

Amornkitvikai, Yot; Harvie, Charles

**Working Paper**

## The impact of finance on the performance of Thai manufacturing small and medium-sized enterprises

ADBI Working Paper, No. 576

**Provided in Cooperation with:**

Asian Development Bank Institute (ADBI), Tokyo

*Suggested Citation:* Amornkitvikai, Yot; Harvie, Charles (2016) : The impact of finance on the performance of Thai manufacturing small and medium-sized enterprises, ADBI Working Paper, No. 576, Asian Development Bank Institute (ADBI), Tokyo

This Version is available at:

<https://hdl.handle.net/10419/161452>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by-nc-nd/3.0/igo/>



## **ADBI Working Paper Series**

### **The Impact of Finance on the Performance of Thai Manufacturing Small and Medium-Sized Enterprises**

Yot Amornkitvikai  
and Charles Harvie

No. 576  
June 2016

**Asian Development Bank Institute**

Yot Amornkitvikai is a lecturer in the Faculty of Economics, Rangsit University, Pathumthani, Thailand. Charles Harvie is an associate professor in the Faculty of Business, University of Wollongong, Wollongong, Australia.

The views expressed in this paper are the views of the author and do not necessarily reflect the views or policies of ADBI, ADB, its Board of Directors, or the governments they represent. ADBI does not guarantee the accuracy of the data included in this paper and accepts no responsibility for any consequences of their use. Terminology used may not necessarily be consistent with ADB official terms.

Working papers are subject to formal revision and correction before they are finalized and considered published.

The Working Paper series is a continuation of the formerly named Discussion Paper series; the numbering of the papers continued without interruption or change. ADBI's working papers reflect initial ideas on a topic and are posted online for discussion. ADBI encourages readers to post their comments on the main page for each working paper (given in the citation below). Some working papers may develop into other forms of publication.

Suggested citation:

Amornkitvikai, Y., and C. Harvie. 2016. The Impact of Finance on the Performance of Thai Manufacturing Small and Medium-Sized Enterprises. ADBI Working Paper 576. Tokyo: Asian Development Bank Institute. Available: <http://www.adb.org/publications/impact-finance-performance-thai-manufacturing-small-and-medium-sized-enterprises/>

Please contact the authors for information about this paper.

E-mail: [yot.a@rsu.ac.th](mailto:yot.a@rsu.ac.th), [charvie@uow.edu.au](mailto:charvie@uow.edu.au)

Notes:

In this publication, “\$” refers to US dollars.

Unless otherwise stated, tables without explicit sources were prepared by the authors.

Asian Development Bank Institute  
Kasumigaseki Building 8F  
3-2-5 Kasumigaseki, Chiyoda-ku  
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500

Fax: +81-3-3593-5571

URL: [www.adbi.org](http://www.adbi.org)

E-mail: [info@adbi.org](mailto:info@adbi.org)

© 2016 Asian Development Bank Institute

**Abstract**

This study sheds light on small and medium-sized enterprise (SME) financing and its performance in Thailand. It elaborates on the key sources of finance existing for Thai manufacturing SMEs and their importance for SME performance as measured by technical efficiency, export performance, and technological innovation. This study also examines the key factors enhancing SME access to external finance. Our results confirm that retained earnings are crucial to increase SME technical efficiency, but loans from unlicensed moneylenders deteriorate their export performance. For external finance, government-owned specialized financial institutions (SFIs) play a leading role in enhancing SME technical efficiency and export performance, but the results from the survey reveal that few Thai manufacturing SMEs actively seek external finance from these institutions. Foreign commercial banks also help enhance SME technical efficiency. The results show that larger SMEs have superior performance as measured by export performance and technological innovation performance. The results also reveal that financial institutions in Thailand still rely on collateral-based lending and SME financial transparency through audited financial statements to reduce asymmetric information and adverse selection costs.

**JEL Classification:** D22, D24, G20, L25, L60

## Contents

1.	Introduction.....	3
2.	Methodology .....	8
2.1	Firm Performance .....	8
2.2	Empirical Models Used to Link Key Factors Contributing to the Performance of Small and Medium-Sized Enterprises .....	9
3.	Literature Review.....	10
4.	Data Source and Data Classification.....	12
5.	Empirical Models and Results.....	12
5.1	Empirical Models.....	13
5.2	Empirical Results .....	15
6.	Conclusions and Policy Implications .....	21
	References .....	24
	Appendix: Variable Definitions and Summary Statistics .....	27

## 1. INTRODUCTION

SMEs are the lifeblood of the Thai economy, contributing significantly to social and economic development (Brimble et al. 2002). They accounted for 99.2% of business establishments and 79.1% of total employment between 2007 and 2013. SME production also represented 37.5% of GDP during the same period (Table 1). However, SME contribution to the country's GDP has gradually declined from 38.2% in 2007 to 37.4% in 2013. Thai manufacturing SMEs played a leading role in the economy, accounting for 19.6% of business establishments, 27.1% of total employment, and 11.6% of GDP from 2007 to 2013 (Table 1). SMEs also assist large enterprises in regional production networks, since they link all key units of industry and fill gaps in industrial clusters that may not be completed by large enterprises alone (Regnier 2000, Mephokee 2004). As suggested by Tapaneeyangkul (2001), SMEs are key sources of supply of goods, services, information, and knowledge for large enterprises, and play a pivotal role in the production process of export goods.

**Table 1: Contribution of Manufacturing SMEs to the Thai Economy, 2007–2013**

Enterprises	2007	2008	2009	2010	2011	2012	2013
<b>Business numbers</b>							
SMEs (% of total firms)	99.6	99.7	99.8	99.6	99.8	98.5	97.2
Manufacturing SMEs (% of total firms)	28.2	19.2	18.9	18.6	17.8	17.4	16.9
<b>SME employment</b>							
SMEs (% of total employment)	76.0	76.2	78.2	77.9	83.9	80.4	80.96
Manufacturing SMEs (% of total employment)	29.6	29.6	26.8	25.9	24.8	26.3	26.6
<b>GDP of SMEs</b>							
SMEs (% of total GDP)	38.2	38.1	37.8	37.1	36.6	37.0	37.4
Manufacturing SMEs (% of total GDP)	11.7	11.8	11.5	12.0	11.4	11.4	11.1
<b>SME exports</b>							
Total exports (% of total GDP)	61.9	64.5	57.4	60.5	63.6	62.3	58.1
SMEs (% of total exports)	30.1	28.9	30.1	27.3	29.4	28.8	25.5
SMEs (% of total GDP)	18.7	18.6	17.3	16.5	18.7	18.0	14.8

GDP = gross domestic product, SMEs = small and medium-sized enterprises.

Source: Office of Small and Medium Enterprises Promotion. 2007–2013. *The White Paper on Small and Medium Enterprises of Thailand and Trends*. Bangkok.

Harvie (2002), however, also pointed out that there are five main difficulties obstructing SME development: (i) access to markets, (ii) access to technology, (iii) access to human resources, (iv) access to financing, and (v) access to information. Similarly, Payasavatsut (2008, p. 294) also mentioned that SMEs confront common constraints in their operations such as limited access to market information and promotional support from government agencies, shortage of financial support, lack of management capabilities, inadequate skilled labor, and uncertainties in government support programs. Charoenrat et al. (2013) also revealed that SMEs face rigid barriers to their future growth and development in areas including access to finance, exporting, marketing, information technology, innovation, management skills, and government bureaucracy and regulations.

The financing challenges faced by SMEs have brought considerable attention from researchers and practitioners, since limited access to financing limits the economic growth and productivity of SMEs which sustains the large productivity gap between large and small firms, wage and income inequality, and poverty (Punyasavatsut 2011;

International Trade Centre 2015, p.15). SMEs face a “financing gap,” since they have considerable difficulty relative to large enterprises in receiving formal financing, and therefore rely heavily on internal financial sources, which can constrain their growth<sup>1</sup> (OECD 2006, Harvie et al. 2013). As SMEs also have fewer financing alternatives than large enterprises, they are impacted more by changes in market credit conditions (OECD 2015). In addition, most banks in Thailand will not apply the national definition of SMEs in their lending policy, where an enterprise is categorized as an SME if it has fewer than 200 employees and fixed capital of less than 200 million Thai baht (B) for production. Instead, each financial institution applies its own definition of an SME, such as sales less than B500 million and/or a credit line less than B200 million (OECD 2005). This makes access to finance even more difficult for those SMEs that do not align with the definitions used by banks. Definitions for SMEs are different across financial institutions. SME loans as indicated in Table 2, therefore, are based upon the various definitions of SMEs used by banks.

**Table 2: SME Loans for Thailand, 2007–2013**

Indicators	Definitions	2007	2008	2009	2010	2011	2012	2013
Debt								
Business loans, SMEs	\$ billion	38.5	43.7	45.6	52.9	56.7	66.3	72.2
Business loans, total	\$ billion	136.9	164.0	169.5	137.7	154.0	176.4	186.4
Business loans, SMEs	% of total business loans	28.1	26.6	26.9	38.4	36.8	37.6	38.7
Short-term loans, SMEs	\$ billion	16.7	19.4	20.2	30.7	25.7	31.8	52.6
Long-term loans, SMEs	\$ billion	21.8	24.3	25.4	22.1	28.8	34.3	33.1
Total short- and long-term loans, SMEs	\$ billion	38.5	43.7	45.6	52.8	54.5	66.1	85.7
Short-term loans, SMEs	% of total SME loans	43.4	44.4	44.2	58.1	47.1	48.1	61.4
Loan guarantees outstanding, SBGC	% billion	—	—	—	2.0	2.8	4.6	8.6
Nonperforming loans, total	\$ billion	13.1	11.9	12.0	0.0	4.8	4.8	4.5
Nonperforming loans, SMEs	\$ billion	3.0	3.0	3.5	2.4	2.0	2.2	2.2
Nonperforming loans, SMEs	% of total business loans	7.9	6.8	7.6	4.5	3.6	3.3	3.1
Nonperforming loans, large	% of total business loans	9.6	7.3	7.1	-	3.1	2.7	-
Interest rate, SME average rate	%	5.9	6.3	6.6	7.1	8.1	7.0	6.4
Interest rate spread (between average interest rate for loans to SMEs and large firms)	%	1.2	1.3	1.4	-	2.7	1.5	1.3
Collateral, SMEs	\$ billion	22.9	66.0	103.5	90.0	307.3	342.9	-
Collateral, SMEs	Value of collateral provided by SMEs over SME business loans, %	1.7	4.5	6.6	5.4	17.8	16.6	-
Average exchange rate (Thai baht: 1 US dollar)		34.56	33.36	34.34	31.73	30.49	31.09	30.73

SBGC = Small Business Credit Guarantee Corporation, SME = small and medium-sized enterprise.

Note: Average exchange rate was used to convert Thai baht (B) to US dollars (\$).

Source: Organisation for Economic Co-operation and Development (OECD). 2015. *Financing SMEs and Entrepreneurs 2015: An OECD Scoreboard*. Paris.

