

The global experience on growth offers many lessons for Thailand. First, technological innovation is the key driver of long-term economic growth. Since the industrial revolution, the world has experienced an unprecedented rise in economic growth that has been fueled by innovation (Angus Maddison and van Zanden 2013). Global GDP per capita accelerated after the First and Second Industrial Revolutions. Second, the innovation process must be supported by a complex set of institutions that supports, for example, free markets, openness to foreign trade and investment, property rights, and education. Third, sustained growth is difficult. Growth reversals may occur.

Figure 3: Growth Trajectories

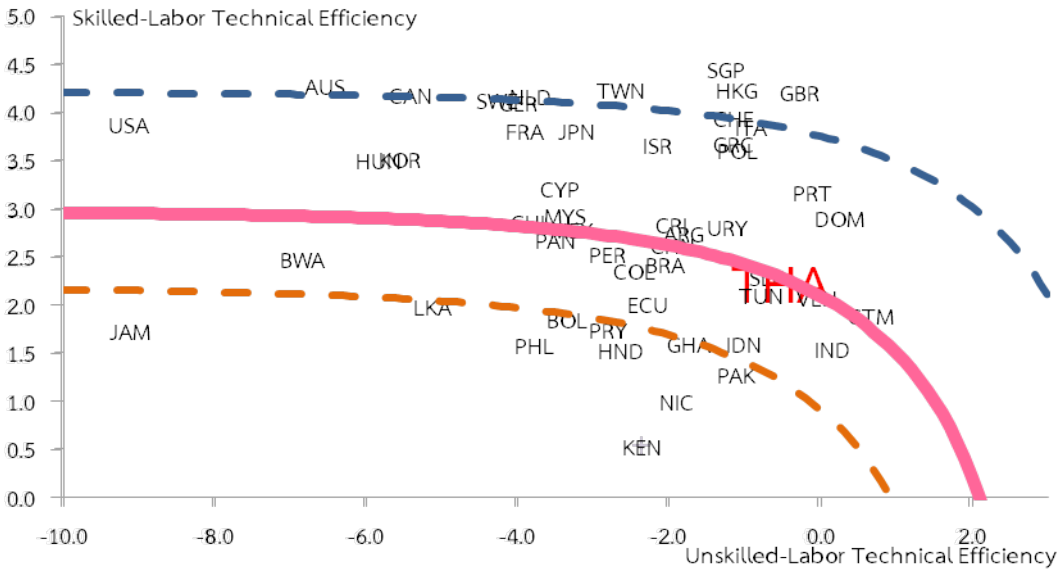


Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.1, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, July 2012.
Note: Country graduates into middle-income status if her real GDP per capita reached $3,000 constant 2005 PPP (year 1).

So what are Thailand's prospects? Trend growth is now slowing and faces considerable headwinds. Demographic change in the form of an ageing labor force means that the gains from labor participation are diminishing. Second, diminishing returns from investment will

eventually set in. Third, structural change is slowing and partly reflects decreasing gains. While it is possible that gains from structural change remain, these gains will arguably decrease.[2] Lastly, the key headwind is probably technological. This point is clearly driven home by an analysis of the world technology frontier. Advanced economies, or those with higher productivity or technology, are on the world frontier while Thailand, as other economies with average levels of technology, are in the middle.[3] Thailand's current ranking in the global economy is determined by technology. Thailand therefore stands at a threshold of growth. Moving beyond this threshold requires innovation-based growth.

Figure 4: World Technology Frontier 2010



Source: Barro and Lee 2013, Caselli and Coleman 2006, Hall and Jones 1999, Heston, Summers and Aten 2012, and calculated by BOT staff

3 Creative Destruction: Evidence

Thailand needs a new a growth model based on technological innovation: creative destruction. Creative destruction is a mechanism that drives long-run growth through incentivizing the creation of new technology and the flow of resources to that technology.[4] In the process, older technologies and sectors are destroyed. This destruction goes hand in hand with the rise of new technologies. The latter cannot happen without the former.

Creative destruction needs the right incubating environment: a mix of market and non-market institutions. Market institutions are needed because market-based incentives

[2] See Ariyapruchya, Chantapant and Apaitan (2011). "Dealing with Structural Change: A Diagnosis of the Thai Economy".
[3] We updated the method of Caselli and Coleman (2006) "The World Technology Frontier".
[4] We follow Aghion and Howitt (1992) which essentially operationalized Schumpeter's notion of creative destruction. Other examples include Segerstorm, Anant and Dinopoulous (1990) and Corriveau (1991).

reward innovation. Large or open economies also help firms recapture large fixed costs of innovation and patents. Financing mechanisms beyond the banking sector are also important. Knowledge is intangible and non-collateralizable so banks will generally not lend. Non-market institutions include education and property law. Higher education is needed as innovation is science-based. Intellectual property law should balance the tradeoff between protecting incentives for innovation and the gains from sharing new knowledge.

The theory on creative destruction offers distinctive predictions regarding the relationship between industrial organization and creative destruction on which firm data can be brought to bear.

3.1 Competition fosters innovation

Firms innovate to capture rents and escape from competition. We attempt to measure innovation and verify if competition fosters innovation. We first construct the following variables:

Innovation Using the Productivity Investment Climate Survey of 2003 (see Appendix 1), we construct an index of innovation which takes on a maximum value of 6 if firm managers answer yes to having both product and process innovation in the last 2 years. Specifically, questions include whether firms have filed any patents or copyrights, developed new product lines, upgraded product lines, entered new markets due to improvements in product quality or costs, upgraded machinery, or introduced new technology that has substantially changed the production process. We stress that this measure captures incremental innovation which arguably plays more of a role in emerging markets than break-through innovations.

Market Concentration The Herfindahl Index is used as a measure of market concentration. It is commonly accepted and often used in anti-trust deliberations.[5] It is defined as the sum of the squares of each firm's market share. As such, it can range from 0 to 10,000 moving from a very large amount of very small firms to a single monopolistic producer. An index value between 1,000 and 1,800 indicates moderate concentration and while an index value above 1,800 indicates high concentration. In our analysis, the index was calculated from the survey sample. However, we find that our results are consistent with estimates from more representative samples since the PICS survey covers small, medium and large firms as well as exporting, non-exporting firms and foreign-owned, domestic firms. The industry level index, denoted HI_{jt}, is the sum of squared firm market shares across all firms in an industry,

[5] For example the US Department of Justice's merger guidelines describe use of the Herfindahl Index in measuring whether a merger will result in excessive market concentration.

$$HI_{jt} = \sum_{i=1}^{n} S_{i_j t}^2$$

where S_i is the market share of firm *i* in the industry *j* in year *t*, and *n* is the number of firms in industry *j*. The Herfindahl Index is vulnerable to one particular criticism. It relies on a measure of the whole market. Given the variety of goods available, the boundaries of the market are difficult to locate, let alone measure. Furthermore, we omit foreign-based producers which may be active in the same market. Nevertheless, only three firms in the PICS survey report import competition as being problematic. We define firms as being in the same market if they are categorized as being in the same sector at the two-digit ISIC level.

Price Dispersion (Market Segmentation) External competition is a significant source of competitive pressure for any economy. This is not surprising given that the global marketplace, by virtue if its size and fluidity, is more competitive than any domestic market. One indicator of external competitive pressure is the spread between the domestic and export prices for a given good. In segmented markets, the price spread for identical goods will be positive. In integrated markets, the prices of identical goods should be equal. If prices differ, arbitrageurs will buy cheap and sell dear until prices equilibrate.

$$\text{Price Spread} = \frac{P^{domestic}}{P^{export}}$$

The price spread reflects market segmentation, price controls, and tariff and non-tariff barriers. If a given good's domestic price is greater than its price abroad, the price spread reflects domestic price controls. If the domestic price of a given good is less than its price abroad, the price spread reflects tariff and non-tariff barriers. The spread is constructed by first identifying which firms sell their primary products in both domestic and foreign markets. Next, we calculate the good price from sales and volume data subtracting transportation costs. We note that a common problem in calculating price spreads is that the spreads may not necessarily measure the spreads between identical goods. However, our measure avoids this problem. Each firm's price spread is obtained from the prices of its primary product only and should therefore reasonably satisfy the assumption of identical goods.

Exporter Firms that export more than half of their products are considered to be exporters. Openness to market entry and foreign competition tends to encourage firms to upgrade their productivity.

A poisson regression of innovation on measures of competition, market concentration, exporter status, price dispersion and controls such as industry, foreign ownership, size, and age shows that certain competition measures are significant in the direction expected. Specifically, the Herfindahl index, a measure of market concentration by industry, and

exporter status are significant. Price dispersion is not. Given that the Herfindahl index as measured across industries in the data is quite wide-ranging, there is significant scope for policy to strengthen product market competition in order to foster innovation.[6]

3.2 Reallocation and competition

Innovation alone is not enough. Innovation can only be implemented if resources flow to innovative firms, away from non-innovative firms.

Using Annual Survey on Thailand's Productivity and industries Performance data during 2008-2011 from the Office of Industrial Economics (OIE), Ministry of Industry, we measure how reallocation of labor and capital between firms in a given industry contribute to industry TFP productivity growth. The descriptive statistics of the data along with the estimation of the productivity are shown in the appendix. The aggregate productivity growth is decomposed following the Petrin and Levinsohn (2012) method[7] as follows:

Technical Efficiency (TE) *Labor Reallocation (LRE)*

$$APG = \sum_i D_{it}\Delta ln\omega_{it} + \sum_i D_{it}(\varepsilon_i^L - s_{it}^L)\Delta lnL_{it} + \sum_i D_{it}(\varepsilon_i^K - s_{it}^K)\Delta lnK_{it} + \sum_i D_{it}(\varepsilon_i^M - s_{it}^M)\Delta lnM_{it} - \sum_i D_{it}\Delta lnF_{it}$$

Capital Reallocation & Other (KRE)

$$Where \quad APG = aggregate\ productivity\ growth$$
$$D_{it} = average\ weight\ of\ value\ added\ of\ firm\ i\ at\ time\ t\ and\ t-1$$
$$\Delta lnL_{it} = labor\ growth\ of\ firm\ i\ at\ period\ t$$
$$\Delta lnK_{it} = capital\ growth\ of\ firm\ i\ at\ period\ t$$
$$\Delta lnM_{it} = intermediate\ input\ growth\ of\ firm\ i\ at\ period\ t$$
$$\Delta lnF_{it} = fixed\ cost\ growth\ of\ firm\ i\ at\ period\ t$$
$$\Delta ln\omega_{it} = TFP\ growth\ of\ firm\ i\ at\ period\ t$$
$$\varepsilon_i^j = elasticity\ of\ factor\ j\ \epsilon\ \{L,K,M\}\ of\ firm\ i$$
$$s_i^j = revenue\ shares\ of\ factor\ j\ \epsilon\ \{L,K,M\}\ of\ firm\ i$$

