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Contents

During the past decade, free trade agreements (FTAs) have been the key policy instrument used by Thailand to integrate itself into the global and regional economy. However, refusal to liberalize the service sector imposes a heavy burden on the Thai economy. See related article on page 3.

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Thailand's Policy toward East Asian Economic Integration*

Somkiat Tangkitvanich
Saowaruj Rattanakhamfu**

1. INTRODUCTION

During the past decade, free trade agreements (FTAs) have been the key policy instrument used by Thailand to integrate itself into the global economy in general and that of East Asia in particular, including the countries belonging to the Association of Southeast Asian Nations (ASEAN). After its accession to the ASEAN Free Trade Area (AFTA), which was the first FTA signed in 1992, Thailand signed and implemented nine other FTAs with its trading partners during the past 10 years. These are the Thailand-India Free Trade Agreement (TIFTA–implemented in 2004), the Thailand-Australia Free Trade Agreement (TAFTA–implemented in 2005), the Thailand-New Zealand Closer Economic Partnership (TNZCEP–implemented in 2005), the ASEAN-China Free Trade Area (ACFTA–implemented in 2005), the Japan-Thailand Economic Partnership Agreement (JTEPA–implemented in 2007), the ASEAN Japan Comprehensive Economic Partnership (AJCEP–implemented in 2009), the ASEAN-Australia-New Zealand Free Trade Agreement (AANZFTA–implemented in 2009), the ASEAN-India Free Trade Agreement (AIFTA–implemented in 2009), and the ASEAN-Korea Free Trade Area (AKFTA–implemented in 2009). Many of the negotiations for these FTAs were launched and hastily concluded during the first term of the Thaksin Shinawatara Administration (2001-2005). Thailand is now in the process of negotiating with a number of countries and areas outside of Asia, most notably the European Union, on other such agreements. As of 2009, 52 percent of Thai exports were shipped to, and 59 percent of Thai imports were sourced from, countries that are parties to these implemented FTAs (see Figure 1) .

Thus, in view of Thailand's involvement in all of these FTAs it may be surprising for the authors to argue that the government actually has no overarching trade policy strategy. Driven partly by a vague idea to promote the country's competitiveness and partly by political motivations, the Thai government appears willing to negotiate as many FTAs as possible and to let members of the private sector decide for themselves how to make use of them.

The objective of this paper is to analyze Thailand's policy toward East Asian economic integration through FTAs. The paper is divided into four parts. Section 2 analyzes the impacts of liberalization of trade in goods. Section 3 describes the progress made in liberalization of service markets. The final section concludes the analysis, assesses Thailand's liberalization strategy, and furnishes some broad policy recommendations.

2. LIBERALIZATION OF TRADE IN GOODS

Gaining access to the goods market of trading partners appears to be a key objective of most of Thailand's FTAs. As such, the country's FTA strategy was criticized by Sally (2005) as being narrowly mercantilist in that export market access in a few sectors has been sought in return for import concessions in a few others, while otherwise preserving the domestic-protectionist status quo. He also criticized this "trade-light" approach as resulting in weak FTAs that would make little positive difference to competition and efficiency in the Thai economy, but would create complications in the process. Many multilateralists also argued that such FTAs would produce little, if any, net liberalization effects since exporters and importers would get tied up in knots of restrictive, overlapping rules of origin requirements, known as the "spaghetti bowl effect."

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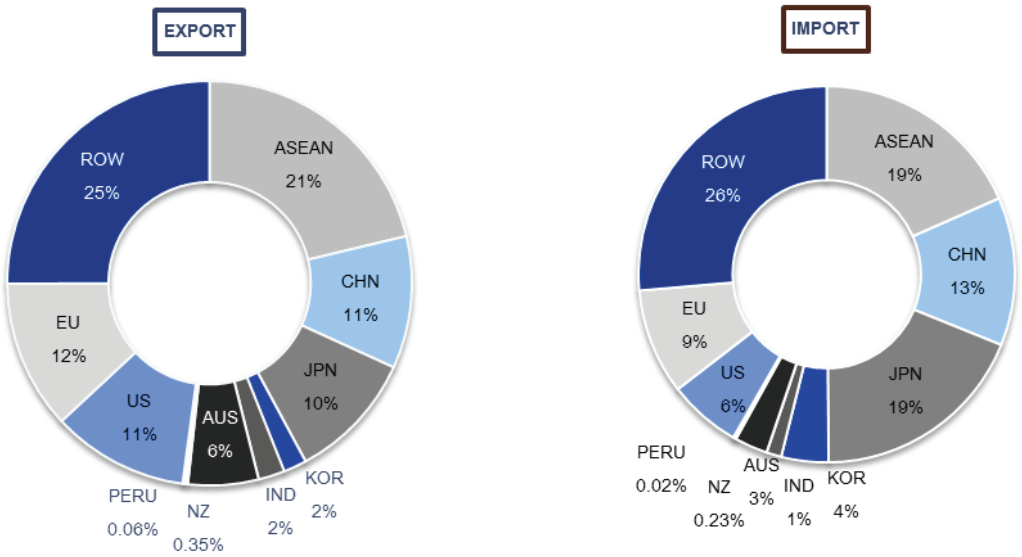
The authors would like to thank Wirot Sukphisan for his excellent research assistance in gathering and compiling data.