According to the Office of Small and Medium Enterprises Promotion (2013), there were 2.8 million SMEs in Thailand in 2013, constituting 97.2% of total enterprises. Even

<sup>1</sup> This is consistent with the so called “pecking order hypothesis” where SMEs utilize internal sources of finance first, as it is the least expensive, before accessing external sources such as in the form of debt (e.g., borrowing from a bank) or issuing equity (Myers and Majluf 1984). The latter may be impractical or very expensive for SMEs.

though SMEs dominated enterprises in Thailand in 2013, their business loans, equal to approximately \$72.2 billion, accounted for only 38.7% of total business loans. This problem has been exacerbated by systemic volatility in financial markets in the past, such as the Asian financial crisis in 1997 and the recent global financial crisis. According to OECD (2005), these financial crises have changed the lending behavior of Thai banks. Banks now consider credit risk besides considering adequate capital alone (OECD 2005). The percentage of SME nonperforming loans decreased from \$3 billion in 2007 to \$2 billion in 2013 (Table 2). In terms of the percentage of total business loans, nonperforming loans decreased from 7.9% in 2007 to 3.1% in 2013. However, with extreme risk aversion pervading bank lending behavior in Thailand, the value of collateral required has increased dramatically, from 1.7% of total SME loans in 2007 to 16.6% in 2012.

Short-term loans have become an increasingly important source of finance for SMEs; they increased by 179.6%<sup>2</sup> over the period 2007–2013. Long-term loans increased by 35.9%<sup>3</sup> over the same period. SMEs are charged higher interest rates than are large enterprises, with an average 1.6% difference in interest rates for loans to SMEs and large enterprises over the period 2007–2013. This implies that banks consider the business operations of SMEs riskier than those of large firms. Punyasavatsut (2011) acknowledged that Thai SMEs are likely to use their own or family funds to start and operate their businesses. Nevertheless, external finance is still important for extended credit, with commercial banks playing a leading role for Thai SME finance, since SMEs can have more chance in accessing loans provided by 30 commercial banks with 9,664 branches across the country. Commercial banks' total assets accounted for 47.9% of the total assets of financial institutions in 2015 (Bank of Thailand 2015a).

Commercial banks provided \$396.28 billion in loans to enterprises in Thailand in 2014, amounting to 3.51 times that of government-owned specialized financial institutions' (SFIs) outstanding loans at the end of 2014 (Table 3). In recent years, however, government-owned specialized financial institutions (SFIs) have become increasingly important for Thai SMEs, since they are another important source of finance for start-ups (SME Bank 2015). They were established to stabilize the country's economy via targeted groups such as low-income households and SMEs. At the end of 2014, government-owned SFIs provided loans to households and enterprises in Thailand amounting to \$119.29 billion. In recent years, the operations of government-owned SFIs have been carried out in response to the government's policy, which aims to alleviate effects from economic downturn and to facilitate access to capital for Thai SMEs. Slow growth in the domestic and global economy adversely impacted SMEs, which then affected the credit quality of government-owned SFIs because most of their customers are SMEs, which have lower levels of financial strength and adaptability compared with large enterprises (SME Bank 2015).

The Small and Medium Enterprise Development Bank of Thailand (SME Bank) was established to assist start-up SMEs or improve their businesses by providing loans, guarantees, venture capital, and counseling services. At the end of 2014, SME Bank had provided loans for 82,306 entrepreneurs, accounting for \$2.62 billion (Table 4). The Thai Credit Guarantee Corporation (TCG) was also established in 1991 to help small firms obtain credit from financial institutions through a guarantee service for Thai SMEs that had the potential to expand their businesses and generate profits into the

---

<sup>2</sup> The growth of short-term loans is calculated by considering Thai baht, but this figure would be 214.4% if we use US dollars instead.

<sup>3</sup> The growth of short-term loans is calculated by considering Thai baht, but this figure would be 52.0% if we use US dollars instead.

future but lacked collateral security. A nonprofit organization owned by the government, TCG has become a key driver in strengthening SMEs' ability to obtain more credit from financial institutions. It has also assisted in improving the social and economic growth of the country. The TCG has outstanding guarantees greater than that of other government-owned SFIs' outstanding loans. At the end of 2014, the approval of guarantee outstanding of the TCG stood at \$12.05 billion and outstanding credit guarantees at \$8.3 billion (Table 3), assisting 92,393 SMEs to acquire \$19.68 billion in loans from financial institutions. These enterprises employed 2.76 million workers in 2014 (TCG 2014).

**Table 3: Government-Owned Specialized Financial Institutions and Commercial Banks' Loans and Credit Guarantees in Thailand  
(US dollars)**

Year	SFIs	Growth Rate (%)	TCG	Growth Rate (%)	SMC	Growth Rate (%)	Local Banks	Growth Rate (%)	Foreign Banks	Growth Rate (%)	All Commercial Banks	Growth Rate (%)
2007	48.87		0.65		0.06		163.50		16.71		180.22	
2008	55.70	14.0	0.66	1.3	0.05	(7.4)	205.30	25.6	20.98	25.5	226.28	25.6
2009	65.01	16.7	1.16	77.3	0.04	(33.7)	202.85	(1.2)	24.53	17.0	227.38	0.5
2010	84.22	29.5	2.30	97.8	0.04	7.1	245.32	20.9	30.87	25.8	276.20	21.5
2011	105.23	24.9	3.71	61.3	0.05	26.9	286.37	16.7	34.41	11.5	320.79	16.1
2012	115.57	9.8	5.81	56.6	0.12	160.3	326.61	14.1	36.19	5.2	362.81	13.1
2013	120.86	4.6	7.93	36.6	0.19	53.5	364.90	11.7	36.70	1.4	401.61	10.7
2014	119.29	(1.3)	8.30	4.7	0.29	54.2	362.27	(0.7)	34.01	(7.3)	396.28	(1.3)

( ) = negative number; SFIs = government-owned specialized financial institutions, which consist of (i) government savings banks, (ii) Bank for Agriculture and Agriculture Co-operatives, (iii) Government Housing Bank, (iv) Islamic Bank, (iv) Export–Import Bank of Thailand (EXIM Bank), and (v) Small and Medium Enterprise Development Bank; TCG = Thailand Credit Guarantee Corporation; SMC = Secondary Mortgage Corporation.

Sources: Bank of Thailand. 2015. Commercial Banks' Loans, Deposits, and L/D Ratio. Bangkok. <http://www2.bot.or.th/statistics/BOTWEBSTAT.aspx?reportID=155&language=ENG> (accessed 20 October 2015); and Government of Thailand, Ministry of Finance. 2015. Table of Loans and Deposits of Specialized Financial Institutions. Fiscal Policy Office. Bangkok. [www.fpo.go.th/FPO/index2.php?mod=Category&file=categoryview&categoryID=CAT0001360](http://www.fpo.go.th/FPO/index2.php?mod=Category&file=categoryview&categoryID=CAT0001360) (accessed 21 October 2015).

For SME exporters, the Export–Import Bank of Thailand (EXIM Thailand) is another government-owned SFI. EXIM Thailand has launched a number of financial services in line with government policies and measures to stimulate the Thai economy, such as (i) SME start-up credit, (ii) SME Export Delight, (iii) SME border trade, (iv) SME relocation and expansion, and (v) SME research and development and innovation credit. At the end of 2014, EXIM Thailand granted loans to all exporting enterprises in Thailand amounting to \$2.25 billion (Table 4).

Although government-owned SFIs have been increasingly crucial for the development of Thai SMEs, a large number of Thai SMEs have not applied for loans or incentives. According to the World Bank Manufacturing Sector Survey for Thailand (2006), only 3.1% and 3.6% of Thai manufacturing SMEs in the survey applied and received loans from the SME Bank and EXIM Thailand, respectively (Table 5). This might be because Thai manufacturing SMEs prefer to obtain loans from commercial banks due to attractive interest rates and greater convenience. In addition, only 1.2% of Thai manufacturing SMEs applied and received credit guarantees from the Thai Credit Guarantee Corporation (Small Business Credit Guarantee Corporation).

**Table 4: Government-Owned Specialized Financial Institutions' Outstanding Loans and Credit Guarantees in Thailand**  
(\$ billion)

Year	GSB	Growth Rate (%)	BAAC	Growth Rate (%)	GHBank	Growth Rate (%)	Islamic Bank	Growth Rate (%)	EXIM Banks	Growth Rate (%)	SME Bank	Growth Rate (%)
2007	13.51	–	15.04	–	17.26	–	0.32	–	1.49	–	1.26	–
2008	16.35	21.00	17.52	16.51	18.50	7.21	0.50	55.65	1.52	2.33	1.31	4.09
2009	22.76	39.23	19.09	8.93	18.85	1.90	1.11	121.03	1.55	1.85	1.66	26.49
2010	35.04	53.95	21.35	11.84	20.78	10.21	2.71	145.47	1.78	14.91	2.56	54.56
2011	44.33	26.52	29.32	37.37	22.43	7.94	3.80	40.15	2.15	20.56	3.20	24.90
2012	47.97	8.21	35.73	21.87	22.71	1.26	3.89	2.20	2.14	(0.06)	3.11	(2.69)
2013	50.09	4.41	38.04	6.45	23.96	5.51	3.52	(9.37)	2.20	2.44	3.04	(2.32)
2014	49.42	(1.33)	37.12	(2.42)	24.45	2.04	3.43	(2.60)	2.25	2.51	2.62	(13.99)

( ) = negative number; BAAC = Bank for Agriculture and Agriculture Co-operatives, EXIM Bank = Export–Import Bank of Thailand, GHBank = Government Housing Bank, GSB = government savings banks, SME Bank = Small and Medium Enterprise Development Bank.

Source: Government of Thailand, Ministry of Finance. 2015. Table of Loans and Deposits of Specialized Financial Institutions (SFIs). Fiscal Policy Office. Bangkok. [www.fpo.go.th/FPO/index2.php?mod=Category&file=categoryview&categoryID=CAT0001360](http://www.fpo.go.th/FPO/index2.php?mod=Category&file=categoryview&categoryID=CAT0001360) (accessed 21 October 2015).

**Table 5: Loans, Guarantees, and Incentives Received from Government-Owned Agencies**

Reasons	SICGC	%	SME Bank	%	EXIM Bank	%	OSMEP	%	BOI	%
Never applied for other reasons	578	75.0	618	80.2	644	83.5	618	80.2	618	80.2
Never applied because process is too long and complicated	21	2.7	24	3.1	21	2.7	24	3.1	24	3.1
Applied and was turned down	3	0.4	9	1.2	6	0.8	9	1.2	9	1.2
Never heard about the scheme	160	20.8	96	12.5	72	9.3	96	12.5	96	12.5
Received the loans/incentives	9	1.2	24	3.1	28	3.6	24	3.1	24	3.1
Total	771	100.0	771	100.0	771	100.0	771	100.0	771	100.0

BOI = Board of Investment, EXIM Bank = Export–Import Bank of Thailand, OSMEP = Office of Small and Medium Enterprises Promotion; SICGC = Small Business Credit Guarantee Corporation (or Thai Credit Guarantee Corporation); SME Bank = Small and Medium Enterprise Development Bank of Thailand.