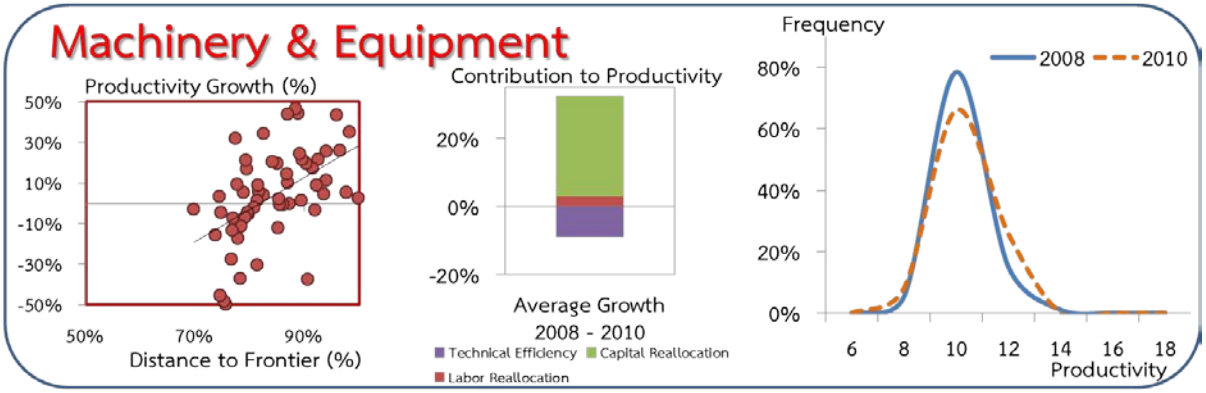
[6] Nevertheless, competition should not eliminate innovation rents. Firms will only innovate if they can recapture the large fixed costs of innovation through rents. A well-calibrated intellectual property rights framework can ensure sufficient rents for innovation while ensuring that the benefits of innovation are eventually disseminated.

[7] Although we follow Petrin and Levinsohn (2012)'s decomposition closely, we aggregate firm-level productivity growth into an industry level (grouped by 3-digit ISIC), instead. Next, industry-level productivity growth is aggregated into the whole manufacturing sector. Doing so allows us to analyze the effect of factor reallocation across firms on industry productivity, or the reallocation within industry.

As in Petrin and Levinsohn (2012), we cannot find a good proxy for the revenue shares of capital and intermediate input. The KRE, therefore, is left as the difference between APG and the sum of TE and LRE. Intuitively, the TE represents each firm within technology growth, whereas the reallocation part measures how resources are reallocated between firms; hence, it becomes positive if the reallocation is from a low to high productivity firm. The average annual growth of aggregate productivity during 2008-2010[8] is 11.7% with TE accounting for 5.5%, while LRE and KRE is -0.4% and 6.6%, respectively. This result means the creative destruction is a functioning mechanism as the total reallocation contributes positively to the aggregate productivity growth.

We also find that reallocation contributes to productivity growth particularly in industries where competition is high. For example, in the machinery and equipment industry, competition is neck-to-neck as reflected by the clustering of firms TFP close to the frontier TFP within the sector. As a result, firms are incentivized to increase productivity, leading the overall distribution of firm TFP to move to the right over 2008-2010. The opposite is seen in the sugar and grain mill products category.

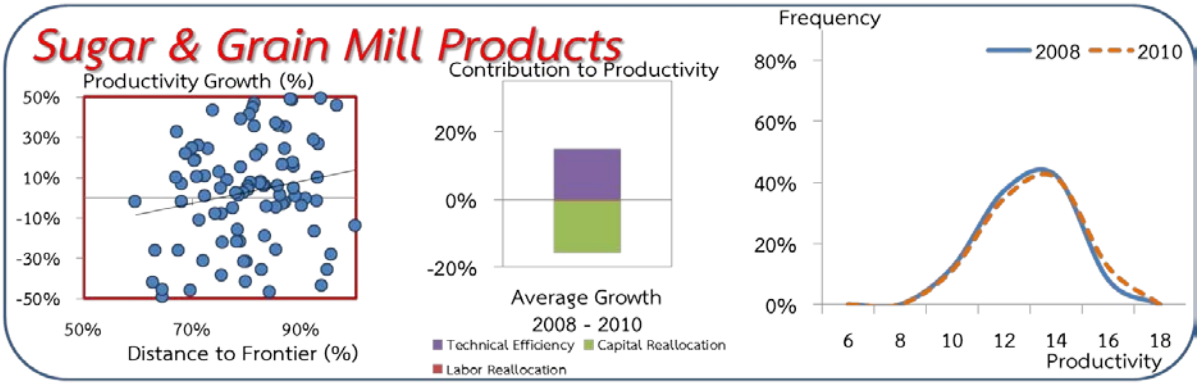
Figure 5.1: Reallocation & Competition (Machinery)



Source: OIE & calculated by BOT staff

[8] Note that we simply compare the growth from 2008 and 2010 to avoid the impact of the subprime crisis (2009) and the great flood (2011). Nevertheless, the annual growth of the whole period is reported in the appendix.

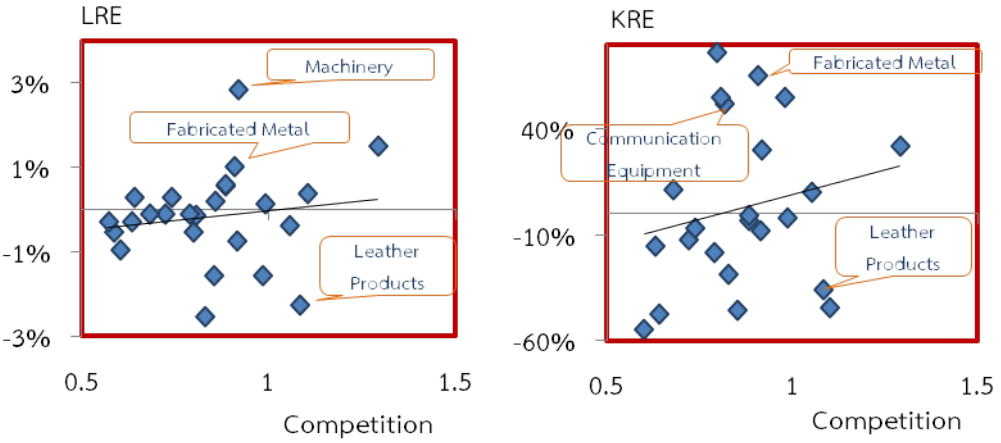
Figure 5.2: Reallocation & Competition (Sugar)



Source: OIE & calculated by BOT staff

In the industry-level data, competition, as measured by an inverse of the standard deviation of TFP in each industry, has a slight positive correlation with the reallocation (a little higher with KRE than LRE as in the figure, reflecting the rigidity in the labor market). This result suggests that the creative destruction process in the manufacturing sector is not functioning fully in some industries such as sugar and grain mill products, textiles and leather products. Nevertheless, it seems to be functioning in the machinery and equipment, metal, fabricated metal and communication equipment industries.

Figure 6: Reallocation & Competition



Source: OIE & calculated by BOT staff

3.3 Firm dynamics: entry, exit and efficiency.

Creative destruction explains how firm micro-dynamics underlie aggregate productivity growth. Beneath the calm macroeconomic surface of economic growth, there is a rich churning characterized by the birth of firms, the death of old firms and the transformation of small and medium-sized firms into larger firms. As firms are born, they undergo a grueling

selection process whereby unfit firms are weeded out. Firms that are productive or innovative survive and grow in size and age. Some of them may even grow to take over the mantle of industry leaders from the previous generation of leading firms. This process results in aggregate productivity growth. This process can be verified by firm data.

Using firm panel data constructed from company financial statements (CPFS) we find that firm size, as measured by sales or assets, is skewed. In other words, there are very many small firms and few large firms. This distribution is consistent with firm dynamics predicted by creative destruction.

Figure 7.1: Firm Size Measured by Sales

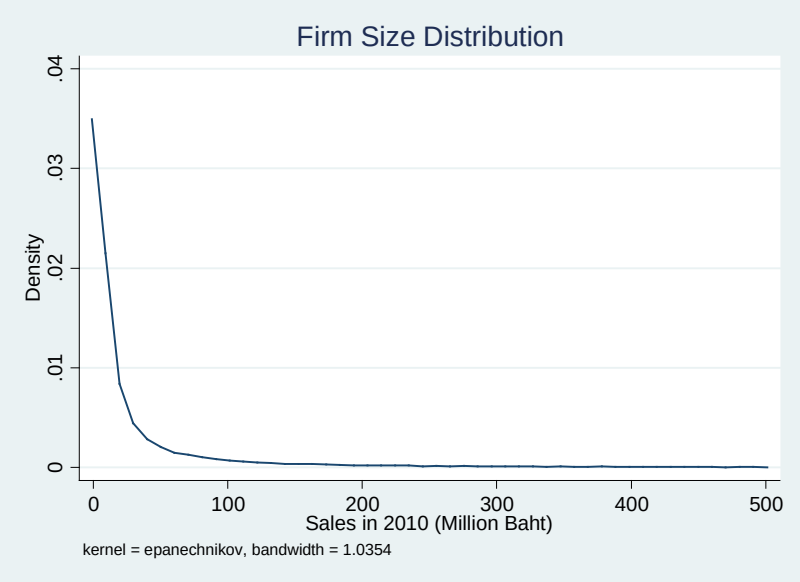
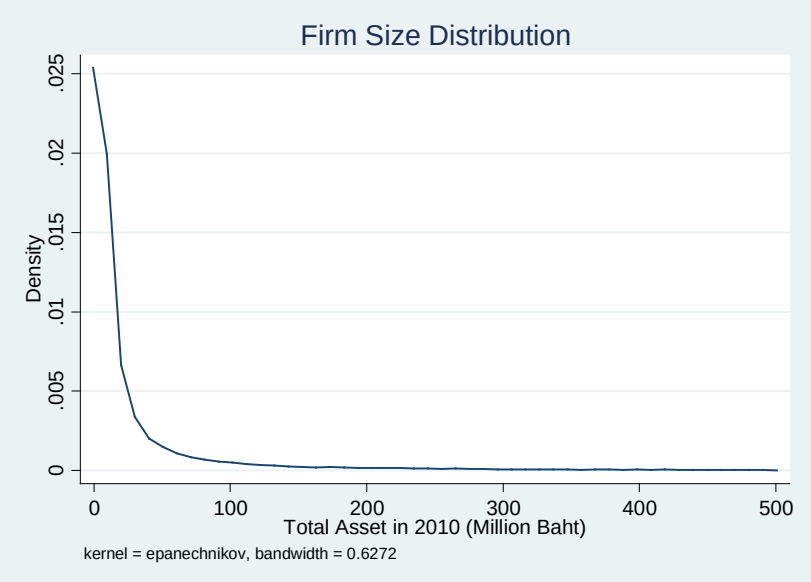