Figure 1 Thailand's Trade Shares with Its Free Trade Agreement Partners



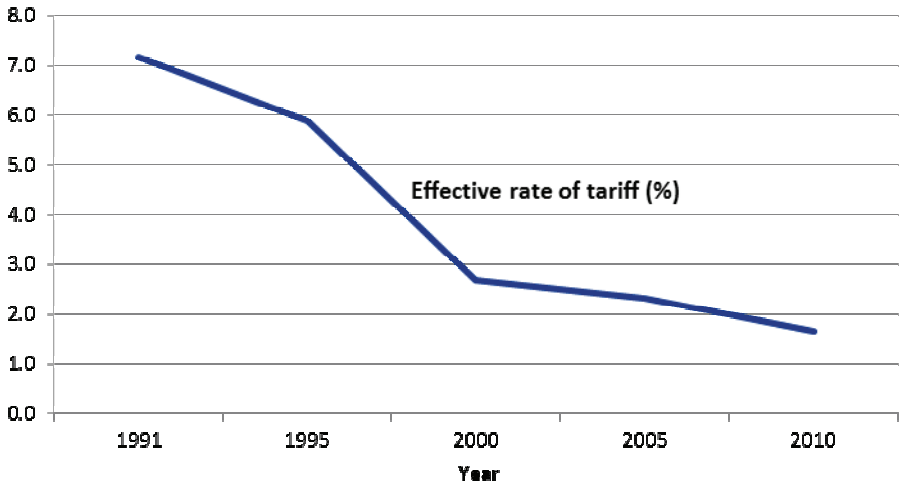
Source: TDRI, from Department of Customs data.

Our analysis of the implemented FTAs, based on utilization statistics from the Department of Foreign Trade, the Customs Department, other official trade data and interviews with persons in the private sector, reveals that the reality is much more subtle than what such experts have suggested.

First, although the most favored nation (MFN) tariff rates in Thailand appear to be high relative to other East Asian countries, the effective rate has become much lower due to FTAs, unilateral liberalizations and other tariff exemption schemes, such as the investment incentives granted by the Board of Investment (BOI), duty drawback under Section 19 bis of the Customs Act, and tariff exemption for importing goods into bonded warehouses. During the past two decades, the effective rate was reduced from 7.2 percent in 1991 to 1.7 percent in 2010 (see Figure 2). Our study shows that tariff savings in 2009 due to FTAs was $1.1 billion, or 15.4 percent of the total savings realized from all schemes (see Figure 3). Among all FTAs, AFTA provides the highest savings on tariffs, i.e., $575 million, followed by ACFTA, which has resulted in savings of $261 million. Thus, FTAs have contributed significantly to the reduction of the otherwise high tariff rates in Thailand.

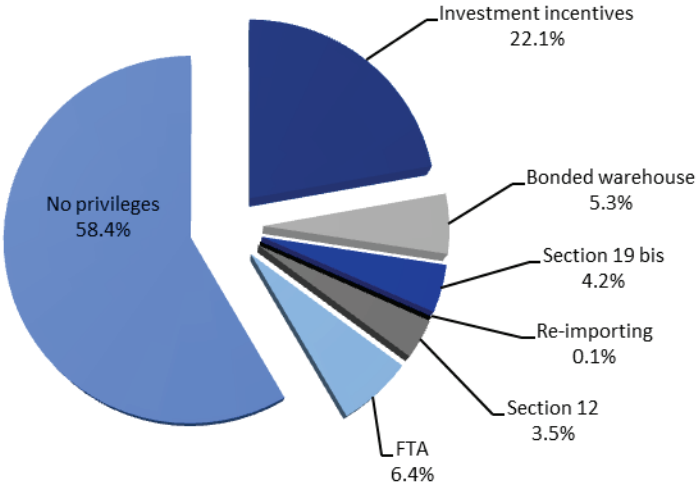
Second, FTAs have brought about even more tariff savings for Thai export products. For example, importers of Thai goods enjoyed $2.4 billion in tariff savings, accounting for 2.76 percent of the total exports to FTA partner countries in 2009 (see Table 1). This renders Thai products more competitive in these markets. AFTA again provides the largest tariff savings of $1.67 billion, followed by ACFTA which has saved $319 million. At the sectoral level, vehicles and processed food are the top two sectors that derive the most benefits from FTA tariff preferences.

Figure 2 Changes in Effective Tariff Rates



Source: TDRI, from official data.

Figure 3 Percentage Contribution to Import Tariff Reductions, by Value of Tariff Savings



Source: TDRI, from Department of Customs data.

Table 1 Tariff Savings Related to Exports and Imports under Free Trade Agreements in 2009

Free trade agreements	Millions of US dollars	
	Exports	Imports
AFTA	1,671	576
JTEPA	156	204
ACFTA	319	261
TAFTA	231	48
TIFTA	24	13
Total	2,401	1,101

Source: TDRI, from Department of Foreign Trade (exports) and Customs Department (imports).

Third, contrary to experts' beliefs, there is no evidence of the "spaghetti bowl" effect. The utilization data suggest that exporters and importers can cope with existing rules of origin. Interviews with exporters and importers also confirm that the rules of origin are not unreasonably restrictive, except for a few product items, such as canned tuna and pet food in the case of JTEPA, and televisions, electrical appliances and jewelry in the case of TIFTA.

Fourth, exporters and importers use bilateral FTAs, which grant deeper tariff cuts, more widely than regional ones, which grant less tariff reduction but allow more generous rules of origin. For example, JTEPA is used much more frequently than AJCEP in exporting to and importing from Japan. The same can be said in the case of exporting to and importing from ASEAN as AFTA is more popular than ACFTA and AJCEP. This confirms that rules of origin are not too restrictive for most products.

Fifth, econometric estimation by Chedtha and Somkiat (2010) has shown that FTAs between Thailand and its partners appear to increase trade; however, they found no evidence of overall trade diversion caused by FTAs. As a result, FTAs are likely to increase rather than decrease the welfare of Thailand and its trading partners.