Source: World Bank Enterprise Survey, Thailand (2007).

In conclusion, Thai manufacturing SMEs rarely apply for and receive loans from government-owned SFIs. They prefer to use their own retained earnings and obtain loans from local commercial banks. To address these problems, this paper will address the following research questions:

- What are the key sources of finance that significantly contribute to Thai manufacturing SMEs' performance in terms of technical efficiency, export performance, and technological innovation?
- What are the key factors that can enhance Thai manufacturing SMEs' access to finance?
- How can Thai manufacturing SMEs gain better access to finance or improve their performance relating to greater financial access?

This paper, therefore, aims to examine the key sources of finance that have significantly contributed to Thai manufacturing SME performance as measured by technical efficiency, export performance, and technological innovation performance. The paper also investigates the key factors that have contributed to SMEs' access to finance. It is important to begin with a review of methodologies, including the concepts

of technical efficiency, export performance, and technological innovation, which are presented in the next section.

## 2. METHODOLOGY

### 2.1 Firm Performance

In this study, three measures of firm performance—technical efficiency, exports, and technological innovation—will be used, which can be defined as follows:

#### 2.1.1 Technical Efficiency Concept

The finance and accounting literature extensively evaluate SME performance by applying financial ratios such as profitability ratios, liquidity ratios, market ratios, and debt ratios. Nevertheless, these financial ratios are just the last performance indicators as they are, in fact, influenced by how firms perform in terms of their efficiency and productivity, and how input and product prices change (Fried et al. 2008). A firm's efficiency and productivity performance, therefore, are fundamental to its financial achievement. Technical efficiency differs from the term "productivity" which refers to "total factor productivity," since productivity is defined as the ratio of the change in total output over the change in total inputs (Coelli et al. 2005). Technical efficiency, however, is defined as the capacity and ability of a firm to produce the maximum possible output from a given bundle of inputs and a given technology (Coelli et al. 2005).<sup>4</sup> A firm's operation is technically efficient when it operates on the efficient production frontier, but its operation can be technically inefficient when it is under this frontier. Therefore, the technical efficiency concept can analyze a firm's technically optimal production, but the productivity concept cannot be applied in this case. A firm can be technically efficient but can enhance its productivity by changing its scale of operations. In addition, technical efficiency also differs from allocative efficiency which refers to the ability and willingness of a firm to equate its marginal revenue with its marginal cost (Kalirajan and Shand 1999).

#### 2.1.2 Exports

Strong export performance plays an important role in driving a country's economic growth, since exports can enhance a firm's production efficiency to overcome higher trade barriers and address various market tastes in intense foreign markets. Thai SMEs, however, are still not fully competitive in foreign markets, since they do not have efficient production, good management practices, market capabilities, product and service improvement to meet high international standards, a supply of high-quality labor, advanced technologies, consumer and environmental reliability, and strong networks in running business operations. The Office of Small and Medium Enterprises Promotion (OSMEP 2011) also stated that Thailand's exports heavily rely on large enterprises. The public and private sectors, therefore, should focus more on promoting greater international trade participation by Thai SMEs. Punyasavatsut (2007) also pointed out that Thai manufacturing SMEs are not ready to face intense competition

---

<sup>4</sup> Productivity is a dynamic concept concerned with identifying changes in output from changes in input. Productivity captures the importance of both technical change and efficiency. Technical efficiency, on the other hand, is a static concept concerned with measuring output from a given input at a point in time. It is interested in measuring this relationship relative to an efficiency frontier. The difference between the efficiency frontier and the actual input–output relationship captures the extent of technical inefficiency.

in export markets arising from the country's increased openness and economic integration, and concurrent intense competition from countries with lower labor costs.<sup>5</sup> Hence, it is crucial to evaluate SME performance in terms of exports in this study.

### **2.1.3 Technological Innovation**

According to the OECD (2005, p. 46), an innovation is defined as “*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.*” Therefore, the minimum requirement for an innovation is that the product, process, marketing method, or organizational method must be new or significantly improved by a firm (OECD 2005, p. 48). In this study, SME performance is evaluated in terms of technological innovation, which consists of the introduction of new products and processes and significant technological changes to products and processes (OECD 2013). Therefore, innovation is crucial in enhancing productivity and competitive advantages in most developing nations, since the transformation of new ideas into new economic solutions through new products, processes, and services can lead to a more effective and productive use of resources (Crespi and Zuniga 2011).

## **2.2 Empirical Models Used to Link Key Factors Contributing to the Performance of Small and Medium-Sized Enterprises**

### **2.2.1 The Stochastic Production Frontier and Inefficiency Effects Model**

To answer part of the first question of the study, a stochastic production frontier and inefficiency effects model can be used to examine the significance of various sources of finance to SME technical efficiency performance. This can be done using a stochastic frontier analysis (SFA). An SFA requires functional forms (e.g., translog or Cobb-Douglas function) to obtain the efficient production frontier, the efficient relationship between firm input and output, and assumes that firms may deviate from this not only because of technical inefficiency but also due to measurement errors, statistical, noise or other nonsystematic influences (Admassie and Matambalya 2002). An SFA also needs strong distribution assumptions for both statistical random errors (i.e., normal distribution) and non-negative technical-inefficiency random variables. Battese and Coelli (1995) presented a model in an attempt to capture the factors that cause technical inefficiency for paddy farmers on an Indian village using panel data. In their model, inefficiency effects are stochastic and the model also allows for the estimation of both technical change in the stochastic frontier and time-varying technical inefficiencies. This paper, therefore, will apply the Battese and Coelli (1995) model in a cross-sectional context to measure SME technical efficiency and investigate the impact of key sources of finance on Thai SME manufacturing technical efficiency.

### **2.2.2 Maximum Likelihood Estimation of a Tobit Model**

To answer part of the first and second research questions, this study also empirically investigates the effects of key sources of finance on SME export and technological innovation performance. In this study, the values of technological innovation are

---

<sup>5</sup> Thailand is in a middle-income trap where the country is caught between the need to move away from competitiveness based on low labor costs to involvement in more value-adding activities. The country is finding major problems in moving out of this trap. It cannot compete on the basis of wage costs but is unable to move into activities requiring more knowledge, skill, innovation, and value addition. This is reflected in poor trade performance, particularly by SMEs.

bounded between zero and one, since technical innovation represents SMEs' capability to undertake technological innovation initiatives as measured by the percentage of completion of all technological innovation initiatives. The value of exports is also bounded between zero and one, since exports are measured by the percentage of exports to total sales. In some cases, SMEs reported that they did not participate in technological innovation initiatives and exports. Focusing on the key factors contributing to SMEs' access to finance, the proxies used to quantify their access to finance are the amount of interest paid and loans received besides the use of binary variables for access to finance. The nature of the data in the 2006 World Bank Manufacturing Sector Survey, therefore, would cause the dependent variable (technological innovation, exports, interest, and loans) to be left-censored to zero. The maximum likelihood Tobit model, which is known as a censored regression model, can be applied in this study. According to Kumbhakar and Lovell (2000) and Coelli et al. (2005), applying the method of ordinary least squares (OLS) will lead to biased and inconsistent estimators, since the OLS method is likely to estimate values greater than one. Therefore, the maximum likelihood estimation for a left-censored Tobit model is applied in this study.

### **2.2.3 Maximum Likelihood Estimation of a Probit Model**

To answer the second research equation, the maximum likelihood estimation of a Probit model is also employed in this study, since the proxy for SMEs' access to finance is the probability of a Thai SME accessing external finance, including access to banks or financial institutions, government-owned financial institutions, and private commercial banks (local and foreign commercial banks). The Probit model is also more popularly compared with the Logit model, since economists are likely to favor the Probit model's normality assumption<sup>6</sup> (Wooldridge 2013). In addition, the Probit model's method of maximum likelihood estimation automatically accounts for the heteroskedasticity problem (Wooldridge 2013).

## **3. LITERATURE REVIEW**

The financing constraints of SMEs can be referred to as the problem of information asymmetry, since financial institutions perceive SMEs as being more risky compared with large enterprises due to lack of collateral, credit history, and credit rating as well as the opaque manner in which these businesses operate. SMEs, therefore, confront financial constraints from external lenders, since lenders are worried about their adverse selection costs and increased risk of moral hazard behavior with SMEs. Referring to the pecking order theory, entrepreneurs use internal sources of finance first, and then debt is used over equity if external finance is required (Mayers and Majluf 1984). Watson and Wilson (2002) also found that retained earnings are preferred over debt for SMEs, and debt will be preferred over issuance of new shares to investors as each of these financial sources gets steadily more expensive. According to Beck et al. (2006) external finance is more costly than internal sources due to asymmetric information and agency problems. A number of empirical works have

---

<sup>6</sup> Probit and logit models are the two most common techniques for estimation of models with a binary dependent variable, which impose the assumption that individuals with a probability of 0.5 of selecting either of two alternatives are most sensitive to changes in independent variables. The scobit (or skewed-logit) model, however, might be appropriate where individuals with any initial probability of selecting either of two alternatives are most sensitive to changes in independent variables (Nagler 1994). However, this is beyond the scope of the present study.

studied SME sources of finance and obstacles in accessing external financing as follows.

Beck et al. (2006) used the World Bank Environment Survey conducted in 1999 and 2000 on a sample of over 10,000 firms across 80 developing and developed countries. They found that older, larger, and foreign-owned enterprises reported fewer financing obstacles. In addition, institutional development is the most important country attribute in explaining cross-country variation in a firm's financing obstacles.

Beck et al. (2008) used a firm-level survey database covering 48 countries to examine how financial and institutional development affects financing of large and small enterprises. They suggested that the pecking order theory holds across nations. They also found that small enterprises and enterprises in countries with poor institutions use less external finance, especially bank financing. Protection of property rights, which represents better institutions, also increases access to external financing for small enterprises and significantly more than that of large enterprises. In addition, small enterprises are not likely to use more leasing or trade finance compared with large enterprises, and therefore these sources of finance cannot be substituted when small firms cannot access bank financing. Finally, financially constrained large firms are able to acquire more external financing than small firms can.

Ayyagari et al. (2005) found that financing obstacles affect the growth rate of firms. They also revealed that only the cost of borrowing has a direct impact on firm growth, although firms face other specific financing obstacles such as lack of access to long-term capital and collateral requirements. The imperfections of financial markets due to lack of breadth of coverage and depth of financial availability, such as being corrupt, underfunded, and requiring excessive paperwork, directly affect the cost of borrowing. They also found that firms that have difficulties in posting collateral and limited access to long-term financing are likely to pay high interest rates.

Harvie et al. (2013) employed a structured questionnaire survey of SMEs conducted in eight Asian countries in 2010, consisting of 1,200 SMEs. They found that a number of SMEs still rely on internal financial sources for both start-up and business expansion. External financing is still important for domestically owned, high growth, less mature, and low-profit SMEs that lack sufficient internal funds and operate in more developed economies. Moreover, they suggested that financial institutions are likely to impose risk premiums or potential credit rationing on SMEs, especially for smaller SMEs, due to their lack of transparency, poor corporate governance, and a higher chance of debt default compared with large enterprises. Finally, they pointed out that access to finance also increases SMEs' innovation capabilities and export market participation.