Figure 7.2: Firm Size Measured by Total Asset



Source: BOT's CPFS Database & calculated by BOT staff

1. Firm size and firm age are highly correlated

Figure 8.1: Firm Size (Measured by Sales) and Firm Age

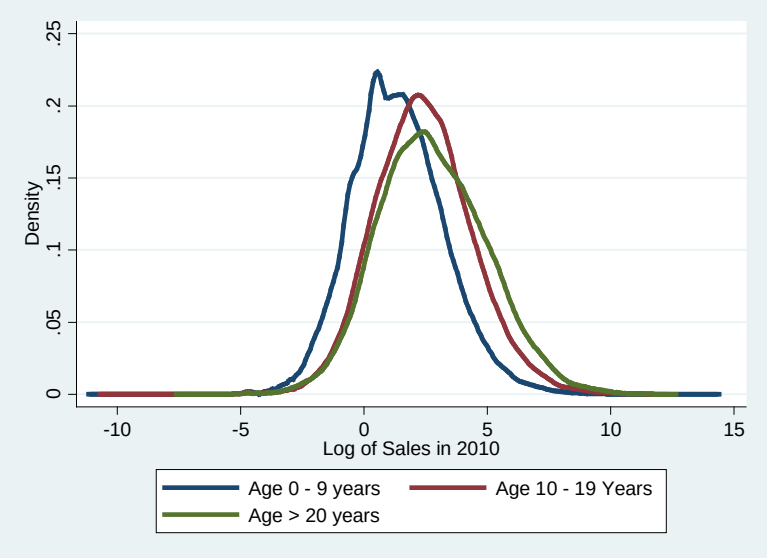
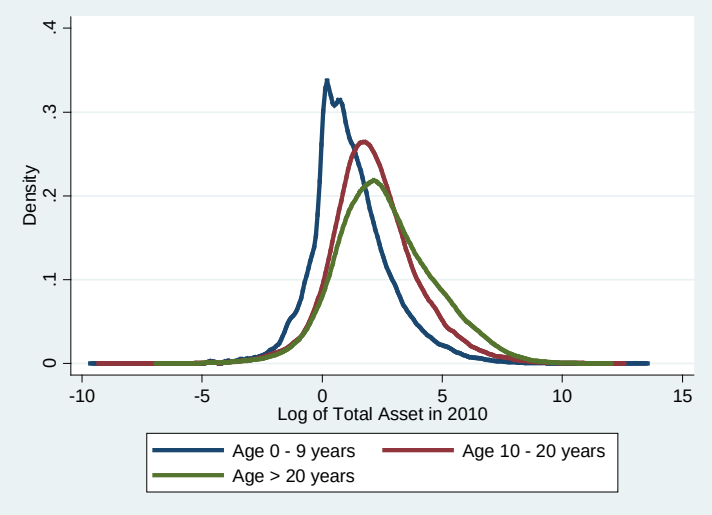


Figure 8.2: Firm Size (Measured by Total Asset) and Firm Age

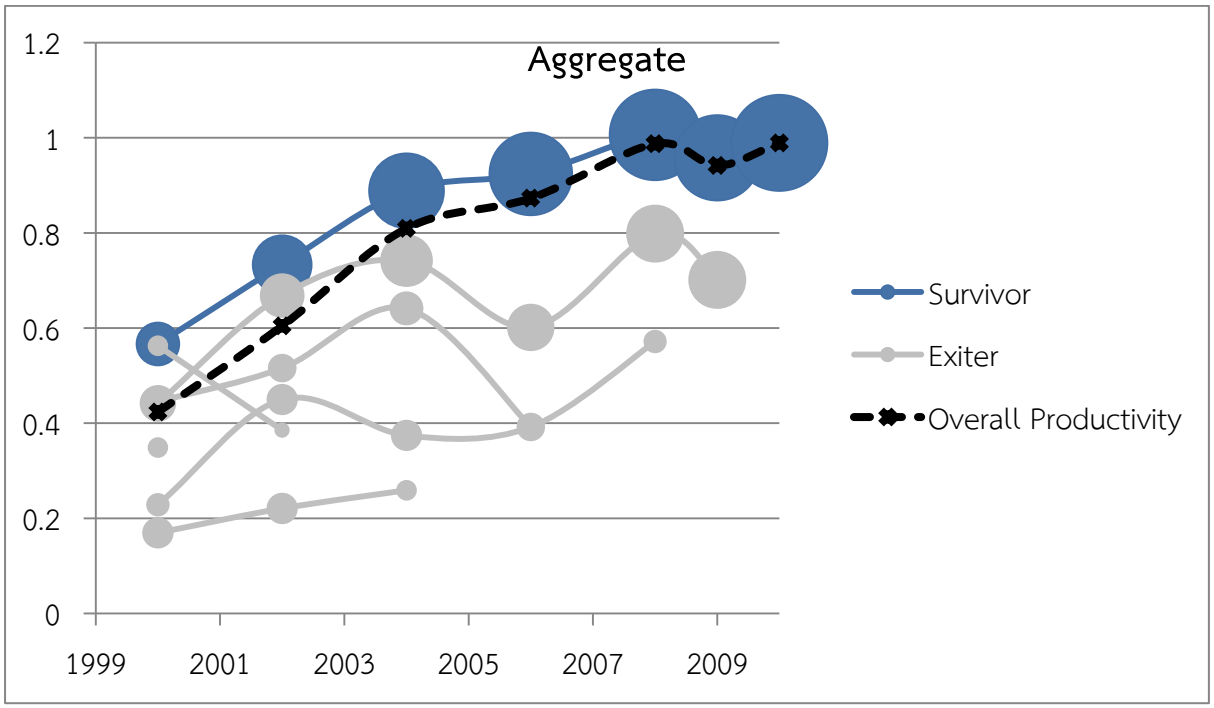


*Firm age since registration

Source: BOT's CPFS Database & calculated by BOT staff

2. undersized firms exit more frequently but the ones that survive tend to grow faster than average rate

Figure 9: Productivity and Average Firm Size of the Entrants of year 2000

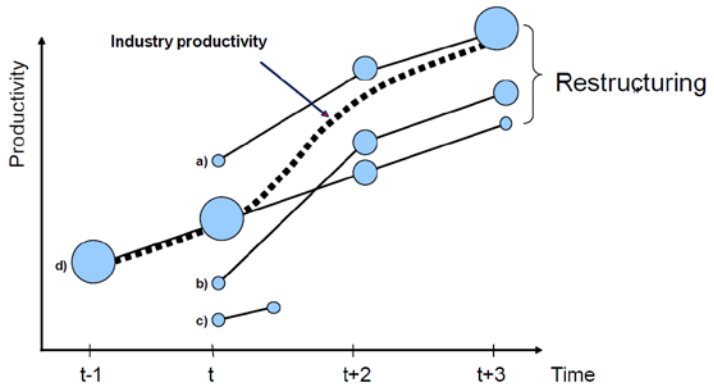


*The dot size represents the average firm size for each group

Source: BOT's CPFS Database & calculated by BOT staff

Firms enter industry with different levels of productivity (i.e. technology or business model). Due to data limitations, we proxy productivity by a notion of "capital productivity"-- total output divided by total assets. The selection process rules out the unsuccessful ideas. Firms that fail to expand or cannot catch up technologically are forced to exit. Once a firm survives, it tends to expand and become more productive. Displacement of weak incumbents by new productive firms promotes the overall growth. As a result, the size distribution of firms tends to be skewed. However, some sectors show the opposite dynamic.

Figure 10: Sources of Productivity Growth

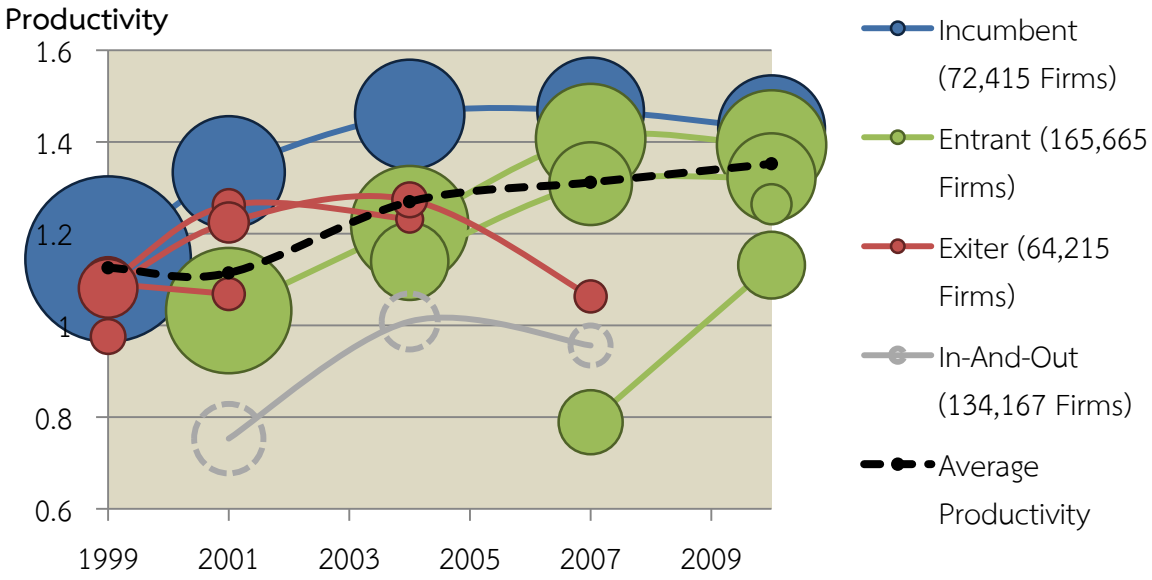


Source: Hyytinen & Maliranta (2013)

There are 4 key components of industry productivity growth (Hyytinen and Maliranta, 2013):

1) Experimentation: Firms enter the industry with different productivity (firm a, b and c). The industry's productivity depends on the average productivity of the entrants.
2) Selection: Firms with low productivity or slow growth are forced to exit (firm c).
3) Reallocation: The higher performance firms acquired more resources (firm a and b).
4) Firm productivity growth: or the growth generated within firm.