While bringing about many benefits, the implemented FTAs still involve a number of weaknesses. First, there are industries that benefit minimally from FTAs. These sectors include most exporting sectors under ACFTA and most importing sectors under JTEPA. These sectors show especially low levels of FTA utilization, a situation which is caused by three sets of problems as described below:

- Problems relating to FTA negotiation. Some product items are still on the exclusion or sensitive lists, while others are eligible for tariff preference but are limited by quota. In addition, tariff preference margins for some products are not attractive enough in comparison with the usage cost. Yet in some other cases, products simply do not pass the rules of origin, as mentioned above.
- Problems relating to FTA utilization. Some exporters and importers do not recognize the benefits of FTAs, do not have access to information regarding preferential tariff treatment and rules of origin, and/or do not understand the procedures for applying for tariff preference. In the case of TIFTA, a problem exists concerning third party re-invoicing, which is currently not accepted.
- Non-tariff barriers and other problems. Even after receiving special tariff treatment, some

Thai products still cannot compete in price with products from countries such as China and Vietnam. Also, in many industries, there are other non-tariff barriers hindering a move toward free trade. Such barriers are related mostly to domestic regulations and thus are not easily solved under the framework of FTA negotiations.

Second, as tariff reduction under most FTAs is not uniform for all products, product classification for customs purposes becomes very important. Our interviews with exporters and importers revealed that there are problems related to customs classification: the Thai Customs Department and the private sector classify products differently.

Finally, owing to pressures from certain interest groups, some sectors are still highly protected. For example, the tariff rates for iron and steel and many vehicles remain relatively high. As a result, there is a significant gap between tariff rates among these product lines and all the rest. This creates distortions in production decisions, and results in inefficiency in the economy.

3. LIBERALIZATION OF TRADE IN SERVICES

3.1 The Importance of the Service Sector

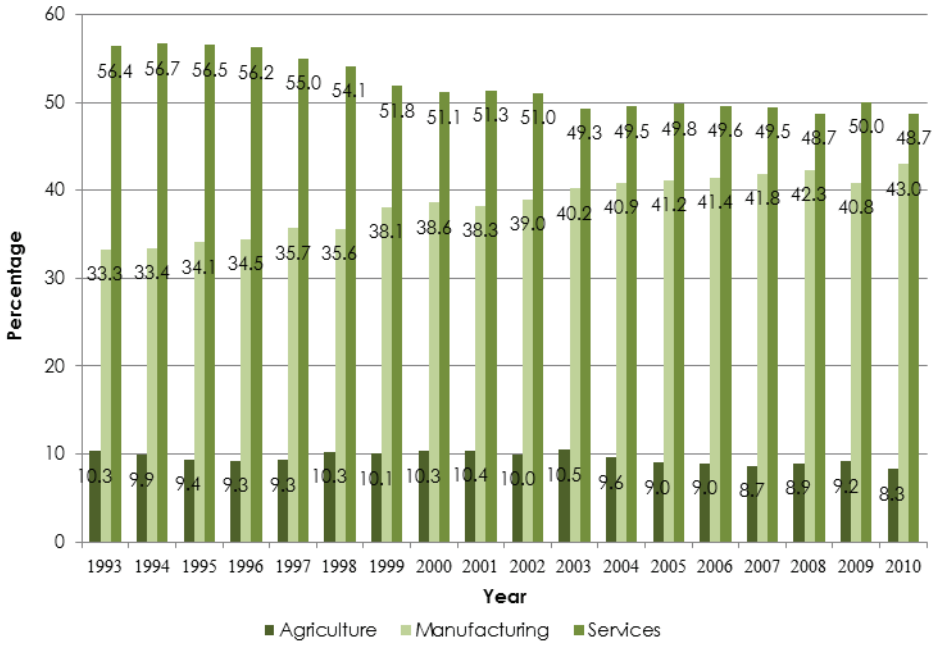
The service sector has contributed significantly to the Thai economy by generating 49-57 percent of GDP during the period 1993-2011 (see Figure 4). Its contribution, however, has continuously declined, reaching the lowest point of 48.7 percent in 2010. The trade in services accounted for 16-22 percent of total trade during the period 1993-2010 (see Figure 5), while the shares of employment in the service sector have increased significantly, from about 41 percent of total employment in 1998 to 48 percent in 2010 (see Figure 6). It should be noted, however, that the real importance of the service sector lies not in its direct contribution to GDP and employment but in its indirect contribution to the production sector.

3.2 Domestic Regulations and Their Implications for Barriers to the Trade in Services

Domestic regulations in Thailand deter not only foreign suppliers but also new domestic firms from entering the market. These regulations take various forms, such as the maximum limit on foreign ownership of capital shares or requiring that registered capital of such owners not exceed 50 percent, the restrictions on aliens being employed in particular occupations, and the requirement of obtaining licenses in some businesses, such in the telecommunications and financial sectors.