Wignaraja and Jinjarak (2015) employed the World Bank Enterprise Survey data to investigate the relationship between firm characteristics and SME finance for the People's Republic of China, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam. They found that SMEs in these countries rely heavily on internal funds due to a lower level of financial and capital market development. In addition, they found that firm characteristics are likely to be correlated with bank borrowing; line of credit availability; and collateral, credit, and lender type. Smaller SMEs are likely to have a significant and negative association with bank borrowing and line of credit availability. Finally, export market participation, firm age, and financial audit make a significant and positive contribution to SME finance.

Punyasavatsut (2011) used an enterprise survey collected by the Economic Research Institute for ASEAN and East Asia (ERIA) in 2010 to examine factors that determine better access to bank credit. He found that 30% of SME financing is from external

funds, since most of them use their own funds and from friends and relatives to start up their businesses. They are likely to use overdrafts for their working capital requirements. However, 40% of Thai SMEs, especially small enterprises, gain access to credit, which still mostly depends on banks. In addition, he pointed out that SMEs' main obstacles to gaining financial access are lack of information and advice from financial institutions, cumbersome loan application processes, and inadequate collateral. Thai banks still rely on collateral-based lending practices and lack the knowledge to evaluate SME risk. He also mentioned that the main obstacles for Thai financial institutions in lending to SMEs are inadequate collateral, lack of business experience and sound business plans, nonperforming loan history, and high transaction costs per loan application.

Poonpatpibul and Limthammahisorn (2005) used the Bank of Thailand survey on demand for financial services in 2003 to investigate factors determining credit access to financial institutions for Thai SMEs. They found that a firm's age, assets, and sales growth facilitate better access to credit. In addition, they found that Thai SMEs rely more heavily on debt financing than on equity financing. They also pointed out that there is evidence of information asymmetry arising between lenders and SMEs in Thailand due to inadequate business experience and financial literacy of SMEs, and insufficient risk-based credit assessment and management. As a result of problems relating to information asymmetry, the country's lending practice is still mostly based on collateral.

## 4. DATA SOURCE AND DATA CLASSIFICATION

This study employs the 2006 World Bank Manufacturing Sector Survey for Thailand. In the survey, business owners and top managers in 1,043 manufacturing firms were interviewed. According to the definition of SMEs proposed by the Ministry of Industry, SMEs in Thailand can be defined using two measures: the number of employees or the level of total fixed assets (excluding land). These two measures differ among four different sectors: manufacturing, services, wholesale, and retail. With respect to the Thai manufacturing sector, a firm that either employs not more than 50 workers or has total fixed assets (excluding land) with a value not exceeding 50 million baht (B) is considered as a small firm. A firm that employs 51–200 workers or has total fixed assets valued between B51 million and B200 million is defined as a medium-sized enterprise. According to this criterion, firms that employ 200 workers or less are classified as SMEs for this study. After excluding the 272 large firms in the survey, the remaining 771 SMEs were used to conduct the empirical analysis in this paper. The next section provides empirical evidence obtained by employing the methodology in section 2 with the data provided in this section.

## 5. EMPIRICAL MODELS AND RESULTS

According to section 2, the stochastic production frontier and inefficiency effects model can be used to investigate the key sources of finance contributing to SME performance as measured by technical efficiency, as is further explained in section 5.1. Other measures of SME performance, such as exports and technological innovation, as well as the key factors affecting SMEs' access to finance are examined in section 5.2.

## 5.1 Empirical Models

### 5.1.1 The Stochastic Production Frontier and Inefficiency Effects Model

The Battese and Coelli (1995) model can be applied for this study, which employs cross-section data. There are two main parts in the Battese and Coelli (1995) model. The first part shows the estimation of the stochastic frontier production function, which consists of two random errors: (i) random errors ( $V_i$ s) and (ii) non-negative random variables ( $U_i$ s). The first random error terms, which capture the problems of omitted variables and model misspecification, are assumed to be independently and identically distributed normal random variables with zero means and variances ( $V_i \sim iid N(0, \sigma_v^2)$ ). The second, non-negative random variables, indicate the technical inefficiency effects and are assumed to be independently and identically distributed normal random variables as truncations (at zero) with  $Z_i\delta$  means and variances  $\sigma_u^2$  ( $U_i \sim iid N(0, \sigma_u^2)$ ). Moreover, these two random error terms are assumed to be independently distributed for all firms ( $i = 1, 2, \dots, N$ ). In addition, the second part of the model links a set of independent variables with the inefficiency effects (or the non-negative random variables). Applying the model of Battese and Coelli (1995), this study uses the Cobb-Douglas functional form, which can be written as:

$$\ln(Y_i) = \beta_0 + \beta_1 \ln(L_i) + \beta_2 \ln(K_i) + V_i - U_i \quad (1)$$

Where:

$Y_i$  = Value added of the  $i^{th}$  firm

$L_i$  = Employee wages and salaries of the  $i^{th}$  firm

$K_i$  = Total fixed assets of the  $i^{th}$  firm

$V_i$  = Random error ( $V_i \sim N(0, \sigma_V^2)$ )

$U_i$  = Non-negative random variable (or technical inefficiency) ( $U_i \sim N(Z_i\delta, \sigma_u^2)$ )

In this study, the inefficiency effects model can be written as follows:

$$\begin{aligned} U_i = & \sigma_0 + \sigma_1 \text{Firm age}_i + \sigma_2 \text{Firm size}_i + \sigma_3 \text{Domestic ownership}_i + \sigma_4 \\ & + \sigma_5 \text{Innovation}_i + \sigma_6 \text{CEO experience}_i + \sigma_7 \text{CEO education}_i \\ & + \sigma_8 \text{Government-owned SFIs}_i + \sigma_9 \text{OSMEP}_i + \sigma_{10} \text{BOI}_i + W_i \end{aligned} \quad (2)$$

$$\begin{aligned} U_i = & \sigma_0 + \sigma_1 \text{Firm age}_i + \sigma_2 \text{Firm size}_i + \sigma_3 \text{Domestic ownership}_i + \\ & \sigma_4 \text{Export participation}_i + \sigma_5 \text{Innovation}_i + \sigma_6 \text{CEO experience}_i + \\ & \sigma_7 \text{CEO education}_i + \sigma_8 \text{Interest}_i + \sigma_9 \text{Retained earnings}_i + \sigma_{10} \text{Local banks}_i + \\ & \sigma_{11} \text{Foreign banks}_i + \sigma_{12} \text{Family & friends}_i + \sigma_{13} \text{Informal sources}_i + \\ & \sigma_{14} \text{Bank numbers}_i + W_i \end{aligned} \quad (3)$$

The variable definitions and summary statistics are explained in the Appendix.

### 5.1.2 Maximum Likelihood Estimation of Tobit and Probit Models

Besides the analysis of SME technical efficiency, this study also empirically investigates the key sources of finance as well as other factors contributing to SME export and technological innovation performance. The maximum likelihood estimation of a Tobit model is used since the values of exports and technological innovation are measured by the percentage of exports to total sales, which are bounded between zero and one. In addition, a number of SMEs did not report these values, and therefore this would cause the dependent variable (technological innovation and exports) to be

left-censored to zero. Therefore, the maximum likelihood estimation for a left-censored Tobit model is adopted and given as follows:

$$y_i^* = f(\text{firm age}_i, \text{firm size}_i, \text{foreign ownership}_i, \text{CEO experience}_i, \text{CEO education}_i, \text{government-owned}, \text{SFI}_i, \text{OSMEP}_i, \text{BOI}_i, \text{interest}_i)$$

$$y_i^* = f(\text{firm age}_i, \text{firm size}_i, \text{foreign ownership}_i, \text{CEO experience}_i, \text{CEO education}_i, \text{interest}_i, \text{retained earnings}_i, \text{local banks}_i, \text{foreign banks}_i, \text{family \& friends}_i, \text{informal source}_i, \text{bank numbers}_i)$$

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases} \quad (4)$$

where  $y_i^*$  = Unobserved variable of exports of firm i

$$y_i^* = \text{Unobserved variable of technological innovation of firm i}$$

For the study of the key sources of finance and other factors on SME access to finance, this study uses the maximum likelihood estimation of Probit and Tobit models, since the dependent variable for access to finance in this study is a binary dependent variable that indicates 1 if a firm can gain access to finance, and 0 otherwise. In addition, the dependent variable for access to finance can be presented as the amount of loans and interest paid. According to the survey, a number of SMEs did not report the amount of loans and interest paid, and therefore this can cause the dependent variable (loans and interest paid) to be left censored at zero. Applying the maximum likelihood estimation of a Probit model, the equations for access to finance of all SMEs are identified and given as follows:

$$Z_i^* = (\text{firm age}_i, \text{firm size}_i, \text{foreign ownership}_i, \text{owner's multiple plants}_i, \text{CEO experience}_i, \text{CEO education}_i, \text{owner family's high wealth}_i, \text{owner family's medium wealth}_i, \text{investment plan}_i, \text{net profit margin}_{t-1}, \text{audited financial statement}_i, \text{collateral}_i, \text{return on assets}_{t-1})$$

$$Z_i^* = (\text{firm age}_i, \text{firm size}_i, \text{foreign ownership}_i, \text{owner's multiple plants}_i, \text{CEO experience}_i, \text{CEO education}_i, \text{owner family's high wealth}_i, \text{owner family's medium wealth}_i, \text{investment plan}_i, \text{net profit margin}_{t-1}, \text{audited financial statement}_i, \text{collateral}_i, \text{return on assets}_{t-1}, \text{auto components}_i, \text{electrical appliances}_i, \text{electronic components}_i, \text{food processing}_i, \text{furniture and wood products}_i, \text{garments}_i, \text{machinery and equipment}, \text{rubber and plastics}_i) \quad (5)$$

where,

$Z_i^*$  is unobserved access to external loans; For Probit model  $Z_i$  is 1 if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ; For Tobit model  $Z_i$  is  $Z_i^*$  if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ;

$Z_i^*$  is unobserved access to banks or financial institutions; For Probit model  $Z_i$  is 1 if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ; For Tobit model  $Z_i$  is  $Z_i^*$  if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ;

$Z_i^*$  is unobserved access to private commercial banks; For Probit model  $Z_i$  is 1 if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ; For Tobit model  $Z_i$  is  $Z_i^*$  if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ;

$Z_i^*$  is unobserved access to government-owned SFIs; For Probit model  $Z_i$  is 1 if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ; For Tobit model  $Z_i$  is  $Z_i^*$  if  $Z_i^* > 0$  and  $Z_i$  is 0 if  $Z_i^* \leq 0$ ;

In addition, applying the maximum estimation of a Tobit model for access to finance as measured by the amount of loans and interest paid, the maximum likelihood estimation for a left-censored Tobit model is adopted and provided as follows:

$\theta_i^* = (\text{firm age}_i, \text{firm size}_i, \text{foreign ownership}_i, \text{owner's multiple plants}_i, \text{CEO experience}_i, \text{CEO education}_i, \text{owner's high wealth}_i, \text{owner's medium wealth}_i, \text{investment plan}_i, \text{net profit margin}_{t-1}, \text{audited financial statement}_i, \text{collateral}_i, \text{return on assets}_{t-t})$

$\theta_i^* = (\text{firm age}_i, \text{firm size}_i, \text{foreign ownership}_i, \text{owner's multiple plants}_i, \text{CEO experience}_i, \text{CEO education}_i, \text{owner's high wealth}_i, \text{owner's medium wealth}_i, \text{investment plan}_i, \text{net profit margin}_{t-1}, \text{audited financial statement}_i, \text{collateral}_i, \text{return on assets}_{t-1}, \text{auto components}_i, \text{electrical appliances}_i, \text{electronic components}_i, \text{food processing}_i, \text{furniture and wood products}_i, \text{garments}_i, \text{machinery and equipment, rubber and plastics}_i)$

$$\theta_i = \begin{cases} \theta_i^* & \text{if } \theta_i^* > 0 \\ 0 & \text{if } \theta_i^* \leq 0 \end{cases} \quad (6)$$

where  $\theta_i^*$  = Unobserved variable of amount of loans of firm i  
Unobserved variable of interest paid by firm i

## 5.2 Empirical Results

### 5.2.1 Empirical Results from the Stochastic Frontier Analysis

According to the SFA results as indicated in Table 6, government-owned SFIs and the Board of Investment (BOI) play a leading role in promoting the technical efficiency of Thai manufacturing SMEs, due to the significant and negative estimated coefficients of these variables associated with SME technical inefficiency. SFIs' operations are likely to be carried out in response to government decisions aimed at helping Thai SMEs, which lack financial strength and adaptability compared with that of large enterprises (SME Bank 2015). In addition, the BOI has promoted improvement of production efficiency for Thai manufacturing SMEs by granting import duty and income tax exemptions. In this study, support from the Office of Small and Medium Enterprises Promotion (OSMEP) is found to be insignificantly related to SME technical efficiency. Unlike SFIs and the BOI, OSMEP mainly provides nonfinancial support for Thai SMEs, which does not help promote SME technical efficiency. With respect to the pecking order theory, this study investigates the contribution of key sources of finance to Thai manufacturing SME performance, such as funds from their retained earnings, family or friends, informal sources given by unlicensed lenders, local commercial banks, and foreign commercial banks.

Based on the magnitude of significance and the estimated coefficients for key internal sources of finance, retained earnings are found to be the most important internal source of finance in this study as indicated in Table 6. Thai manufacturing SMEs that employ more retained earnings and used them for working capital are likely to have their technical efficiency enhanced, since they can gain more flexibility by using their own funds, leading to higher levels of technical efficiency. For external sources of finance, Thai manufacturing SMEs that receive loans from foreign commercial banks are likely to have higher levels of technical efficiency. However, other sources of finance, such as funds from informal sources, family or friends, and local commercial

banks, are not significantly related to SME technical efficiency. It might be the case that lenders from informal sources and family or friends do not seriously consider the business feasibility of the SME, and that SMEs who borrow money from local commercial banks have limited flexibility in operating their businesses due to too much monitoring by the lender. With respect to entrepreneurial characteristics, SMEs that have CEOs with more working experience are likely to have higher levels of technical efficiency, but SMEs that have CEOs with at least a bachelor's degree are likely to perform worse than those SMEs whose CEOs have below a bachelor's degree. This could be due to the fact that CEOs with vocational, high vocational, or technical training are likely to have more technical expertise than those with a university education due to the latter's focus on more theoretical aspects of learning. Exports also help increase SME technical efficiency due to the existence of a learning-by-exporting effect.

**Table 6: Maximum-Likelihood Estimates for Parameters of the Stochastic Frontier Production Function and the Inefficiency Effects Model**

	Model 1		Model 2	
	Coefficient	Standard Error	Coefficient	Standard Error
<b>Cobb-Douglas stochastic production:</b>				
Constant	0.577	(0.368)	0.8056*	(0.4056)
In(Labour)	0.858*	(0.028)	0.8377*	(0.0307)
In(Capital)	0.184*	(0.015)	0.1902*	(0.0143)
<b>Inefficiency effects model:</b>				
Constant	-0.200	(0.450)	0.3798	(0.2864)
Firm age <sub>i</sub>	0.004	(0.008)	-0.0002	(0.0066)
Firm size <sub>i</sub>	0.001	(0.001)	0.0005	(0.0013)
Domestic ownership <sub>i</sub>	-0.002	(0.002)	0.0000	(0.0020)
Export participation <sub>i</sub>	-0.323*	(0.153)	-0.2639	(0.1329)
Innovation <sub>i</sub>	0.008	0.006	0.0127*	(0.0043)
CEO experience <sub>i</sub>	-0.065*	(0.033)	-0.0474*	(0.0193)
CEO education <sub>i</sub>	0.381*	(0.233)	0.2083*	(0.1223)
Government-owned SFI <sub>i</sub>	-0.811*	(0.295)		
OSMEP <sub>i</sub>	-0.566	(1.107)		
BOI <sub>i</sub>	-1.850*	(0.497)		
Interest <sub>i</sub>			-1.0990	(1.2157)
Retained earnings <sub>i</sub>			-0.0074*	(0.0026)
Local banks <sub>i</sub>			0.0002	(0.0015)
Foreign banks <sub>i</sub>			-0.0184*	(0.0098)
Family and friends <sub>i</sub>			0.0034	(0.0030)
Informal sources <sub>i</sub>			-0.0016	(0.0037)
Bank numbers <sub>i</sub>	0.459*	(0.069)	-0.1805*	(0.0644)
sigma-squared	0.340*	(0.100)	0.4165*	(0.0308)
Gamma	0.577*	(0.368)	0.2492*	(0.0619)

BOI = Board of Investment, CEO = chief executive officer, OSMEP = Office of Small and Medium Enterprises Promotion.

Note: Robust standard errors are in parentheses; \* indicates a 5% level of significance; \*\* indicates a 10% level of significance.

The two null hypothesis tests—(i) the absence of inefficiency effects and (ii) the insignificance of joint inefficiency variables—have been examined. They are strongly rejected at the 1% level of significance, which implies that the model of inefficiency effects exists for the case of Thai manufacturing SMEs and inefficiency effects are a linear function of all explanatory variables for the first model.

### 5.2.2 Empirical Results from the Maximum Likelihood Estimation of the Tobit Model for Export and Technological Innovation Performance

Besides the SME technical efficiency performance, this study also examines SME performance in terms of exports and technological innovation. As shown in Table 7, SMEs that obtain loans and credit guarantees from government-owned SFIs such as the SME bank, Export–Import Bank of Thailand, and Small Business Credit Guarantee Corporation are likely to perform better in terms of exports than SMEs that do not receive loans and credit guarantees from these institutions. However, a significant result is not found for the case of the technological innovation performance of Thai manufacturing SMEs.

**Table 7: Maximum Likelihood Estimation of a Tobit Model: Sources of Finance Affecting SME Export and Technological Innovation Performance**

Independent Variable	Dependent Variable (Model 1)				Dependent Variable (Model 2)			
	Exports		Innovations		Exports		Innovations	
	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.
Firm age <sub>i</sub>	-0.2542	(0.3580)	-0.0013	(0.0008)	-0.3244	(0.3643)	-0.0013	(0.0008)
Firm size <sub>i</sub>	0.3715*	(0.0459)	0.0004*	(0.0001)	0.3710*	(0.0447)	0.0004*	(0.0001)
Domestic ownership <sub>i</sub>	0.5400 *	(0.1003)	0.0000	(0.0002)	0.4728*	(0.1024)	-0.0001	(0.0003)
CEO experience <sub>i</sub>	-0.1600	(0.4569)	0.0006	(0.0009)	-0.0678	0.4632	0.0006	(0.0009)
CEO education <sub>i</sub>	14.6370*	(6.2856)	0.0484*	(0.0122)	15.6440*	(6.2811)	0.0441*	(0.0122)
Government-owned SFI <sub>i</sub>	22.1646*	(9.0577)	0.0184	(0.0222)				
OSMEP <sub>i</sub>	7.5144	(25.0038)	0.0011	(0.0367)				
BOI <sub>i</sub>	5.4967	(9.6980)	-0.0158	(0.0187)				
Interest <sub>i</sub>	1.1017*	(0.4804)	0.0023*	(0.0010)	1.3374*	(0.5047)	0.0024*	(0.0010)
Retained earnings <sub>i</sub>					0.0089	(0.1004)	0.0002	(0.0002)
Local banks <sub>i</sub>					-0.1060	(0.1058)	-0.0001	(0.0002)
Foreign banks <sub>i</sub>					0.2867	(0.4300)	-0.0001	(0.0011)
Family and friends <sub>i</sub>					-0.5841	(0.5612)	-0.0002	(0.0006)
Informal sources <sub>i</sub>					-0.5522**	(0.3306)	0.0004	(0.0006)
Bank numbers <sub>i</sub>					-0.7747	(2.1129)	0.0129*	(0.0045)
Constant	-71.7786	(8.8751)	0.2042	(0.0171)	-65.1274*	(11.1501)	0.1744*	(0.0247)
Number of obs.	771		771		771		771	
Prob > F	0.00		0.00		0.00		0.00	
Pseudo R2	0.04		-0.11		0.04		-0.13	

BOI = Board of Investment, CEO = chief executive officer, OSMEP = Office of Small and Medium Enterprises Promotion, SFI = specialized financial institution, SME = small and medium-sized enterprise.

Note: Robust standard errors are in parentheses, \* indicates the 5% level of significance, \*\* indicates the 10% level of significance.

SMEs that receive more loans from unlicensed lenders (informal lenders) perform worse in terms of exports than those with no loans from unlicensed lenders. This is because they are generally weaker firms and therefore cannot get access to formal finance. SMEs that pay more interest are likely to have better performance in exports and technological innovation performance than those paying lower total interest charges. More interest paid implies that SMEs with better performance in exports and technological innovation need more external finance for their working capital. For

export performance this result is similar to the empirical findings of Harvie et al. (2013), suggesting that SMEs that have larger loans at a lower cost tend to export more.

Moreover, SMEs managed by CEOs with at least a bachelor's degree have better export and technological innovation performance than those managed by CEOs with less than a bachelor's degree. This evidence implies that better performance in export and technological innovation needs the type of theoretical knowledge and managerial skills obtained from a university education rather than specific technical expertise received from vocational, high vocational, or technical training. Similarly, larger SMEs tend to have better export and technological innovation performance, since smaller SMEs tend to face difficulties such as insufficient access to external loans for their investments and lack of efficient resources, economies of scale, and formal contracts with customers and suppliers (Alvarez and Crespi 2003). SMEs that have a higher share of foreign ownership achieve better export performance, since foreign investors bring advanced technology, managerial expertise, good practice in corporate governance, and a strong foreign-market network (Kimura and Kiyota 2007).