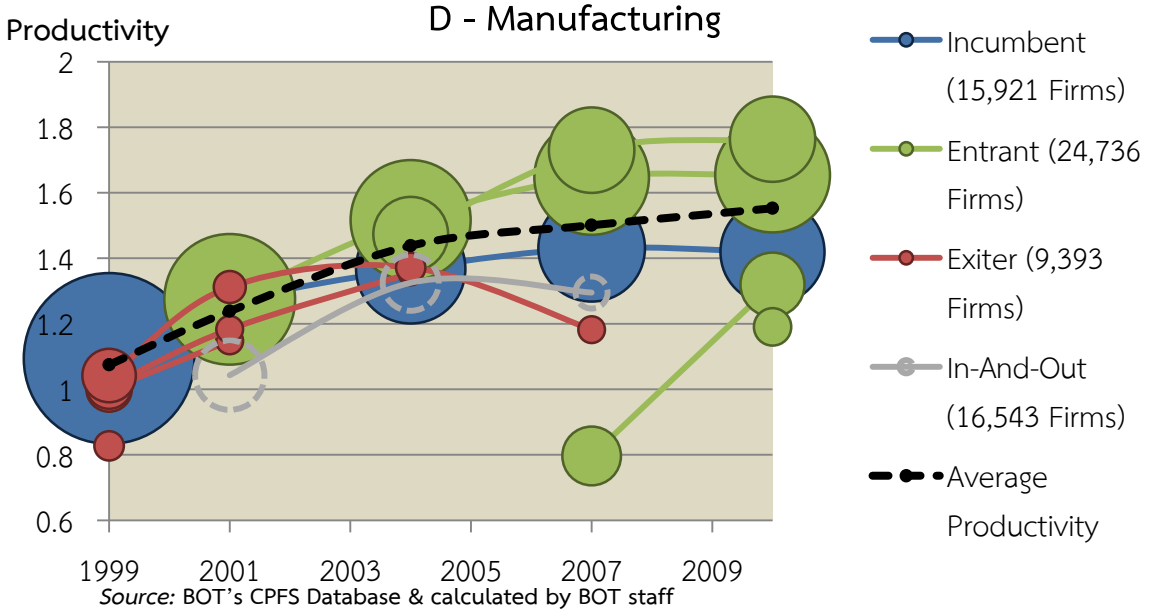
Figure 11: Evolution of Thai Firms between 1999 and 2010



Source: BOT's CPFS Database & calculated by BOT staff

Our data shows that average productivity across Thai firms improved significantly over the past decade. Productivity growth is driven mainly by incumbents. However, the dynamics of firm entry and exit also supports overall growth. Weak firms are forced to exit after experiencing large drops in productivity. New entrants, although they enter the market with lower productivity than the incumbents, try to catch up to the productivity frontier. Survivors tend to converge to the same level of productivity. The painful selection process at the micro level reflects a vibrant economy. At the aggregate level, creative destruction process serves to boost overall productivity quite well. Nonetheless, looking into sectoral level, the signs are mixed.

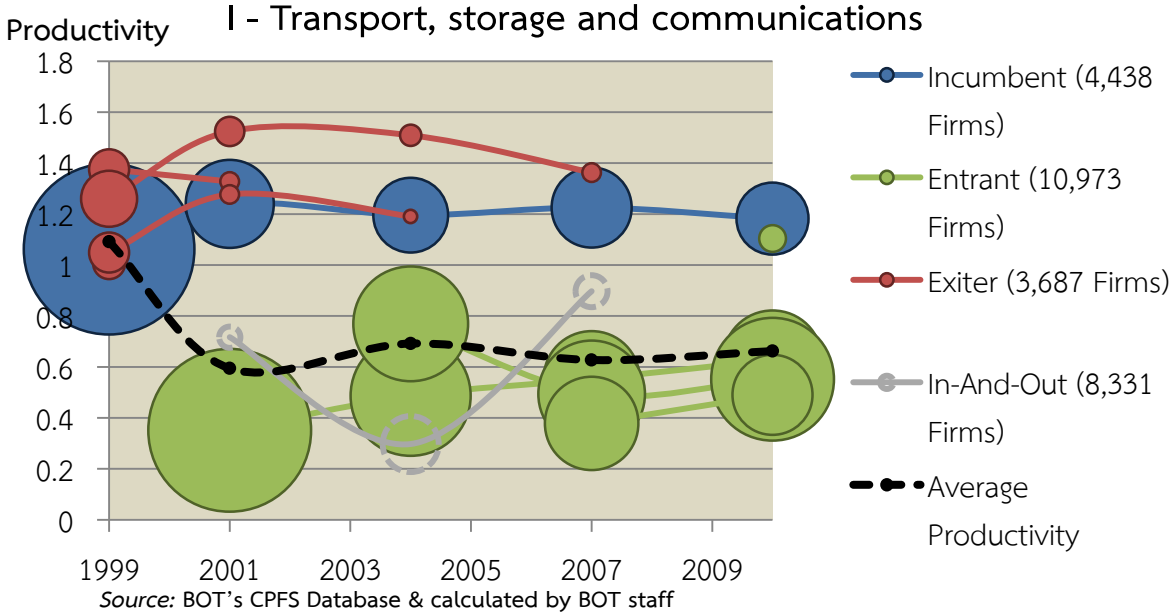
Figure 12.1: Evolution of Thai Firms (Manufacturing)



Source: BOT's CPFS Database & calculated by BOT staff

Manufacturing benefits greatly from creative destruction in the past 10 years. New entrants are more productive than incumbents and become the main engine of the industry.

Figure 12.2: Evolution of Thai Firms (Transport)



Source: BOT's CPFS Database & calculated by BOT staff

Transportation, storage and communications, on the other hand, experiend a sharp drop during 2000-2001 and stagnates. Surprisingly, productive incumbents shrink, some top performers leave the industry and low-productivity firms enter and survive without upgrading productivity.

Table 1: Productivity Growth and the Decomposition between 1999 and 2010 (Transport)

Industry	Within	Between	Entry	Exit	Total
A - Agriculture, hunting and forestry	0.36	0.03	0.15	0.07	0.62
B - Fishing	-0.03	-0.01	-0.18	-0.13	-0.34
C - Mining and quarrying	0.13	-0.15	-0.13	-0.07	-0.23
D - Manufacturing	0.13	0.07	0.21	0.06	0.48
E - Electricity, gas and water supply	0.19	-0.32	-0.42	-0.28	-0.82
F - Construction	-0.02	0.05	-0.03	0.05	0.05
G - Wholesale and retail trade; repair	0.11	0.14	0.25	0.13	0.63
H - Hotels and restaurants	0.07	0.02	-0.01	-0.00	0.08
I - Transport, storage and communications	0.03	-0.13	-0.26	-0.07	-0.43
J - Financial intermediation	0.00	-0.02	-0.09	-0.07	-0.18
K - Real estate, renting and business activities	-0.06	0.09	0.09	0.04	0.15
M - Education	0.06	-0.03	-0.03	-0.01	-0.01
N - Health and social work	0.31	0.01	0.07	0.03	0.42
O - Other community, social and personal service activities	0.08	0.08	0.08	0.06	0.30
Overall	**0.09**	**0.03**	**0.06**	**0.04**	**0.23**

*See appendix for GR Decomposiotion (Griliches and Regev 1995)

Source: BOT's CPFS Database & calculated by BOT staff

The above table summarizes the sources of productivity growth into 4 components (see appendix). We define the Between, Entry and Exit components as the outcomes of Creative Destruction (CD) process. At the aggregate level, CD contributes about 58% of the overall productivity growth. However, it can also be argued that CD incentivizes within-level productivity increases too due to competition. Most of weaker or stagnant industries suffer from negative contributions of CD. Large contributions in outputs by entering and exiting firms reaffirm the process of creative destruction. The entrants contribute the most to output expansion and this far outweighs the loss from exiting firms. Thus the net flows are positive in most industries.

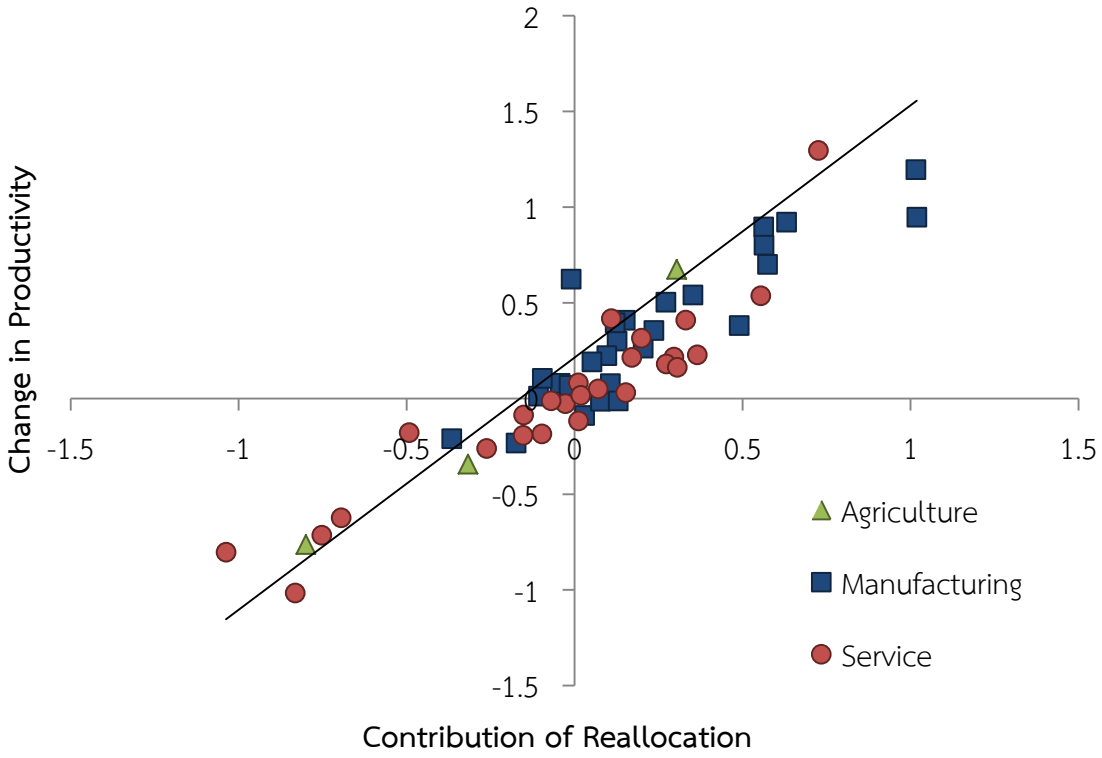
Table 2: Source of Output (Sales) Growth between 1999 and 2010