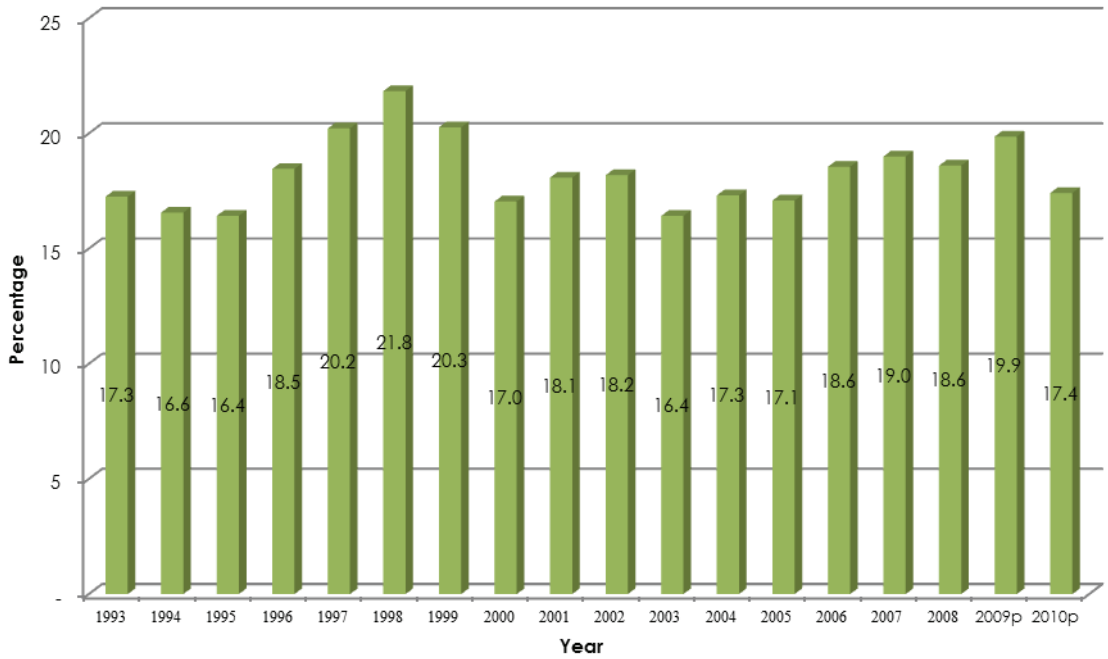
In particular, under the Foreign Business Act (1999), foreigners[1] with few exceptions,[2] are prohibited from owning 50 percent or more of the shares in services companies, unless permission has been granted by the Director-General of the Business Development Department. Foreigners may own the majority of shares in service companies if they get permission under the Investment Promotion Act (1977), the Industrial Estate Authority of Thailand Act (1979), the Treaty of Amity and Economic Relations between Thailand and the United States or any FTAs that allow such investment.

Figure 4 Sectoral Contribution to GDP



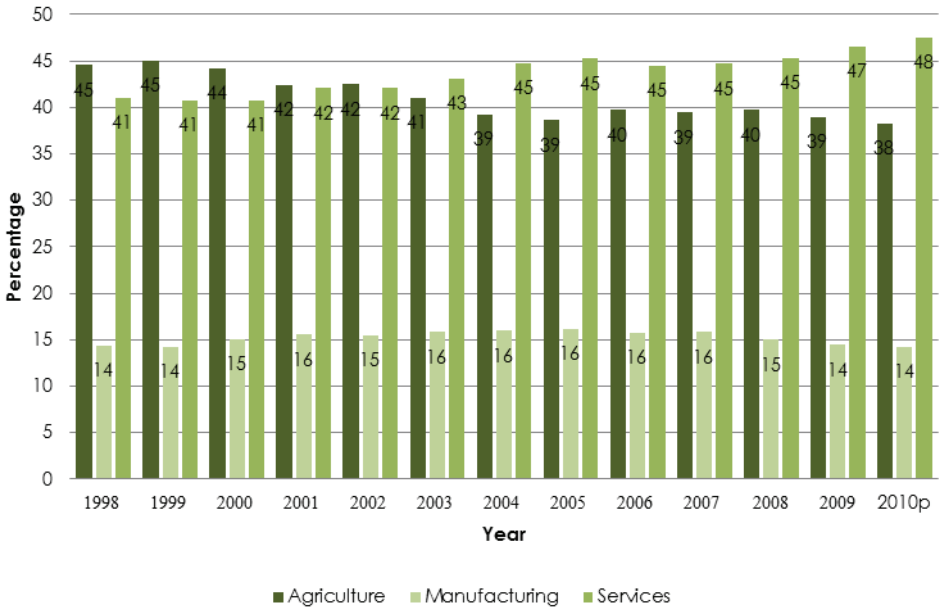
Source: National Economic and Social Development Board.

Figure 5 Share of Service Trade in Total Trade



Source: National Economic and Social Development Board.

Figure 6 Contribution to Total Employment



Source: National Statistical Office, Thailand.

Under the Alien Employment Act (1978), foreigners must obtain a work permit from the Ministry of Labor before starting to work in Thailand, as well as obtain a non-immigrant visa from a Thai embassy abroad. However, a work permit would not be granted for many occupations[3] under the Royal Decree Stipulating Work in Occupations and Professions Prohibited to Aliens (1979).

In addition to the general restrictions on working in service businesses, foreigners are required to comply with specific rules and regulations in particular service sectors. For example, under the Financial Institution Act (2008), a supplier wishing to operate financial institutions, such as commercial banks (local, subsidiaries and branches of foreign banks), credit fonciers, and finance companies, must obtain a license from the Ministry of Finance with the recommendation of the Bank of Thailand. In addition, at least 75 percent of the shares of financial institutions must be held by Thai nationals, and at least three-fourths of the board of directors must be

Thai. Similarly, the Telecommunications Business Act (2006) prohibits foreigners from owning 50 percent or more of the shares to operate Type Two and Type Three telecom services.[4]

3.3 Liberalization of Trade in Services under FTAs

Thailand has signed a number of bilateral and regional FTAs that contain provisions on liberalization of trade in services, such as JTEPA, ACFTA and AKFTA. In order to compare the level of restrictions on the trade in services across these FTAs, we estimated barriers to that trade by following the methodology of Hoekman (1996). Hoekman's index indicates the relative degree of restrictions for a given sector and mode of supply, by scoring one for no restrictions, one-half for partial liberalization, and zero for no commitment. Its main limitation, however, is the equal weight given to any degree of restriction.

Our study finds that Thailand's offers under the General Agreement on Trade in Services (GATS) and the ASEAN Framework Agreement on Services (AFAS) provide more openness in the trade in services than those under FTAs with trading partners (see Appendix). In particular, Thailand's offers under GATS cover more liberalization across all sectors and modes of supply than those under FTAs. However, the liberalization extends most of all to the ASEAN countries as almost all sectors (especially in health-related and social services) and modes of supply (especially in modes 1, 2 and 3) are committed under AFAS.