### **5.2.3 Empirical Results from the Maximum Likelihood Estimation of Tobit and Probit Models for Access to Finance**

This study examines the key factors affecting SME access to finance, which is classified into (i) access to all external loans, (ii) access to banks or financial institutions, (iii) access to private commercial banks, and (iv) access to government-owned SFIs (Table 8). This study also examines their access to finance in terms of the amount of interest paid and loans received besides the use of binary variables for access to finance (Table 9). From Table 8 it can be seen that SMEs that have collateral and externally certified financial statements are more likely to gain access to all external loans, including loans from banks or financial institutions. Collateral and certified financial statements are required to obtain external loans from all lenders, not just loans from banks or financial institutions, as these help reduce the problems of asymmetric information arising between SMEs and lenders. As shown in Table 9, a larger loan size of Thai manufacturing SMEs is likely to increase with their collateral. This finding is similar to the empirical results of Wignaraja and Jinjarkak (2015), which suggested that financial audits are significantly and positively related to SMEs' access to bank borrowing and line of credit availability for Thailand and Malaysia. Harvie et al. (2015) also found that collateral is significantly and positively related to the term of the loan for selected Asian countries, and Poonpatpibul and Limthammasorn (2005) revealed that Thai SMEs' credit access was found to increase with assets mortgaged as collateral.

SMEs which have multiple plants are also likely to gain access to all external loans including banks or financial institutions, since such SMEs are likely to have more assets which can be offered as collateral and are likely to be perceived as less risky by lenders. SMEs with multiple plants tend to have a larger loan size, and the total amount they pay in the form of interest will be higher as indicated in Table 9. This result suggests that SMEs with multiple plants need more working capital than those with no multiple plants, and therefore they actively seek external finance from all external lenders including banks or financial institutions. This finding is similar to the finding of Harvie et al. (2013), suggesting that SMEs in Asian countries with multiple businesses tend to gain access to at least two types of external finance. Similarly, larger SMEs are actively seeking external sources of finance including loans from banks or financial institutions. Larger SMEs are found to actively seek to expand their loan size, reflecting a higher cost of debt as measured by interest paid (Table 9). This result implies that larger SMEs are likely to produce more goods, leading to more demand for labor and

other inputs, and therefore they actively require external sources of finance including loans and working capital from banks or financial institutions. This result is consistent with the findings of Harvie et al. (2013), which found a significant and positive association between SME size and loan size, and is similar to the empirical results of Poonpatpibul and Limthammasorn (2005), which revealed that Thai SMEs' credit access was found to increase with assets and sales.

**Table 8: Maximum Likelihood Estimation of Probit Model: SMEs' Access to External Loans and to Banks or Financial Institutions**

Independent Variable	Dependent Variable (Model 1)				Dependent Variable (Model 2)			
	Access to External Loans		Access to Banks or Financial Institutions		Access to External Loans		Access to Banks or Financial Institutions	
	Robust Coef.	Robust Std. Err.	Robust Coef.	Robust Std. Err.	Robust Coef.	Robust Std. Err.	Robust Coef.	Robust Std. Err.
Firm age	0.0059	(0.0077)	-0.0020	(0.0073)	0.0650	(0.0829)	-0.0053	(0.0074)
Firm size	0.0050*	(0.0011)	0.0037*	(0.0010)	0.3833*	(0.0693)	0.0044*	(0.0010)
Foreign ownership	-0.0061*	(0.0022)	-0.0067*	(0.0021)	-0.0065*	(0.0022)	-0.0075*	(0.0022)
Owner's multiple plants	0.2448**	(0.1404)	0.2068**	(0.1137)	0.2340**	(0.1382)	0.2074**	(0.1182)
CEO experience	0.0048	(0.0091)	-0.0121	0.0083	0.0540	(0.0792)	-0.0119	(0.0084)
CEO education	-0.0176	(0.1126)	-0.1104	0.1072	-0.0161	(0.1135)	-0.1144	(0.1086)
Owner family's high wealth	0.2363	(0.2944)	0.4491	0.3070	0.2599	(0.2874)	0.4596	(0.2961)
Owner family's medium wealth	0.0706	(0.1416)	0.0896	0.1346	0.0631	(0.1441)	0.0952	(0.1376)
Investment plan	0.2085*	(0.1068)	0.0185	0.1016	0.2110**	(0.1120)	-0.0475	(0.1055)
Net profit margin <sub>t-1</sub>	-0.1275	(0.0933)	-0.2477	0.2388	-0.1595**	(0.0866)	-0.2725	(0.2544)
Audited financial statement	0.2981**	(0.1801)	0.4121*	(0.1749)	0.2325	(0.1845)	0.3467*	(0.1758)
Collateral	0.6198*	(0.1510)	0.5189*	(0.1479)	0.6422*	(0.1550)	0.5186*	(0.1484)
Return on assets <sub>t-1</sub>	-0.5527**	(0.3159)	-0.3862	0.3012	-0.6303**	(0.3495)	-0.4330	(0.3175)
Auto components					-0.1451	(0.2532)	0.1215	(0.2253)
Electrical appliances					-0.1052	(0.3288)	0.2000	(0.3434)
Electronic components					-0.3959	(0.2720)	-0.0544	(0.2564)
Food processing					-0.3185	(0.2370)	-0.0354	(0.2105)
Furniture and wood products					-0.1909	(0.2288)	0.0942	(0.2043)
Garments					-0.6113*	(0.2025)	-0.3317**	(0.1883)
Machinery and equipment					-0.0444	(0.2358)	0.2851	(0.2135)
Rubber and plastics					-0.2167	(0.1887)	0.3320*	(0.1710)
Constant	-0.9703*	(0.3064)	-0.6401*	(0.2784)	-1.9612*	(0.4109)	-0.6364*	(0.3102)
Number of obs.	771		771		771		771	
Prob > chi2	0.00		0.00		0.00		0.00	
Pseudo R2	0.09		0.07		0.12		0.09	

Note: Robust standard errors are in parentheses, \* indicates the 5 % level of significance, \*\* indicates the 10% level of significance.

The empirical results of this study also suggest that SMEs with more foreign shareholders are financially self-reliant and do not seek external sources of finance including loans and working capital from banks or financial institutions. SMEs with more foreign shareholders tend to reduce their loan size. This is consistent with the findings of Harvie et al. (2013), who found foreign-owned SMEs are not actively seeking external finance, and Wignaraja and Jinjarak (2015), who suggest that SMEs with greater foreign ownership are less likely access bank borrowing and other lines of credit in Thailand and Malaysia. In addition, SMEs with sound financial strength, as measured by higher levels of net profit margin or return on assets, are less likely to access external sources of finance since they tend to be more financially self-reliant, and therefore require less loans from all external lenders, resulting in a lower cost of debt as measured by interest paid. In other words, this result is consistent with the pecking order hypothesis. In addition, SMEs with an investment plan actively seek

external finance, since investment plans require a large amount of funds, and, therefore, external finance is required in launching a new investment. This result is consistent with Harvie et al. (2013), which found that SMEs with a business plan need more loans for their investment and find it easier to access loans because of greater transparency. With respect to entrepreneurial characteristics, having a CEO with more experience or at least a bachelor's degree is not found to be significantly related to SMEs' access to external finance including access to banks or financial institutions.

In this study the age of the SME is also not significantly related to its access to external finance including banks or financial institutions. Similarly, an owner's family wealth is not found to be significantly related to SME access to external finance including banks or financial institutions. With respect to manufacturing subsectors it is found that SMEs in the garment sector are less likely to access external finance, including from banks or financial institutions, than those in textiles as the base group of submanufacturing sectors.<sup>7</sup> In addition, SMEs in garments and those in food processing do not actively seek to increase their loan size compared with those in textiles. Thai SMEs in other submanufacturing sectors are not observed for their statistical significance in this paper.

**Table 9: Maximum Likelihood Estimation of Tobit Model:  
SMEs' Loan Size and Interest**

Independent Variable	Dependent Variable (Model 1)				Dependent Variable (Model 2)			
	Loan Size		Interest		Loan Size		Interest	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Firm age	0.0377	(0.0448)	0.0716**	(0.0421)	0.0206	(0.0452)	0.0460	(0.0421)
Firm size	0.0325*	(0.0054)	0.0350*	(0.0051)	0.0349*	(0.0054)	0.0386*	(0.0053)
Foreign ownership	-0.0300**	(0.0161)	0.0006	(0.0126)	-0.0326*	(0.0160)	-0.0053	(0.0123)
Owner's multiple plants	1.1948*	(0.3910)	1.3823*	(0.3866)	1.1611*	(0.3813)	1.2998*	(0.3520)
CEO experience	0.0276	(0.0556)	-0.0293	(0.0518)	0.0252	(0.0566)	-0.0365	(0.0508)
CEO education	-0.2800	(0.7109)	0.2539	(0.6636)	-0.3023	(0.7116)	0.2130	(0.6579)
Owner's high wealth	1.6223	(1.6963)	0.7678	(1.5992)	1.5661	(1.6113)	0.7174	(1.5205)
Owner's medium wealth	0.6093	(0.9049)	0.4836	(0.8318)	0.6401	(0.9026)	0.5381	(0.8340)
Investment plan	1.6411*	(0.6463)	1.4395*	(0.5903)	1.5420*	(0.6577)	0.9041	(0.6070)
Net profit margin $t-1$	-0.6023*	(0.1711)	-0.3503*	(0.1928)	-0.6457*	(0.1714)	-0.3640*	(0.1763)
Audited financial statement	2.1212	(1.4265)	1.7665	(1.1973)	1.6841	(1.3986)	1.2266	(1.1717)
Collateral	4.7566*	(1.2800)	0.8333	1.0038	4.9121*	(1.2788)	0.8798	(0.9712)
Return on assets $t-1$	-3.3967*	(1.3342)	-3.6552*	(1.3707)	-3.6539*	(1.3671)	-3.9602*	(1.4824)
Auto components					-0.6654	(1.3864)	1.2682	(1.2055)
Electrical appliances					-0.6481	(2.0998)	-1.1272	(2.3200)
Electronic components					-2.6550	(1.7766)	-1.1134	(1.6039)
Food processing					-2.4544**	(1.3644)	-0.4926	(1.2704)
Furniture and wood products					-1.6248	(1.2593)	-1.9072	(1.2754)
Garments					-4.3407*	(1.2388)	-3.3023*	(1.1566)
Machinery and equipment					-0.7058	(1.2924)	1.2704	(1.2135)
Rubber and plastics					-1.2858	(1.0031)	1.1717	(0.9792)
Constant	-1.1764	(2.0932)	-0.2680	(1.7957)	0.9050	(2.1627)	0.9508	(1.9247)
Number of obs.	771		771		771		771	
Prob > F	0.00		0.00		0.00		0.00	
Pseudo R2	0.02		0.02		0.03		0.03	

Note: Robust standard errors are in parentheses, \* indicates the 5% level of significance, \*\* indicates the 10% level of significance.