Industry	Expansion			Contraction			Net flows	Base year
	Total	Due to entering firms	Due to continuing firms	Total	Due to exiting firms	Due to continuing firms		
A - Agriculture, hunting and forestry	138 (502.6%)	99 (361.4%)	39 (141.2%)	-10 (-35.3%)	-7 (-24.6%)	-3 (-10.7%)	119 (432.0%)	27
B - Fishing	3 (82.4%)	2 (59.2%)	1 (23.2%)	-3 (-80.0%)	-1 (-39.9%)	-1 (-40.1%)	-3 (-77.6%)	4
C - Mining and quarrying	178 (1362.4%)	166 (1271.3%)	12 (91.1%)	-5 (-36.8%)	-3 (-23.2%)	-2 (-13.7%)	168 (1288.7%)	13
D - Manufacturing	12,809 (783.5%)	10,211 (624.6%)	2,598 (158.9%)	-460 (-28.2%)	-314 (-19.2%)	-146 (-9.0%)	11,888 (727.2%)	1,635
E - Electricity, gas and water supply	121 (3899.5%)	112 (3630.6%)	8 (268.9%)	-1 (-48.0%)	-1 (-46.7%)	0 (-1.2%)	118 (3803.6%)	3
F - Construction	597 (224.3%)	362 (135.9%)	235 (88.3%)	-135 (-50.9%)	-94 (-35.4%)	-41 (-15.5%)	326 (122.6%)	266
G - Wholesale and retail trade; repair	7,096 (439.3%)	4,779 (295.8%)	2,318 (143.5%)	-633 (-39.2%)	-460 (-28.5%)	-173 (-10.7%)	5,830 (360.9%)	1,615
H - Hotels and restaurants	157 (222.5%)	106 (149.8%)	51 (72.7%)	-23 (-32.9%)	-17 (-23.5%)	-7 (-9.4%)	111 (156.8%)	71
I - Transport, storage and communications	1,061 (718.5%)	861 (583.2%)	200 (135.3%)	-55 (-37.5%)	-34 (-22.7%)	-22 (-14.7%)	950 (643.6%)	148
J - Financial intermediation	584 (817.4%)	447 (624.8%)	138 (192.6%)	-39 (-54.5%)	-32 (-45.4%)	-6 (-9.1%)	506 (708.4%)	71
K - Real estate, renting and business activities	1,027 (437.9%)	825 (351.8%)	202 (86.2%)	-134 (-57.0%)	-83 (-35.2%)	-51 (-21.8%)	759 (323.9%)	234
M - Education	13 (441.0%)	8 (280.1%)	5 (160.9%)	-1 (-34.0%)	0 (-16.1%)	-1 (-17.9%)	11 (372.9%)	3
N - Health and social work	77 (304.0%)	29 (114.2%)	48 (189.8%)	-3 (-13.2%)	-3 (-11.3%)	0 (-1.9%)	71 (277.6%)	25
O - Other community, social and personal service activities	97 (343.8%)	69 (244.7%)	28 (99.1%)	-15 (-53.3%)	-11 (-38.6%)	-4 (-14.6%)	67 (237.3%)	28
Total	**23,959 (578.1%)**	**18,076 (436.1%)**	**5,883 (141.9%)**	**-1,519 (-36.6%)**	**-1,060 (-25.6%)**	**-458 (-11.1%)**	**20,922 (504.8%)**	**4,145**

* growth rates in parentheses, compared to base year

Source: **BOT's CPFS Database & calculated by BOT staff**

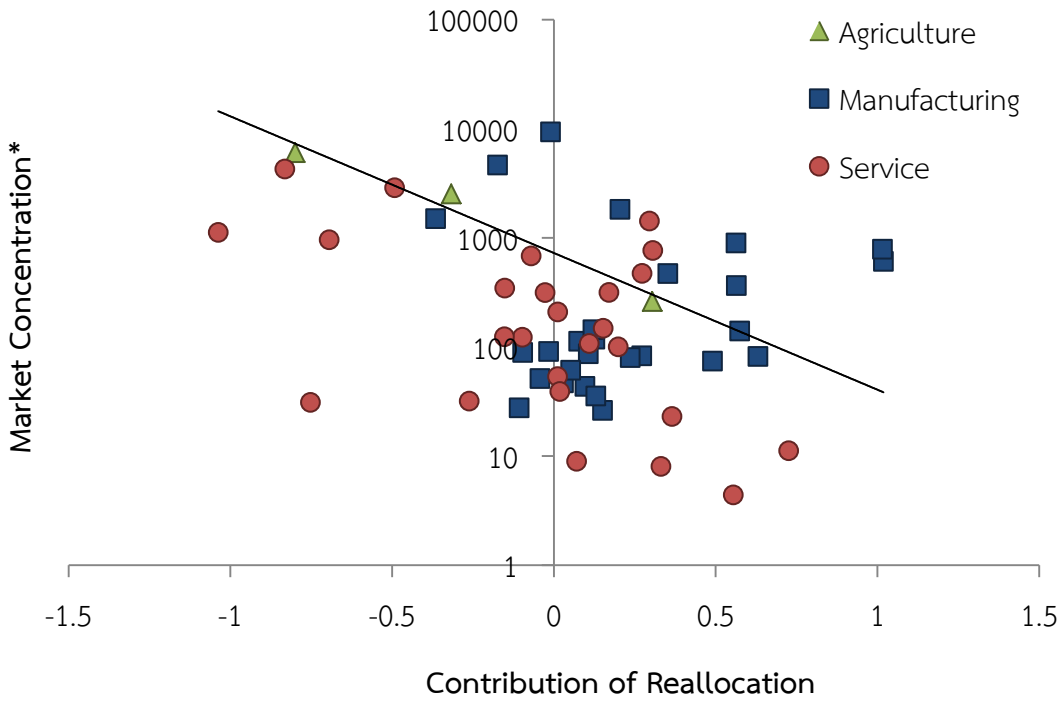
Figure 13: Productivity Growth Is Correlated with Growth-Inducing Reallocation



Source: BOT's CPFS Database & calculated by BOT staff

Examining the relationship between change in productivity (calculated for 2-digit ISIC industries (see appendix for the table)) and the contribution of reallocation shows a strong correlation. This suggests that productivity growth of Thai industries is attributable to creative destruction, or lack thereof. Interestingly, many sectors that show low productivity growth and low reallocation tend to be in the service sector and may reflect the protection bias towards service industries.

Figure 14: Competition Fosters Growth-Inducing Reallocation



*Herfindahl index, log scale

Source: BOT's CPFS Database & calculated by BOT staff

4 Conclusion and Policy Implications

This paper finds that the forces of creative destruction are at work in the Thai economy. However, it is not prevalent throughout all sectors, suggesting that the economy is bifurcated: a dynamic Thailand co-exists alongside a stagnant Thailand. The challenge for policymakers is therefore how to unleash the forces of creative destruction across the economy.

An innovation-based economy consists of both market and non-market institutions; policy-makers must implement reforms and coordinate policies across diverse areas such as competition policy, education, labor market, capital market and the institutional environment concerning for example intellectual property rights. Corruption is also an issue as it reflects unproductive rent-seeking due to a distorted regulatory environment and therefore inhibits research and development. Key findings stemming directly from this paper include fostering product market competition to incentivize innovation and factor reallocation. As a first step, policymakers can reduce barriers to market functioning such as price controls or subsidies. In addition, protected sectors tend to exhibit low creative destruction and need to be deregulated.

As Thailand is an emerging market, it may be tempting to think that pursuing innovation-led growth model is premature. In fact, any emerging market can set the stage for innovation. A growth strategy based on innovation is a strategy that will pay handsome dividends in the long term. Thailand already is already partially harnessing the forces of creative destruction. However, this is significant room for improvement. For example, China, India and Malaysia have already overtaken Thailand in terms of patents per capita. Furthermore, dispersion of Thailand's marginal revenue product of capital lags behind the US benchmark.[9] Thailand can begin laying the foundation for an innovation economy today.

[9] See Ariyapruchya, Chantapant and Apaitan (2011). "Dealing with Structural Change: A Diagnosis of the Thai Economy".

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Appendix

1 Competition fosters innovation

Data

Productivity Investment Climate Survey(PICS) is a survey of nearly 1400 manufacturing firms in Thailand. The survey was implemented by the National Economic Development Board, the Productivity Institute and the World Bank. The survey is based on a core set of questions that have been applied to firms in several other countries. The survey provides a rich data on firm characteristics and perceived business climate.

The PICS is divided into the following modules: CEO, Finance Manager, Personnel Manager and Workers Survey. PICS surveyed 1,385 firms surveyed from March 2004 to February 2005 with a response rate of 40 percent. The survey covers six regions: North, North East, Central, Bangkok and Vicinity, East and South; and eight industries: food processing, textiles, wearing apparel, auto parts, electronic parts and electrical appliances, rubber and plastic, wooden furniture and product, and machinery and equipment. Sampling is random by industry with the goal of obtaining observations of small, medium and large firms. However, the data is biased towards the larger companies as evidenced by the high occurrence of exporting and foreign ownership.

The PICS survey responses are gleaned from interviews with CEOs, human resource managers, and a sample of workers. Most variables contain information for the years 2001 and 2002. The details are as follows:

Production Variables The survey includes 3 years regarding firm output and capital input spanning 2000, 2001 and 2002; employment questions span 3 years: 2001, 2002, 2003. In effect, 2 years of data can be used for production function estimation.

Real Value Added We estimate production functions with value added as the dependent variable. To obtain a measure of value added we deflate these nominal values of total sales using producer price inflation (PPI) and subtract deflated expenditure on raw materials (direct material cost + purchased parts cost + electricity + fuel and other energy).

Labor variables Data is available on the number of workers within production and non-production assignments. Production workers are assumed to be unskilled workers, while non-production workers, such as managers, specialists and professionals are skilled.

Physical Capital We have firm balance sheet information that gives us a book value of capital such as equipment, machinery, factories and real estate. This is our proxy for the capital stock. In addition, we have a question on productive capital investment. First difference in the capital stock proxy for missing values in the productive capital investment responses.