In comparing all three FTAs, Thailand's commitments under the more recent FTA with the Republic of Korea offers more liberalization in the trade in services than those under JTEPA and ACFTA, especially in construction and related engineering services. Thailand, however, provides more liberalization for trade in financial services under JTEPA, and tourism and travel-related services under ACFTA.

It appears that differential commitments under the three FTAs reflect the lack of a coherent national strategy regarding a priority to liberalize the service sector. In addition, complicated and different barriers to trade in services in existing FTAs cause difficulties for government officials and related agencies in implementing the commitments.

In summary, Thailand's commitment to liberalize its service sector is mostly not beyond the extent of existing domestic laws and regulations, except for certain specific cases. For example, under JTEPA, Thailand allows Japanese investors to hold up to 100 percent ownership in general consulting services, and up to 60 percent in major hotels and restaurants, whereas normally the maximum foreign equity limit is kept below 50 percent under the domestic law. In addition, the fact that the liberalized sectors differ among the concluded FTAs reflects a situation in which the country has yet to formulate a coherent national strategy to develop the service sector.

3.4 Impact of Liberalization of Trade in Services

Barriers to trade in services can lead to inefficiencies, rent creation, and cost escalation. Infrastructure-related services, such as telecommunications and transport, as well as other important service sectors, such as finance and retail, currently have relatively high barriers to entry, especially for foreign suppliers. As a result, sectors that rely heavily on foreigners to provide inputs have to bear the high costs incurred as a result of these barriers. Based on an analysis of an input-output table in 2005, we found that the sectors that rely most heavily on communication services in terms of input cost are post and telecommunications, banking services, wholesale trade, retail trade, broadcasting and related services, business services, and hotels and restaurants. Likewise, the sectors that rely most heavily on banking services are wholesale trade, banking services, retail trade, electricity, post and telecommunications, real estate, and air transport.

While there are very few quantitative studies on the impact for Thailand of liberalization of trade in services, there are indications that such liberalization could bring about sizeable benefits for the economy. For example, Somkiat and Taratorn (2005) applied a model based on a social accounting matrix (SAM) to assess the impact of liberalization on the telecommunications sector, and found that it would contribute to an increase in GDP by 0.47 percent. The sectors that benefit most from such liberalization are downstream telecommunications, hotels, publishing, tourism, personal and household services, restaurants, repairing services, banking and financial sectors, beverages, and entertainment.

4. CONCLUSION

Although Thailand has no overarching strategy toward economic integration, it appears that the adopted FTA strategy has achieved moderate success. In particular, the concluded FTAs have resulted in significant tariff savings for exporters and importers. Rules of origin do not appear to be a major problem restricting bilateral and regional trade. FTAs between Thailand and its trading partners have also been found to increase total trade. Existing evidence has so far suggested no sign of overall trade diversion. As a result, FTAs are likely to increase rather than decrease the welfare of Thailand and its trading partners. However, the current regime is far from being optimal. Many manufacturing sectors are still highly protected. As a result, there is a significant gap between tariff rates among product lines, which creates not only distortion in production decisions but also potential opportunities for corruption related to the classification of products by customs officials.

Refusal to liberalize the service sector also imposes a heavy burden on the Thai economy. In other

words, the Thai economy is becoming increasingly dualistic as most of the manufacturing sectors have to face intense competition while the service sectors are still tightly guarded. In the long run, the inefficiency of the latter is likely to erode the competitiveness of the former. As the return on investment in services becomes higher, the sector can attract higher quality human resources and thus crowd out the manufacturing sectors. High economic rents generated in the service sector also make it subject to rent-seeking activities, as witnessed by a high rate of political donation and direct political involvement (Pramuan and Yupana, 2006). Thus, from an economic and political perspective, there is an urgent need to liberalize the service sector.