<sup>7</sup> To avoid the dummy trap problem, we dropped the textiles industry, which is classified as the base industrial group among submanufacturing sectors in this study.

Comparing access to private commercial bank finance with government-owned SFI finance (Table 10), collateral is required to access finance from private commercial banks, both local and foreign, but it is not found to be important for access to finance from government-owned SFIs. SMEs that provide audited financial statements tend to have more access to finance from private commercial banks as well as government-owned SFIs. SMEs with more plants are more likely to access finance from private commercial banks, but this is not significant for the case of access to finance from government-owned SFIs. SMEs with more foreign ownership are less likely to use finance from both private commercial banks and government-owned SFIs, since they are financially self-reliant and, therefore, are not actively seeking external finance. Larger SMEs tend to access finance from both private commercial banks and government-owned SFIs. Larger SMEs are likely to produce more goods and they are also likely to have more ambitious investment plans for further growth, leading to more demand for labor and other inputs used for production, and therefore they are actively seeking external finance from private commercial banks and government-owned financial institutions.

**Table 10: Maximum Likelihood Estimation of the Probit Model: SMEs' Access to Private Commercial Banks and SMEs' Access to Government-Owned SFIs**

Independent Variable	Dependent Variable			
	Access to Private Commercial Banks		Access to Government-Owned SFIs	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Firm age	0.0097	(0.0074)	-0.0162	(0.0110)
Firm size	0.0042*	(0.0010)	0.0040*	(0.0012)
Foreign ownership	-0.0101*	(0.0022)	-0.0123*	(0.0041)
Owner's multiple plants	0.1600*	(0.0928)	0.0891	(0.1198)
CEO experience	-0.0018	(0.0085)	0.0082	(0.0114)
CEO education	-0.0806	(0.1088)	0.2340	(0.1614)
Owner's high wealth	0.0089	(0.2903)	0.2974	(0.4250)
Owner's medium wealth	-0.0167	(0.1383)	0.2934	(0.2232)
Investment plan	0.0026	(0.1030)	0.0172	(0.1425)
Net profit margin <sub>t-1</sub>	-0.1133	(0.0811)	0.1726	(0.3772)
Audited Financial statement	0.3633*	(0.1833)	0.7443*	(0.4465)
Collateral	0.7662*	(0.1520)	-0.1656	(0.2234)
Return on assets <sub>t-1</sub>	0.0239	(0.1835)	0.0095	(0.2050)
Constant	-0.9064*	(0.2792)	-2.6890*	(0.5056)
Number of obs.	771		771	
Prob > chi2	0.00		0.00	
Pseudo R2	0.10		0.07	

SFI = specialized financial institution.

Note: Robust standard errors are in parentheses, \* indicates the 5% level of significance, \*\* indicates the 10% level of significance.

## 6. CONCLUSIONS AND POLICY IMPLICATIONS

In summary, our empirical results confirm that retained earnings are still important to enhance SME technical efficiency, but loans from unlicensed lenders (or informal

sources) decrease their export performance. External finance from government-owned SFIs can help Thai manufacturing SMEs increase their technical efficiency and export performance. In recent years, government-owned SFIs have initiated working capital and loan programs for Thai SMEs in response to the government's policy of facilitating access to capital sources for Thai SMEs. The results presented suggest that these programs are successful. The groups of borrowers from SFIs are mainly SMEs that are financially constrained and have less adaptability in sourcing finance compared with large enterprises. Unlike in the case of private commercial banks, most SMEs are not seeking external finance from government-owned SFIs. This evidence can be found from the survey, which indicates that only 3.1%, 1.2%, and 3.6% of Thai manufacturing SMEs received loans from the SME Bank, Small Business Credit Guarantee Corporation, and EXIM Thailand in 2006, respectively. Therefore, the financial services provided by these government-owned SFIs should be promoted, since SMEs currently perceive that it is more convenient to use working capital and loans from private commercial banks due to a large number of branches across the country. In addition, the lending process should be closely monitored, since the SFIs' assessment for SME loans may be too lenient. Moreover, government agencies should provide necessary financial information and literacy for Thai SMEs, especially start-up SMEs.

Besides government-owned SFIs, foreign commercial banks can also help increase SME technical efficiency. In addition, the results reveal that larger SMEs have superior performance in export and technological innovation. Therefore, policies to support the success of larger SMEs should be encouraged; this can be accomplished, for instance, by credit financing or equity financing from venture capital funds or the Market for Alternative Investment (MAI). SME age is not significantly related to SME performance as measured by technical efficiency, exports, and technological innovation. Higher costs of debt as measured by interest costs significantly correlated to SME export and technological innovation, since exporting SMEs or innovative SMEs require more loans as reflected by interest paid than non-exporting and non-innovative SMEs. Focusing on CEO characteristics, experience can help increase SME technical efficiency. In reality, start-up SMEs do not have entrepreneurs with high working experience. Workshops and training for start-up SMEs should be emphasized to provide necessary knowledge in conducting their businesses. CEO education also promotes SME export and technological innovation performance.

Due to asymmetric information and adverse selection costs relating to Thai SMEs, the results show that financial institutions in Thailand still heavily rely on collateral-based lending and SME financial transparency. The reliability of externally audited financial statements can reduce information asymmetry, adverse selection costs paid by lenders, and moral hazard behavior of borrowers. Many SMEs, especially start-up SMEs, do not have the collateral required by financial institutions. For instance, 12.18% of Thai manufacturing SMEs in the survey were found not to have collateral. Relationship-based lending should be promoted to financial institutions in Thailand as this can encourage close linkages between credit officers and potential SMEs, which can help credit officers obtain better information about SME prospects and their business plans. In addition, information sharing through credit bureaus should substitute for collateral as a screening device, but the screening cost should be reduced to promote information sharing among financial institutions. More importantly, credit guarantees provided by the Thai Credit Guarantee Corporation (TCG), previously known as the Small Business Credit Guarantee Corporation, should be promoted for SMEs, especially start-up SMEs, which have insufficient collateral. The network among the TCG, commercial banks, and other government-owned SFIs should be strengthened as this can help Thai SMEs to obtain sufficient credit in a timely manner and allow the institutions to share financial information on SMEs.

For legal issues, the amendment of some sections in the TCG Act should be encouraged, since the TCG has currently limited its guarantee services to banks due to the act. The TCG's guarantee services through the capital market, therefore, should be promoted, since SMEs can access new funds by issuing debt instruments such as debentures backed up by debenture issuance guarantees by the TCG. However, credit guarantees provided for SMEs might lead to nonperforming credit guarantees in the future, and so there should be continuous development of credit risk management tools, such as credit scoring to ensure that each credit type and credit limit are accurately provided for each SME client. This can help protect against overborrowing and the higher risk of moral hazard behavior among SMEs. A certified financial statement is required for SMEs to access external finance, including from private commercial banks and government-owned financial institutions. Hence, transparency and good accounting standards should be promoted for Thai SMEs. This is because it can help reduce the problem of asymmetric information arising between SMEs and lenders and adverse selection costs borne by financial institutions. In practice, most start-up SMEs lack financial literacy in preparing a good business plan and documentation necessary for loan approval. Seminars, training, or financial services related to improving the financial literacy of SMEs should be promoted, especially to start-up SMEs.

## REFERENCES

- Admassie, A., and F. A. S. T. Matambalya. 2002. Technical Efficiency of Small-and Medium-Scale Enterprises: Evidence from a Survey of Enterprises in Tanzania. *Eastern Africa Social Science Research Review*. 18(2). pp. 1–29.
- Alvarez, R., and G. Crespi. 2003. Determinants of Technical Efficiency in Small Firms. *Small Business Economics*. 20(1). pp. 233–244.
- Ayyagari, M., A. Demirgürç-Kunt, and V. Maksimovic. 2005. *How Important Are Financing Constraints? The Role of Finance in the Business Environment*. World Bank Policy Research Working Paper No. 3820. Washington, DC: World Bank.
- Battese, G., and T. Coelli. 1995. A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. *Empirical Economics*. 20(1). pp. 325–332.
- Beck, T., A. Demirgürç-Kunt, L. Laeven, and V. Maksimovic. 2006. The Determinants of Financing obstacles. *Journal of International Money and Finance*. 25(1). pp. 932–952.
- Beck, T., A. Demirgürç-Kunt, and V. Maksimovic. 2008. Financing Patterns Around the World: Are Small Firms Different? *Journal of Financial Economics*. 89(1). pp. 467–487.
- Bank of Thailand. 2015a. Thailand's Financial Landscape. Bangkok. <https://www.bot.or.th/English/FinancialInstitutions/FIStructure/Pages/default.aspx> (accessed 20 October 2015).
- . 2015b. Commercial Banks' Loans, Deposits, and L/D Ratio. Bangkok. <http://www2.bot.or.th/statistics/BOTWEBSTAT.aspx?reportID=155&language=ENG> (accessed 20 October 2015).
- Brimble, P., D. Oldfield, and M. Monsakul. 2002. Policies for SME Recovery in Thailand. In C. Harvie and B. Lee, eds. *The Role of SMEs in National Economies in East Asia*. pp. 202–237. Cheltenham, UK: Edward Elgar.
- Charoenrat, T., C. Harvie, and Y. Amornkitvikai. 2013. Thai Manufacturing Small and Medium Sized Enterprise Technical Efficiency: Evidence from Firm-Level Industrial Census Data. *Journal of Asian Economics*. 27(1). pp. 42–56.
- Coelli, T., D. Rao, C. O'Donnell, and G. Battese. 2005. *An Introduction to Efficiency and Productivity Analysis*. New York, USA: Springer.
- Crespi, G., and P. Zuniga. 2011. Innovation and Productivity: Evidence from Six Latin American Countries. *World Economy*. 40(2). pp. 273–290.
- Fried, H., K. Lovell, and S. Schmidt. 2008. *The Measurements of Productive Efficiency and Productivity Growth*. New York: Oxford University Press.
- Fiscal Policy Office, Ministry of Finance. 2015. Table of Loans and Deposits of Specialized Financial Institutions (SFIs) (in Thai). Fiscal Policy Office. Bangkok. [www.fpo.go.th/FPO/index2.php?mod=Category&file=categoryview&categoryID=CAT0001360](http://www.fpo.go.th/FPO/index2.php?mod=Category&file=categoryview&categoryID=CAT0001360) (accessed 21 October 2015).
- Harvie, C., D. Narjoko, and S. Oum. 2013. Small and Medium Enterprises' Access to Finance: Evidence from Selected Asian Economies. *ERIA Discussion Paper Series*. ERIA-DP-2013-23. Jakarta: Economic Research Institute for ASEAN and East Asia.