Investment Climate Variables As one of the main goals of the survey is measuring the impact of the regulatory and investment climate on firm performance, firms were asked to judge how a broad range of problematic business investment climate factors impacted firm operation.

2 Reallocation and competition

OIE's Annual Survey on Thailand's Productivity and industries Performance Data

- Firm's performance data in the manufacturing sector over 2008-2011
- Total 9,306 observations represent the population in the manufacturing sector.

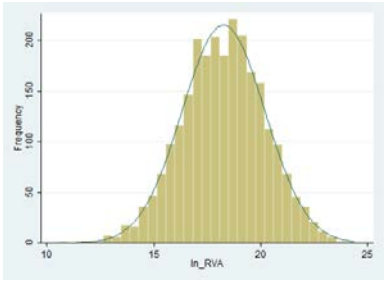
Summary Stats

Where RVA = the real value added of each firm in each period

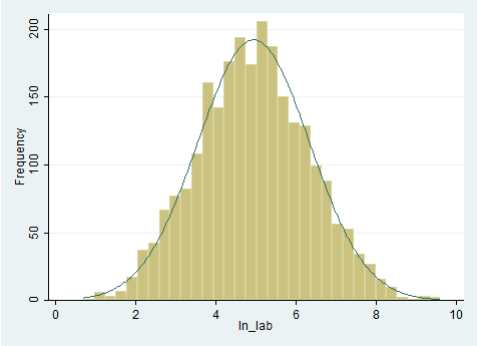
lab = the number of labor of each firm in each period

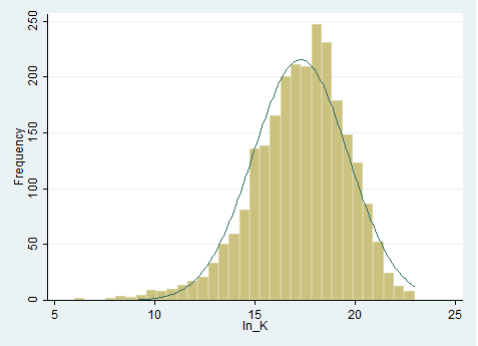
K = the real net fixed assets of each firm in each period

2008

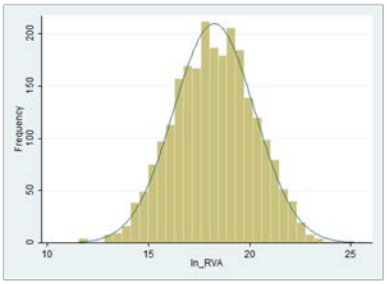


2008	N	mean	sd	min	max
RVA	2,488	464,000,000	1,490,000,000	37,635	39,000,000,000
lab	2,488	365	788	2	14,773
K	2,488	222,000,000	643,000,000	1,893	9,400,000,000

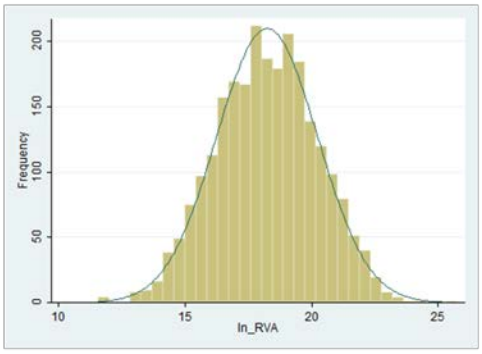


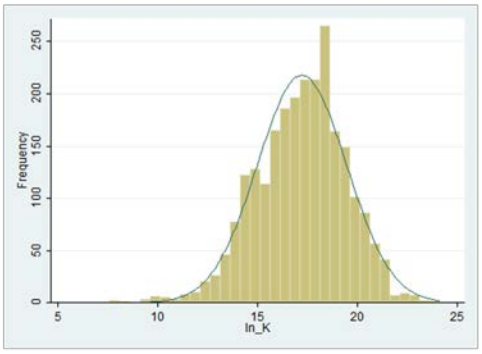


2009

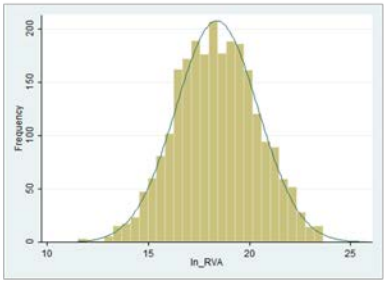


2009	N	mean	sd	min	max
RVA	2,431	540,000,000	3,510,000,000	103,785	160,000,000,000
lab	2,431	398.5668	910.9605	2	15,200
K	2,431	232,000,000	980,000,000	2,008	31,000,000,000

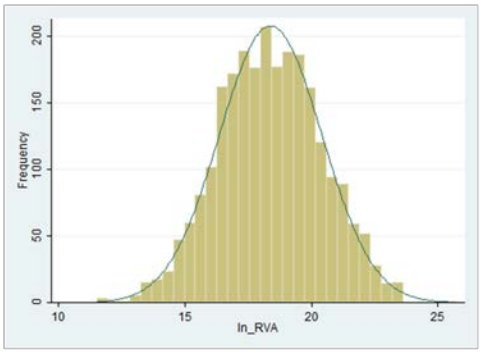


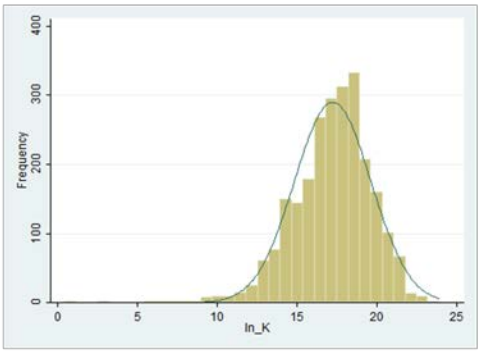


2010

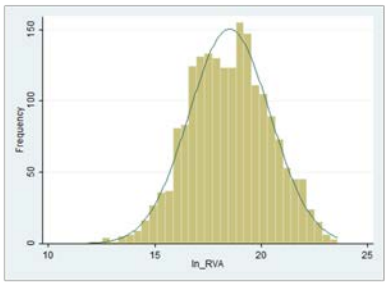


2010	N	mean	sd	min	max
RVA	2,445	661,000,000	3,600,000,000	100,853	160,000,000,000
lab	2,445	388.5194	926.1928	3	15,200
K	2,445	238,000,000	862,000,000	1,265	24,000,000,000

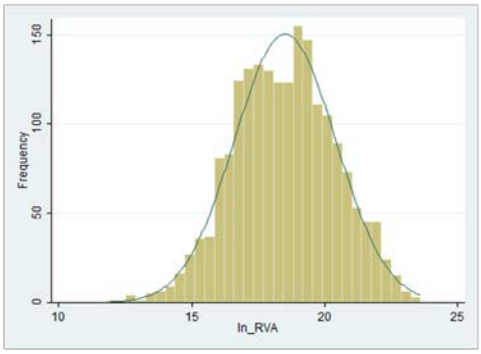


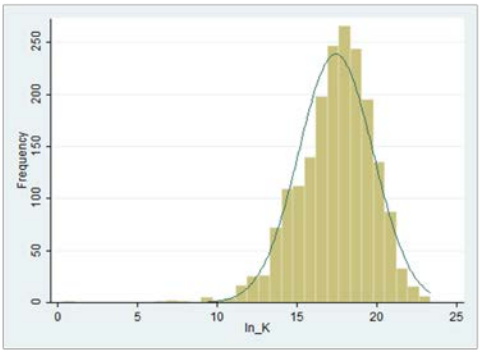


2011



2011	N	mean	sd	min	max
RVA	1,942	538,000,000	1,300,000,000	134,632	18,000,000,000
lab	1,942	374.8728	711.1976	3	9,763
K	1,942	255,000,000	777,000,000	1,132	14,000,000,000





OIE's Estimation of TFP

The total factor productivity (TFP) in this study is estimated as the residual from the Cobb-Douglas production function estimation as follows:

$$Y = AL^{\varepsilon^L} K^{\varepsilon^K}$$

This equation is vastly estimated by ordinary least square (OLS), pointed by Olley and Pakes (1996) that the OLS estimates may suffer from simultaneity and selection biases. So, they develop a semiparametric estimator using investment to proxy for an unobserved productivity shock. Then, Levinsohn and Petrin (2003) (LP) proposes to use intermediate inputs instead of imposing a polynomial approximation of investment to control for correlation between input levels and the unobserved firm-specific productivity process. We follow the Wooldridge (2009) modification of the LP (WLP) which specifies instruments for different equations and applies generalized method of moments (GMM). The WLP estimation has some advantages over the LP method such as allowing the labor input to be a deterministic function of unobserved productivity and state variables, providing fully robust standard errors, and efficiently accounting for serial correlation and heteroskedasticity. The WLP estimations of the elasticity of labor (ε^L) and capital (ε^K) for each industry (grouped by the 3-digit ISIC) are reported along with OLS, Fixed Effect (FE), First Difference (FD) and LP estimators. The standard errors are shown in parentheses, whereas ***, ** and * represents the rejection of the null hypothesis that an estimate is negative at 1%, 5% and 10% significance level, respectively.