Appendix: Thailand's Commitments to Liberalize Its Service Sectors

Sectors/sub-sectors	Thailand's commitments under the General Agreement on Trade in Services[a]												
	Limitations on market access (MA)				Limitations on national treatment (NT)				MA +NT				Average
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	
Business services	**3.3**	**50.0**	**50.0**	**18.5**	**3.3**	**50.0**	**50.0**	**18.5**	**3.3**	**50.0**	**50.0**	**18.5**	**30.4**
Professional services	0.0	45.5	45.5	4.5	0.0	45.5	45.5	4.5	0.0	45.5	45.5	4.5	23.9
Computer and related services	0.0	100.0	100.0	50.0	0.0	100.0	100.0	50.0	0.0	100.0	100.0	50.0	62.5
R&D services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real estate services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rental/leasing services without operators	0.0	20.0	20.0	10.0	0.0	20.0	20.0	10.0	0.0	20.0	20.0	10.0	12.5
Other business services	7.5	60.0	60.0	25.0	7.5	60.0	60.0	25.0	7.5	60.0	60.0	25.0	38.1
Communication services	**14.6**	**29.2**	**22.9**	**18.8**	**27.1**	**37.5**	**22.9**	**18.8**	**20.8**	**33.3**	**22.9**	**18.8**	**24.0**
Postal services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Courier services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Telecommunications services	23.3	33.3	23.3	23.3	43.3	46.7	23.3	23.3	33.3	40.0	23.3	23.3	30.0
Audiovisual services	0.0	33.3	33.3	16.7	0.0	33.3	33.3	16.7	0.0	33.3	33.3	16.7	20.8
Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction and related engineering services	**0.0**	**60.0**	**60.0**	**30.0**	**0.0**	**60.0**	**60.0**	**30.0**	**0.0**	**60.0**	**60.0**	**30.0**	**37.5**
Distribution services	**0.0**	**40.0**	**40.0**	**10.0**	**0.0**	**40.0**	**40.0**	**10.0**	**0.0**	**40.0**	**40.0**	**10.0**	**22.5**
Educational services	**0.0**	**100.0**	**80.0**	**50.0**	**0.0**	**100.0**	**80.0**	**0.0**	**0.0**	**100.0**	**80.0**	**25.0**	**51.3**
Environmental services	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**65.6**
Financial services	**41.2**	**44.1**	**38.2**	**38.2**	**67.6**	**70.6**	**41.2**	**8.8**	**54.4**	**57.4**	**39.7**	**23.5**	**43.8**
Health-related and social services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Tourism and travel-related services	**0.0**	**75.0**	**62.5**	**37.5**	**0.0**	**75.0**	**75.0**	**37.5**	**0.0**	**75.0**	**68.8**	**37.5**	**45.3**
Recreational, cultural and sporting services	**0.0**	**40.0**	**40.0**	**20.0**	**0.0**	**40.0**	**40.0**	**20.0**	**0.0**	**40.0**	**40.0**	**20.0**	**25.0**
Transport services	**18.6**	**31.4**	**20.0**	**15.7**	**20.0**	**30.0**	**25.7**	**14.3**	**19.3**	**30.7**	**22.9**	**15.0**	**22.0**
Maritime transport services	50.0	66.7	33.3	33.3	58.3	66.7	41.7	33.3	54.2	66.7	37.5	33.3	47.9
Internal waterways transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Air transport services	30.0	40.0	20.0	20.0	30.0	30.0	30.0	10.0	30.0	35.0	25.0	15.0	26.3
Space transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rail transport services	40.0	40.0	40.0	20.0	40.0	40.0	40.0	20.0	40.0	40.0	40.0	20.0	35.0
Road transport services	0.0	40.0	20.0	20.0	0.0	40.0	40.0	20.0	0.0	40.0	30.0	20.0	22.5
Pipeline transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services auxiliary to all modes of transport	0.0	25.0	25.0	12.5	0.0	25.0	25.0	12.5	0.0	25.0	25.0	12.5	15.6
Other transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services not included elsewhere	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
ALL SECTORS	**7.5**	**47.5**	**42.8**	**24.1**	**10.9**	**50.3**	**44.6**	**17.3**	**9.2**	**48.9**	**43.7**	**20.7**	**30.6**

[a] TN/S/O/THA/Rev.1 of 8 November 2005.

(Continued on page 10)

Appendix (Continued)

Sectors/sub-sectors	Thailand's commitments under ASEAN Framework Agreement on Services (7th Package)[b]												
	Limitations on market access (MA)				Limitations on national treatment (NT)				MA +NT				Average
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	
Business services	**59.8**	**73.9**	**68.5**	**16.3**	**54.3**	**73.9**	**72.8**	**16.3**	**57.1**	**73.9**	**70.7**	**16.3**	**54.5**
Professional services	45.5	54.5	40.9	4.5	22.7	54.5	54.5	4.5	34.1	54.5	47.7	4.5	35.2
Computer and related services	100.0	100.0	100.0	50.0	100.0	100.0	100.0	50.0	100.0	100.0	100.0	50.0	87.5
R&D services	100.0	100.0	100.0	33.3	100.0	100.0	100.0	33.3	100.0	100.0	100.0	33.3	83.3
Real estate services	100.0	100.0	100.0	0.0	100.0	100.0	100.0	0.0	100.0	100.0	100.0	0.0	75.0
Rental/leasing services without operators	60.0	80.0	70.0	10.0	60.0	80.0	70.0	10.0	60.0	80.0	70.0	10.0	55.0
Other business services	47.5	70.0	67.5	15.0	47.5	70.0	70.0	15.0	47.5	70.0	68.8	15.0	50.3
Communication services	**27.1**	**37.5**	**35.4**	**22.9**	**45.8**	**54.2**	**35.4**	**22.9**	**36.5**	**45.8**	**35.4**	**22.9**	**35.2**
Postal services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Courier services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Telecommunications services	30.0	33.3	30.0	30.0	60.0	60.0	30.0	30.0	45.0	46.7	30.0	30.0	37.9
Audiovisual services	33.3	66.7	66.7	16.7	33.3	66.7	66.7	16.7	33.3	66.7	66.7	16.7	45.8
Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction and related engineering services	**0.0**	**100.0**	**100.0**	**50.0**	**0.0**	**100.0**	**100.0**	**50.0**	**0.0**	**100.0**	**100.0**	**50.0**	**62.5**
Distribution services	**60.0**	**80.0**	**80.0**	**0.0**	**60.0**	**80.0**	**80.0**	**0.0**	**60.0**	**80.0**	**80.0**	**0.0**	**55.0**
Educational services	**100.0**	**100.0**	**70.0**	**20.0**	**100.0**	**100.0**	**70.0**	**0.0**	**100.0**	**100.0**	**70.0**	**10.0**	**70.0**
Environmental services	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**65.6**
Financial services	**5.9**	**64.7**	**32.4**	**32.4**	**64.7**	**64.7**	**32.4**	**64.7**	**35.3**	**64.7**	**32.4**	**48.5**	**45.2**
Health-related and social services	**75.0**	**75.0**	**37.5**	**37.5**	**75.0**	**75.0**	**37.5**	**37.5**	**75.0**	**75.0**	**37.5**	**37.5**	**56.3**
Tourism and travel-related services	**50.0**	**75.0**	**62.5**	**37.5**	**50.0**	**75.0**	**75.0**	**37.5**	**50.0**	**75.0**	**68.8**	**37.5**	**57.8**
Recreational, cultural and sporting services	**40.0**	**100.0**	**100.0**	**30.0**	**40.0**	**100.0**	**100.0**	**30.0**	**40.0**	**100.0**	**100.0**	**30.0**	**67.5**
Transport services	**32.9**	**42.9**	**31.4**	**17.1**	**32.9**	**42.9**	**37.1**	**15.7**	**32.9**	**42.9**	**34.3**	**16.4**	**31.6**
Maritime transport services	75.0	83.3	50.0	33.3	75.0	83.3	50.0	33.3	75.0	83.3	50.0	33.3	60.4
Internal waterways transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Air transport services	20.0	20.0	10.0	10.0	20.0	20.0	20.0	0.0	20.0	20.0	15.0	5.0	15.0
Space transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rail transport services	40.0	40.0	40.0	20.0	40.0	40.0	40.0	20.0	40.0	40.0	40.0	20.0	35.0
Road transport services	40.0	80.0	60.0	20.0	40.0	80.0	80.0	20.0	40.0	80.0	70.0	20.0	52.5
Pipeline transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services auxiliary to all modes of transport	50.0	75.0	62.5	37.5	50.0	75.0	75.0	37.5	50.0	75.0	68.8	37.5	57.8
Other transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services not included elsewhere	**100.0**	**100.0**	**100.0**	**0.0**	**100.0**	**100.0**	**100.0**	**0.0**	**100.0**	**100.0**	**100.0**	**0.0**	**75.0**
ALL SECTORS	**46.9**	**79.1**	**68.1**	**26.1**	**52.9**	**80.5**	**70.0**	**27.1**	**49.9**	**79.8**	**69.1**	**26.6**	**56.3**