- International Trade Centre. 2015. *SME Competitiveness Outlook 2015: SMEs and Global Markets: The Missing Link for Inclusive Growth*. Geneva.
- Kalirajan, K. P., and R. T. Shand. 1999. Frontier Production Functions and Technical Efficiency Measures. *Journal of Economic Surveys*. 13(2). pp.149–172.
- Kimura, F., and K. Kiyota. 2007. Foreign-Owned Versus Domestically-Owned Firms: Economic Performance in Japan. *Review of Development Economics*. 11(1). pp. 31–48.
- Kodde, D., and F. Palm. 1986. Wald Criteria for Jointly Testing Equality and Inequality Restrictions. *The Econometric Society*. 54(5). pp.1243–1248.
- Kumbhakar, S., and C. Lovell. 2000. *Stochastic Frontier Analysis*. Cambridge, UK: Cambridge University Press.
- Mayers, S., and N. Majluf. 1984. Corporate Financing and Investment Decisions When Firms Have Information the Investors Do Not have. *Journal of Financial Economics*. 13(2). pp. 187–221.
- Mephokee, C. 2004. *The Thai SME Development Policies: Country Report*. Bangkok: Thammasat University.
- Nagler, J. 1994. Scobit: An Alternative Estimator to Logit and Probit. *American Journal of Political Science*. 38(1). pp. 230–255.
- Organisation for Economic Co-operation and Development (OECD). 2005. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. Paris: Organisation for Economic Co-operation and Development.
- OECD. 2006. The SME Financing Gap: Theory and Evidence. *Financial Market Trends*. 2006(2). Paris. [www.oecd-ilibrary.org/finance-and-investment/the-sme-financing-gap-theory-and-evidence\\_fmt-v2006-art11-en](http://www.oecd-ilibrary.org/finance-and-investment/the-sme-financing-gap-theory-and-evidence_fmt-v2006-art11-en) (accessed 21 October 2015).
- . 2015. *Financing SMEs and Entrepreneurs 2015: An OECD Scoreboard*. Paris.
- Office of Small and Medium Enterprises Promotion (OSMEP). 2007. *The White Paper on Small and Medium Enterprises of Thailand in 2006 and Trends 2007*. Bangkok.
- . 2008. *The White Paper on Small and Medium Enterprises of Thailand in 2007 and Trends 2008*. Bangkok: The Office of Small and Medium Enterprises Promotion.
- . 2010. *The White Paper on Small and Medium Enterprises of Thailand in 2009 and Trends 2010*. Bangkok: The Office of Small and Medium Enterprises Promotion.
- . 2011. *The White Paper on Small and Medium Enterprises of Thailand in 2010 and Trends 2011*. Bangkok: The Office of Small and Medium Enterprises Promotion.
- . 2012. *The White Paper on Small and Medium Enterprises of Thailand in 2011 and Trends 2012*. Bangkok: The Office of Small and Medium Enterprises Promotion.
- . 2013. *The White Paper on Small and Medium Enterprises of Thailand in 2012 and Trends 2013*. Bangkok: The Office of Small and Medium Enterprises Promotion.

- Poonpatpibul, C., and W. Limthammahisorn. 2005. Financial Access of SMEs in Thailand: What Are the Roles of the Central Bank? Bank of Thailand Discussion Paper DP/05/2005. Bangkok: Monetary Policy Group, Bank of Thailand.
- Punyasavatsut, C. 2008. SMEs in the Thai Manufacturing Industry: Linking with MNES. In H. Lim, ed. *SME in Asia and Globalization*. pp. 287–321. ERIA Research Project Report 2007-5. Jakarta: Economic Research Institute for ASEAN and East Asia.
- . 2011. SMEs Access to Finance in Thailand. In C. Harvie, S. Oum, and D. Narjoko, eds. *Small and Medium Enterprises (SMEs) Access to Finance in Selected East Asian Economies*. pp. 193–230. ERIA Research Project Report 2001-14. Jakarta: Economic Research Institute for ASEAN and East Asia.
- Regnier, P. 2000. *Small and Medium Enterprises in Distress: Thailand, the East Asian Crisis and Beyond*. Burlington: Ashgate Publishing,
- Small and Medium Enterprise Development Bank of Thailand (SME Bank). 2014. *Annual Report 2014*. Bangkok.
- Tapaneeyangkul, P. 2001. *Government Policies in Assisting SMEs for Sustainable Development*. Bangkok: The Office of Small and Medium Enterprises Promotion.
- Thai Credit Guarantee Corporation (TCG). 2014. *Annual Report 2014*. Bangkok.
- Watson, T., and N. Wilson. 2002. Small and Medium Size Enterprise Financing: A Note on Some of the Empirical Implications of a Pecking Order. *Journal of Business Finance & Accounting*. 29(3-4). pp. 557–578.
- Wignaraja, G., and Y. Jinjarak, Y. 2015. Why Do SMEs Not Borrow More from Banks? Evidence from the People's Republic of China and Southeast Asia. *ADBI Working Paper Series*. No. 509. Tokyo: Asian Development Bank Institute.
- Wooldridge, J. M. 2013. *Introductory Econometrics: A Modern Approach*. 5th ed. Mason, Ohio, USA: South-Western College Publishing, Cengage Learning.

## APPENDIX: VARIABLE DEFINITIONS AND SUMMARY STATISTICS

<b>Variable</b>	<b>Definition</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
Value added	Logarithm of firm's value added	771	16.663	1.310	12.542	20.859
Labor	Logarithm of firm's number of workers	771	15.560	1.052	11.963	19.267
Capital	Logarithm of firm's total fixed assets	771	15.868	1.940	1.386	20.982
Access to external loans	Dummy variable takes a value of 1 for a firm that has accessed external finance, or 0 otherwise	771	0.741	0.439	0.00	1.00
Access to banks or financial institutions	Dummy variable takes a value of 1 for a firm with access to banks or financial institutions, or 0 otherwise	771	0.686	0.464	0.00	1.00
Access to government-owned SFIs	Dummy variable takes a value of 1 for a firm with access to government-owned financial institutions, or 0 otherwise	771	0.071	0.258	0.00	1.00
Access to private commercial banks	Dummy variable takes a value of 1 for a firm with access to local commercial banks and foreign commercial banks, or 0 otherwise	771	0.694	0.461	0.00	1.00
Innovation	A firm's capability to undertake technological innovation initiatives, measured by the percentage in completing all technologically innovative initiatives	771	0.281	0.154	0.00	0.92
Export participation	Dummy variable takes a value of 1 for a firm participating in export market, or 0 otherwise	771	0.380	0.486	0.00	1.00
Exports	A firm's exports to total sales	771	18.081	32.591	0.00	100.00
Domestic ownership	A firm's domestic ownership as measured by the percentage of Thai-owned shares	771	91.018	23.423	0.000	100.00
Foreign ownership	A firm's foreign ownership as measured by the percentage of shares owned by foreigners	771	9.459	23.970	0.00	100.00
CEO experience	A firm CEO's working years	771	10.319	7.344	0.00	47.00
CEO education	Dummy variable takes a value of 1 for a firm with a CEO who holds at least a bachelor's degree, or 0 otherwise	771	0.656	0.475	0.00	1.00
Family owner's high wealth	Dummy variable takes a value of 1 for family owner's high wealth, or 0 otherwise	771	0.036	0.187	0.00	1.00
Family owner's medium wealth	Dummy variable takes a value of 1 for family owner's medium wealth, or 0 otherwise	771	0.808	0.394	0.00	1.00
Return of assets <sub>t-1</sub>	A firm's return of assets in Year t-1	771	0.017	0.246	(2.024)	4.798
Net profit margin <sub>t-1</sub>	A firm's net profit margin in Year t-1	771	(0.040)	0.662	(16.45)	1.55
Investment plan	Dummy variable takes a value of 1 for a firm's plan to substantially expand its investment, or 0 otherwise	771	0.440	0.497	0.00	1.00
Collateral	Dummy variable takes a value of 1 if a firm provides collateral to obtain bank credit, or 0 otherwise	771	0.879	0.326	0.00	1.00
Audited financial statement	Dummy variable takes a value of 1 if a firm provides an externally audited financial statement to obtain a bank credit, or 0 otherwise	771	0.916	0.278	0.00	1.00

*continued on next page*

*Table continued*

<b>Variable</b>	<b>Definition</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
Firm age	A firm's total number of operating years	771	12.965	8.496	0.00	49.00
Firm size	A firm's total number of employees	771	75.549	56.920	8.00	200.00
Access to government-owned SFIs	Dummy variable takes a value of 1 for a firm that receives loans and credit guarantees from SME banks, Export-Import Bank of Thailand, or Small Business Credit Guarantee Corporation, or 0 otherwise	771	0.741	0.439	0.00	1.00
OSMEP	Dummy variable takes a value of 1 for a firm that receives support from the Office of Small and Medium Enterprises Promotion (OSMEP), or 0 otherwise	771	0.012	0.107	0.00	1.00
Board of Investment	Dummy variable takes a value of 1 for a firm that receives support from the Board of Investment (BOI), or 0 otherwise	771	0.113	0.317	0.00	1.00
Loan Interest	Logarithm of a firm's loan interest	771	11.492	6.934	0.00	20.00
Interest ratio	A firm's total interest rates to total liabilities	771	9.316	6.208	0.00	19.49
Retained earnings	A firm's retained earnings represented as the percentage of total working capital	771	0.024	0.028	0.000	0.218
Local banks	A firm's funds obtained from local commercial banks represented as the percentage of total working capital	771	36.774	34.397	0.00	100.00
Foreign banks	A firm's funds obtained from foreign banks represented as the percentage of total working capital	771	36.202	34.197	0.00	100.00
Family and friends	A firm's funds obtained from family and friends represented as the percentage of total working capital	771	1.578	9.115	0.00	100.00
Informal sources	A firm's funds obtained from unlicensed money lenders represented as the percentage of total working capital	771	1.588	8.506	0.00	100.00
Bank numbers	The number of banks used by a firm	771	2.226	1.255	1.00	10.00
Auto components	Dummy variable takes a value of 1 for a firm in auto components, or 0 otherwise	771	0.087	0.282	0.00	1.00
Electrical appliances	Dummy variable takes a value of 1 for a firm in electrical appliances, or 0 otherwise	771	0.026	0.159	0.00	1.00
Electronic components	Dummy variable takes a value of 1 for a firm in electronic components, or 0 otherwise	771	0.054	0.227	0.00	1.00
Food processing	Dummy variable takes a value of 1 for a firm in food processing, or 0 otherwise	771	0.086	0.280	0.00	1.00
Furniture and wood products	Dummy variable takes a value of 1 for a firm in furniture and wood products, or 0 otherwise	771	0.109	0.312	0.00	1.00
Garments	Dummy variable takes a value of 1 for a firm in garments, or 0 otherwise	771	0.143	0.350	0.00	1.00
Machinery and equipment	Dummy variable takes a value of 1 for a firm in machinery and equipment, or 0 otherwise	771	0.097	0.297	0.00	1.00
Rubber and plastics	Dummy variable takes a value of 1 for a firm in rubber and plastics, or 0 otherwise	771	0.278	0.448	0.00	1.00

( ) = negative number, CEO = chief executive officer, SD = standard deviation, SFI = specialized financial institution.

Source: World Bank Enterprise Survey, Thailand (2007).