Table A1: Estimated Elasticity by Industry

Industry	The estimated elasticity of labor					The estimated elasticity of capital				
	OLS	FE	FD	LP	WLP	OLS	FE	FD	LP	WLP
Meat & Fruit	0.73***	0.01	0.13	0.51***	0.57***	0.37***	0.21***	0.24***	0.25***	0.25***
	(0.0582)	(0.0939)	(0.1159)	(0.0702)	(0.0833)	(0.0445)	(0.041)	(0.0876)	(0.0653)	(0.0556)
Sugar & Grain Mill Products	0.64***	0.15**	-0.03	0.44***	0.41***	0.43***	-0.04	-0.05	0.00	0.07
	(0.0698)	(0.0773)	(0.0953)	(0.0542)	(0.0739)	(0.0407)	(0.043)	(0.0502)	(0.0566)	(0.0628)

Industry	The estimated elasticity of labor					The estimated elasticity of capital				
	OLS	FE	FD	LP	WLP	OLS	FE	FD	LP	WLP
Textiles	0.7***	0.31***	0.27**	0.39***	0.41***	0.29***	0.02	0.06*	0.1**	0.14***
	(0.0658)	(0.0737)	(0.1575)	(0.0682)	(0.0822)	(0.038)	(0.032)	(0.0443)	(0.0576)	(0.0558)
Apparel	0.65***	0.27***	0.33**	0.4***	0.45***	0.29***	0.15***	0.17***	0.11*	0.17***
	(0.0783)	(0.0724)	(0.1714)	(0.066)	(0.0744)	(0.053)	(0.0314)	(0.0651)	(0.0765)	(0.0542)
Leather Products: Handbag	0.34***	0.14*	0.14*	0.23**	0.23*	0.32***	0.16**	0.16*	0.01	0.05
	(0.1088)	(0.0907)	(0.0903)	(0.1135)	(0.1501)	(0.0702)	(0.08)	(0.0996)	(0.205)	(0.1201)
Leather Products: Footwear	0.6***	0.1	-0.04	0.32***	0.2**	0.32***	0.34***	0.11**	0.3***	0.19***
	(0.1043)	(0.1265)	(0.1375)	(0.0989)	(0.1031)	(0.087)	(0.0599)	(0.0599)	(0.1207)	(0.0748)
Wood	0.91***	0.39**	0.32	0.53***	0.44***	0.13*	-0.01	-0.11	0.10	-0.02
	(0.1353)	(0.2173)	(0.4339)	(0.1515)	(0.1214)	(0.0793)	(0.0628)	(0.1045)	(0.2319)	(0.0924)
Paper	0.41***	0.06	-0.12	0.26***	0.3***	0.52***	0.05	0.02	0.01	0.01
	(0.1665)	(0.1329)	(0.0905)	(0.0923)	(0.1241)	(0.0944)	(0.0654)	(0.0692)	(0.0887)	(0.091)
Printing	0.75***	0.48***	0.31**	0.48***	0.42***	0.25***	0.25***	0.33***	0.23**	0.22**
	(0.1073)	(0.1545)	(0.1651)	(0.1132)	(0.1029)	(0.0572)	(0.0573)	(0.1109)	(0.1191)	(0.1049)
Chemicals	0.55***	0.43***	0.31**	0.34***	0.35***	0.46***	0.2***	0.13***	0.14***	0.17***
	(0.0623)	(0.0819)	(0.1871)	(0.0594)	(0.0741)	(0.0428)	(0.0319)	(0.0372)	(0.0475)	(0.0523)
Rubber	0.93***	0.51***	0.36**	0.38***	0.35***	0.17**	0.05*	0.03	0.04	0.07*
	(0.132)	(0.1527)	(0.2176)	(0.0705)	(0.0925)	(0.0815)	(0.0325)	(0.0295)	(0.0497)	(0.0443)
Plastic	0.5***	0.12**	0.24**	0.24***	0.26***	0.37***	0.1***	0.13***	0.25***	0.24***
	(0.0566)	(0.0622)	(0.1379)	(0.0539)	(0.0568)	(0.0368)	(0.028)	(0.0434)	(0.0546)	(0.0491)

Industry	The estimated elasticity of labor					The estimated elasticity of capital				
	OLS	FE	FD	LP	WLP	OLS	FE	FD	LP	WLP
Glass	0.51**	-0.14	-0.35	0.39*	0.85***	0.51***	0.76***	0.75***	0.55***	0.46***
	(0.2723)	(0.2434)	(0.3226)	(0.268)	(0.1976)	(0.2028)	(0.0815)	(0.2177)	(0.2249)	(0.1507)
Ceramic & Cement	0.56***	0.13*	-0.03	0.30***	0.22***	0.47***	0.40***	0.3***	0.35***	0.4***
	(0.0796)	(0.0926)	(0.0979)	(0.0571)	(0.0603)	(0.0516)	(0.0368)	(0.1243)	(0.1404)	(0.1043)
Metal I	0.54***	0.71***	0.51*	0.33***	0.24*	0.4***	0.15	0.08	0.46***	0.38***
	(0.1349)	(0.239)	(0.3351)	(0.1384)	(0.1462)	(0.0853)	(0.122)	(0.1469)	(0.1553)	(0.1116)
Structural Metal Products	0.80***	0.26**	0.11	0.45***	0.79***	0.31***	0.04	0.03	-0.01	0.01
	(0.16)	(0.1467)	(0.1912)	(0.1021)	(0.1423)	(0.118)	(0.0442)	(0.0413)	(0.2708)	(0.0603)
Fabricated Metal	0.50***	0.14*	0.00	0.24***	0.30***	0.45***	0.22***	0.26***	0.36***	0.36***
	(0.0806)	(0.0859)	(0.1516)	(0.0548)	(0.0805)	(0.0489)	(0.0493)	(0.1099)	(0.1255)	(0.0891)
Machinery & Equip	0.71***	0.41***	0.16	0.31***	0.6***	0.35***	0.27***	0.25***	0.25***	0.27***
	(0.0778)	(0.119)	(0.1737)	(0.0681)	(0.0913)	(0.0428)	(0.052)	(0.0756)	(0.1042)	(0.0813)
Electrical Machinery	0.70***	0.98***	0.96***	0.45***	0.34***	0.38***	0.13**	0.19**	0.48***	0.42***
	(0.1667)	(0.1964)	(0.3182)	(0.1025)	(0.108)	(0.0779)	(0.0656)	(0.1063)	(0.1288)	(0.1031)
Communication Equip	0.59***	0.43***	0.49**	0.21***	0.24***	0.34***	0.11***	0.13***	0.19***	0.21***
	(0.0891)	(0.0937)	(0.2329)	(0.0637)	(0.0781)	(0.0592)	(0.0275)	(0.0438)	(0.0668)	(0.0568)
Medical & Optical Inst	0.82***	0.18	0.13	0.31***	0.32***	0.23***	0.04	0.04	-0.03	-0.04
	(0.094)	(0.1519)	(0.1407)	(0.117)	(0.1158)	(0.0681)	(0.052)	(0.0402)	(0.1319)	(0.0693)
Autoparts	0.35***	0.18***	0.11	0.05	-0.03	0.5***	0.23***	0.19***	0.27***	0.3***
	(0.1)	(0.0739)	(0.1046)	(0.0765)	(0.0848)	(0.0552)	(0.0364)	(0.0675)	(0.1094)	(0.0671)
Jewelry, Sport & Toys	0.69***	0.34	0.15	0.52***	0.51***	0.26***	-0.03	0.16	-0.21	0.09
	(0.1027)	(0.3696)	(0.3612)	(0.1061)	(0.1086)	(0.0769)	(0.1319)	(0.1873)	(0.356)	(0.0942)

Source: OIE & calculated by BOT staff

OIE's Estimation of Reallocation and Competition

The annual aggregate productivity growth and its reallocation contribution are summarized as follows:

Table A2: Reallocation & Competition

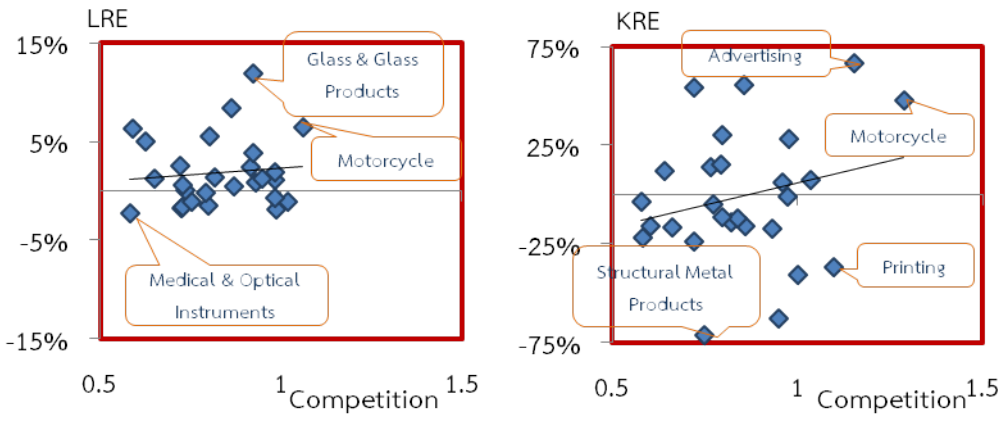
Year	APG	TE	LRE	KRE
2009	-1.3%	-23.7%	0.3%	22.1%
2010	27.8%	38.4%	-0.5%	-10.1%
2011	-23.1%	-34.1%	1.2%	9.8%

Source: OIE & calculated by BOT staff

The aggregate productivity growth is consistent with the economic activity as they drop during 2009 (subprime) and 2011 (the great flood). The total reallocation (LRE + KRE), nevertheless, moves in the opposite direction, implying that firms may compete more to attract both labor and capital when economy is slow down.

With an inverse of TFP's standard deviation as a proxy of competition, its relationship with reallocation is illustrated as:

Figure A1: Reallocation & Competition 2008-2011



Source: OIE & calculated by BOT staff

3 Firm dynamics: entry, exit and efficiency.

Bank of Thailand's Corporate Profile and Financial Statement (CPFS) Database

Financial statements (1999-2010). Industries are classified by Thailand Standard Industrial Classification (TSIC 2009), based on ISIC Rev.4. Covers 598,349 firms (with 353,137 still-active firms in 2010) Original source is the Department of Business Development (DBD), Ministry of Commerce.