[b] Thailand's commitments on the liberalization in financial services are embodied in "Protocol to Implement the Second Package of Commitments on Financial Services under the ASEAN Framework Agreement on Services," while its commitments on liberalization of air transport services are embodied in the "Protocol to Implement the Fourth Package of Commitments on Air Transport Services under the ASEAN Framework Agreement on Services."

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Appendix (Continued)

Sectors/sub-sectors	Thailand's commitments under the ASEAN-China Free Trade Area (1st Package)												
	Limitations on market access (MA)				Limitations on national treatment (NT)				MA + NT				Average
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	
Business services	**8.7**	**8.7**	**5.4**	**1.1**	**0.0**	**8.7**	**8.7**	**1.1**	**4.3**	**8.7**	**7.1**	**1.1**	**5.3**
Professional services	36.4	36.4	22.7	4.5	0.0	36.4	36.4	4.5	18.2	36.4	29.5	4.5	22.2
Computer and related services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R&D services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real estate services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rental/leasing services without operators	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other business services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communication services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Postal services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Courier services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Telecommunications services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Audiovisual services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction and related engineering services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Distribution services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Educational services	**10.0**	**60.0**	**20.0**	**30.0**	**10.0**	**60.0**	**20.0**	**10.0**	**10.0**	**60.0**	**20.0**	**20.0**	**27.5**
Environmental services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Financial services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Health-related and social services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Tourism and travel-related services	**37.5**	**75.0**	**62.5**	**37.5**	**37.5**	**75.0**	**75.0**	**37.5**	**37.5**	**75.0**	**68.8**	**37.5**	**54.7**
Recreational, cultural and sporting services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Transport services	**0.0**	**2.9**	**1.4**	**1.4**	**0.0**	**2.9**	**2.9**	**1.4**	**0.0**	**2.9**	**2.1**	**1.4**	**1.6**
Maritime transport services	0.0	16.7	8.3	8.3	0.0	16.7	16.7	8.3	0.0	16.7	12.5	8.3	9.4
Internal waterways transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Air transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Space transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rail transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pipeline transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services auxiliary to all modes of transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services not included elsewhere	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
ALL SECTORS	**4.7**	**12.2**	**7.4**	**5.8**	**4.0**	**12.2**	**8.9**	**4.2**	**4.3**	**12.2**	**8.2**	**5.0**	**7.4**

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Appendix (Continued)

Sectors/sub-sectors	Thailand's commitments under the ASEAN-Korea Free Trade Area												
	Limitations on market access (MA)				Limitations on national treatment (NT)				MA + NT				Average
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	
Business services	**1.1**	**50.0**	**50.0**	**18.5**	**1.1**	**50.0**	**46.7**	**18.5**	**1.1**	**50.0**	**48.4**	**18.5**	**29.5**
Professional services	0.0	45.5	45.5	4.5	0.0	45.5	45.5	4.5	0.0	45.5	45.5	4.5	23.9
Computer and related services	0.0	100.0	100.0	50.0	0.0	100.0	80.0	50.0	0.0	100.0	90.0	50.0	60.0
R&D services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real estate services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rental/leasing services without operators	0.0	20.0	20.0	10.0	0.0	20.0	20.0	10.0	0.0	20.0	20.0	10.0	12.5
Other business services	2.5	60.0	60.0	25.0	2.5	60.0	57.5	25.0	2.5	60.0	58.8	25.0	36.6
Communication services	**14.6**	**29.2**	**22.9**	**18.8**	**27.1**	**37.5**	**22.9**	**18.8**	**20.8**	**33.3**	**22.9**	**18.8**	**24.0**
Postal services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Courier services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Telecommunications services	23.3	33.3	23.3	23.3	43.3	46.7	23.3	23.3	33.3	40.0	23.3	23.3	30.0
Audiovisual services	0.0	33.3	33.3	16.7	0.0	33.3	33.3	16.7	0.0	33.3	33.3	16.7	20.8
Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction and related engineering services	**0.0**	**100.0**	**100.0**	**50.0**	**0.0**	**100.0**	**70.0**	**50.0**	**0.0**	**100.0**	**85.0**	**50.0**	**58.8**
Distribution services	**0.0**	**20.0**	**20.0**	**0.0**	**0.0**	**20.0**	**20.0**	**0.0**	**0.0**	**20.0**	**20.0**	**0.0**	**10.0**
Educational services	**10.0**	**100.0**	**80.0**	**50.0**	**10.0**	**100.0**	**70.0**	**0.0**	**10.0**	**100.0**	**75.0**	**25.0**	**52.5**
Environmental services	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**65.6**
Financial services	**41.2**	**44.1**	**38.2**	**38.2**	**67.6**	**70.6**	**38.2**	**8.8**	**54.4**	**57.4**	**38.2**	**23.5**	**43.4**
Health-related and social services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Tourism and travel-related services	**0.0**	**75.0**	**62.5**	**37.5**	**0.0**	**75.0**	**62.5**	**37.5**	**0.0**	**75.0**	**62.5**	**37.5**	**43.8**
Recreational, cultural and sporting services	**0.0**	**20.0**	**20.0**	**10.0**	**0.0**	**20.0**	**20.0**	**10.0**	**0.0**	**20.0**	**20.0**	**10.0**	**12.5**
Transport services	**20.0**	**31.4**	**20.0**	**15.7**	**20.0**	**30.0**	**22.9**	**11.4**	**20.0**	**30.7**	**21.4**	**13.6**	**21.4**
Maritime transport services	58.3	66.7	33.3	33.3	58.3	66.7	33.3	16.7	58.3	66.7	33.3	25.0	45.8
Internal waterways transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Air transport services	30.0	40.0	20.0	20.0	30.0	30.0	20.0	10.0	30.0	35.0	20.0	15.0	25.0
Space transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rail transport services	40.0	40.0	40.0	20.0	40.0	40.0	40.0	20.0	40.0	40.0	40.0	20.0	35.0
Road transport services	0.0	40.0	20.0	20.0	0.0	40.0	40.0	20.0	0.0	40.0	30.0	20.0	22.5
Pipeline transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services auxiliary to all modes of transport	0.0	25.0	25.0	12.5	0.0	25.0	25.0	12.5	0.0	25.0	25.0	12.5	15.6
Other transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services not included elsewhere	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
ALL SECTORS	**8.3**	**47.5**	**42.8**	**24.1**	**11.5**	**50.3**	**39.4**	**17.1**	**9.9**	**48.9**	**41.1**	**20.6**	**30.1**