Table A3: Productivity Growth and the Decomposition between 1999 and 2010 at 2-digit ISIC level

Industry	Within	Between	Entry	Exit	Total	HI1999*	HI2010*
01 - Agriculture, hunting and related service activities	0.37	0.05	0.19	0.07	0.67	261.29	351.49
02 - Forestry, logging and related service activities	0.04	-0.49	-0.60	0.30	-0.76	6050.46	2847.44
05 - Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	-0.03	-0.01	-0.18	-0.13	-0.34	2529.35	426.86
10 - Mining of coal and lignite; extraction of peat	0.63	-0.00	0.00	-0.01	0.62	9367.76	10000.00
11 - Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	-0.06	0.15	-0.12	-0.20	-0.23	4658.61	5145.50
13 - Mining of metal ores	-0.07	0.36	0.57	0.08	0.95	610.62	2807.74
14 - Other mining and quarrying	0.17	0.11	0.03	-0.01	0.30	118.11	114.03
15 - Manufacture of food products and beverages	0.12	-0.01	-0.08	-0.01	0.01	27.69	58.62
16 - Manufacture of tobacco products	0.06	0.07	0.02	0.11	0.26	1825.98	2164.05
17 - Manufacture of textiles	0.12	-0.05	-0.00	0.01	0.08	51.52	81.01
18 - Manufacture of wearing apparel; dressing and dyeing of fur	-0.12	0.07	-0.01	-0.03	-0.09	46.92	96.07
19 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	-0.09	0.12	-0.01	-0.03	-0.01	112.97	204.22
20 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-0.11	0.11	0.14	0.24	0.38	74.45	97.94
21 - Manufacture of paper and paper products	0.08	-0.04	-0.00	0.02	0.07	91.10	254.76
22 - Publishing, printing and reproduction of recorded media	-0.03	0.07	0.04	0.00	0.08	86.79	69.87
23 - Manufacture of coke, refined petroleum products and nuclear fuel	0.33	0.16	0.45	-0.04	0.90	899.44	3746.12
24 - Manufacture of chemicals and chemical products	0.13	0.03	0.04	0.03	0.22	43.58	379.63
25 - Manufacture of rubber and plastics products	0.26	0.03	0.10	0.03	0.41	26.23	108.11
26 - Manufacture of other non-metallic mineral products	0.20	-0.07	-0.07	0.05	0.11	89.18	227.36
27 - Manufacture of basic metals	0.23	0.02	0.11	0.14	0.50	83.18	180.58
28 - Manufacture of fabricated metal products,	0.14	0.02	-0.01	0.04	0.19	61.34	94.54

Industry	Within	Between	Entry	Exit	Total	HI1999*	HI2010*
except machinery and equipment							
29 - Manufacture of machinery and equipment n.e.c.	0.12	0.03	0.16	0.04	0.36	80.09	167.16
30 - Manufacture of office, accounting and computing machinery	0.18	0.42	0.63	-0.03	1.20	788.71	1976.84
31 - Manufacture of electrical machinery and apparatus n.e.c.	0.28	-0.01	0.10	0.03	0.40	144.20	308.44
32 - Manufacture of radio, television and communication equipment and apparatus	0.13	0.11	0.30	0.17	0.70	140.39	341.84
33 - Manufacture of medical, precision and optical instruments, watches and clocks	0.19	0.27	-0.08	0.16	0.54	471.54	1898.20
34 - Manufacture of motor vehicles, trailers and semi-trailers	0.29	0.12	0.43	0.09	0.92	81.87	553.59
35 - Manufacture of other transport equipment	0.24	0.07	0.40	0.09	0.80	366.04	1491.37
36 - Manufacture of furniture; manufacturing n.e.c.	-0.14	0.07	0.06	0.00	-0.01	35.57	117.74
37 - Recycling	0.16	-0.28	-0.02	-0.07	-0.21	1502.70	854.90
40 - Electricity, gas, steam and hot water supply	0.23	-0.33	-0.41	-0.30	-0.80	1123.69	1687.40
41 - Collection, purification and distribution of water	-0.18	-0.20	-0.51	-0.12	-1.02	4281.54	3821.41
45 - Construction	-0.02	0.05	-0.03	0.05	0.05	8.96	22.43
50 - Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	0.57	0.14	0.41	0.18	1.30	11.21	67.42
51 - Wholesale trade and commission trade, except of motor vehicles and motorcycles	-0.02	0.18	0.24	0.14	0.54	4.41	23.69
52 - Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	0.08	0.07	0.17	0.09	0.41	8.05	165.60
55 - Hotels and restaurants	0.07	0.02	-0.01	-0.01	0.08	53.49	71.43
60 - Land transport; transport via pipelines	0.04	-0.23	-0.39	-0.13	-0.71	31.04	4617.91
61 - Water transport	-0.09	0.02	-0.05	-0.07	-0.18	122.96	80.63
62 - Air transport	-0.08	0.24	0.09	-0.03	0.22	1427.83	2432.99
63 - Supporting and auxiliary transport activities; activities of travel agencies	0.00	-0.01	-0.22	-0.03	-0.26	31.97	65.33
64 - Post and telecommunications	0.07	-0.33	-0.32	-0.04	-0.62	961.00	1518.54
65 - Financial intermediation, except insurance and pension funding	-0.04	-0.02	-0.09	-0.05	-0.19	124.30	443.86
66 - Insurance and pension funding, except compulsory social security	0.07	-0.05	-0.06	-0.04	-0.09	346.68	695.87
67 - Activities auxiliary to financial intermediation	0.00	0.06	-0.08	-0.01	-0.03	315.36	228.49
70 - Real estate activities	-0.00	0.02	0.02	-0.02	0.02	39.14	127.43
71 - Renting of machinery and equipment without operator and of personal and household goods	-0.13	0.07	-0.05	-0.01	-0.12	209.94	130.33
72 - Computer and related activities	0.04	-0.08	0.12	0.13	0.21	316.31	112.60
73 - Research and development	-0.09	0.31	0.01	-0.05	0.18	473.66	439.75
74 - Other business activities	-0.14	0.11	0.18	0.07	0.23	23.14	1281.49
80 - Education	0.06	-0.03	-0.03	-0.01	-0.01	684.50	191.57
85 - Health and social work	0.31	0.01	0.07	0.03	0.42	107.66	96.86
90 - Sewage and refuse disposal, sanitation and	-0.14	0.27	0.10	-0.06	0.16	766.92	353.51

Industry	Within	Between	Entry	Exit	Total	HI1999*	HI2010*
similar activities							
91 - Activities of membership organizations n.e.c.	0.31	-0.40	-0.10	0.00	-0.18	2882.78	766.00
92 - Recreational, cultural and sporting activities	0.12	0.06	0.07	0.07	0.32	100.54	138.55
93 - Other service activities	-0.12	0.15	0.01	-0.02	0.03	148.76	235.51
Overall	0.09	0.03	0.06	0.04	0.23	n/a	n/a

*Herfindahl index

Source: **BOT's CPFS Database & calculated by BOT staff**

Griliches and Regev (1995) decomposition for aggregate efficiency change

We define turnover as $\frac{Sales}{Total\ Assets}$ and use it as a proxy for capital efficiency and productivity. Thus, sector-level turnover ratio can be expressed by the weighted average of individual turnover ratios using firms' share of total asset as weights

$$T_t = \sum_i a_{i,t} t_{i,t}$$

where 'a' is assets share of firm i, t is the turnover ratio of firm i. Following Griliches and Regev (1995), we decompose the change in turnover ratio into four components: within, between, entry and exit:

$$\begin{aligned}\Delta T_t = & \sum_{i \in Incumbent} \bar{a}_i \Delta t_{i,t} \\ & + \sum_{i \in Incumbent} \Delta a_{i,t} (\bar{t}_i - \bar{T}) \\ & + \sum_{i \in Entrant} a_{i,t} \left(t_{i,t} - \bar{T}\right) \\ & - \sum_{i \in Exiter} a_{i,t-k} \left(t_{i,t-k} - \bar{T}\right)\end{aligned}$$

Where $\bar{a}_i = \left(a_{i,t} + a_{i,t-k}\right)/2$ and $\bar{T} = (T_t + T_{t-k})/2$

- The 'within' component reflects gains from within-firm growth. Given that asset shares do not change, and turnover of incumbent firms grows, sector's turnover grows at the same time.
- The 'between' component captures gains from the expansion of firms with relatively higher turnover. If an incumbent firm with a turnover ratio above the sector's average expands, so does the sector's turnover.
- The 'entry' component reflects gains due to entries of 'good firms' (firms that have turnover above the sector average).
- The 'exit' component reflects gains due to exits of 'bad firms' (firms that have turnover below the sector average).

Table A4: Number of Firms Classified by Industry

Industry	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
A - Agriculture, hunting and forestry	1,373	1,334	1,396	1,181	1,193	1,553	1,576	1,825	1,940	2,017	2,138	2,200
B - Fishing	227	212	194	163	169	187	169	166	182	185	179	171
C - Mining and quarrying	1,176	1,113	1,091	841	766	1,011	986	1,057	1,108	1,154	1,207	1,252
D - Manufacturing	35,116	35,217	37,772	30,918	30,824	44,855	43,109	42,033	45,805	47,471	48,730	50,523
E - Electricity, gas and water supply	292	300	306	221	201	295	444	685	315	409	564	832
F - Construction	30,435	30,556	30,067	15,916	14,396	31,176	30,624	32,941	35,156	37,231	38,232	40,712
G - Wholesale and retail trade; repair	94,574	94,208	98,241	71,795	69,961	105,551	99,509	105,354	113,915	119,239	120,553	125,410
H - Hotels and restaurants	8,533	8,509	8,925	7,659	8,099	11,220	8,407	12,259	14,510	16,140	16,687	17,711
I - Transport, storage and communications	12,796	13,177	13,928	10,828	10,512	15,981	14,923	16,372	18,272	19,627	19,887	21,024
J - Financial intermediation	3,979	4,025	4,471	4,299	4,480	5,325	5,470	5,705	6,078	6,356	6,399	6,858
K - Real estate, renting and business activities	36,486	36,206	38,992	36,203	37,752	48,330	53,370	59,078	64,771	68,981	69,170	73,648
L - Public administration and defence; compulsory social security	1	1	1	n/a	n/a	1	40	5	4	2	1	1
M - Education	470	475	581	599	649	844	1,375	968	1,012	1,049	1,071	1,120
N - Health and social work	843	867	900	841	913	1,182	1,150	1,272	1,469	1,663	1,812	1,973
O - Other community, social and personal service activities	3,885	4,014	4,262	3,638	3,629	4,943	4,070	4,708	5,190	5,602	5,820	8,702
P - Private households with employed persons	n/a	n/a	n/a	n/a	n/a	n/a	10	n/a	n/a	n/a	n/a	n/a
Grand Total	**230,186**	**230,214**	**241,127**	**185,102**	**183,544**	**272,454**	**265,232**	**284,428**	**309,727**	**327,126**	**332,450**	**352,137**

Source: **BOT's CPFS Database & calculated by BOT staff**

Table A5: Number of Firms Classified by Type

Firm type	No. of firms
Entrant	165,665
Exiter	64,215
In-And-Out	134,167
Incumbent	72,415
Unidentified and Outlier	161,887
Total	**598,349**

*Between 1999 and 2010

Source: BOT's CPFS Database & calculated by BOT staff

Table A6: Number of Entrants and the Exiters Classified by Year of Entry and Exit

Year	In	Out	Net
1999		-8,317	
2000	9,772	-7,544	2,228
2001	11,075	-11,104	-29
2002	8,363	-4,588	3,775
2003	8,988	-3,715	5,273
2004	20,988	-8,205	12,783
2005	15,258	-2,463	12,795
2006	15,504	-3,944	11,560
2007	16,736	-3,821	12,915
2008	17,990	-4,269	13,721
2009	18,721	-6,245	12,476
2010	22,270		
Total	**165,665**	**-64,215**	

Source: BOT's CPFS Database & calculated by BOT staff