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Appendix (Continued)

Sectors/sub-sectors	Thailand's commitments under the Japan-Thailand Economic Partnership Agreement												
	Limitations on market access (MA)				Limitations on national treatment (NT)				MA + NT				Average
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	
Business services	**2.2**	**41.3**	**37.0**	**18.5**	**2.2**	**41.3**	**37.0**	**17.4**	**2.2**	**41.3**	**37.0**	**17.9**	**24.6**
Professional services	0.0	45.5	45.5	9.1	0.0	45.5	45.5	4.5	0.0	45.5	45.5	6.8	24.4
Computer and related services	0.0	100.0	50.0	50.0	0.0	100.0	50.0	50.0	0.0	100.0	50.0	50.0	50.0
R&D services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real estate services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rental/leasing services without operators	0.0	20.0	20.0	10.0	0.0	20.0	20.0	10.0	0.0	20.0	20.0	10.0	12.5
Other business services	5.0	40.0	42.5	22.5	5.0	40.0	42.5	22.5	5.0	40.0	42.5	22.5	27.5
Communication services	**14.6**	**27.1**	**20.8**	**18.8**	**27.1**	**35.4**	**20.8**	**25.0**	**20.8**	**31.3**	**20.8**	**21.9**	**23.7**
Postal services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Courier services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Telecommunications services	23.3	33.3	23.3	23.3	43.3	46.7	23.3	33.3	33.3	40.0	23.3	28.3	31.3
Audiovisual services	0.0	25.0	25.0	16.7	0.0	25.0	25.0	16.7	0.0	25.0	25.0	16.7	16.7
Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction and related engineering services	**0.0**	**50.0**	**50.0**	**30.0**	**0.0**	**50.0**	**50.0**	**30.0**	**0.0**	**50.0**	**50.0**	**30.0**	**32.5**
Distribution services	**0.0**	**10.0**	**30.0**	**0.0**	**0.0**	**10.0**	**30.0**	**0.0**	**0.0**	**10.0**	**30.0**	**0.0**	**10.0**
Educational services	**10.0**	**90.0**	**80.0**	**50.0**	**10.0**	**90.0**	**80.0**	**0.0**	**10.0**	**90.0**	**80.0**	**25.0**	**51.3**
Environmental services	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**12.5**	**100.0**	**100.0**	**50.0**	**65.6**
Financial services	**41.2**	**44.1**	**38.2**	**38.2**	**64.7**	**67.6**	**44.1**	**73.5**	**52.9**	**55.9**	**41.2**	**55.9**	**51.5**
Health-related and social services	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Tourism and travel-related services	**0.0**	**37.5**	**25.0**	**25.0**	**0.0**	**37.5**	**37.5**	**25.0**	**0.0**	**37.5**	**31.3**	**25.0**	**23.4**
Recreational, cultural and sporting services	**0.0**	**20.0**	**20.0**	**10.0**	**0.0**	**20.0**	**20.0**	**10.0**	**0.0**	**20.0**	**20.0**	**10.0**	**12.5**
Transport services	**12.9**	**32.9**	**24.3**	**15.7**	**12.9**	**32.9**	**27.1**	**14.3**	**12.9**	**32.9**	**25.7**	**15.0**	**21.6**
Maritime transport services	58.3	58.3	33.3	33.3	58.3	58.3	33.3	33.3	58.3	58.3	33.3	33.3	45.8
Internal waterways transport	0.0	33.3	33.3	0.0	0.0	33.3	33.3	0.0	0.0	33.3	33.3	0.0	16.7
Air transport services	20.0	20.0	10.0	20.0	20.0	20.0	10.0	10.0	20.0	20.0	10.0	15.0	16.3
Space transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rail transport services	0.0	40.0	40.0	20.0	0.0	40.0	40.0	20.0	0.0	40.0	40.0	20.0	25.0
Road transport services	0.0	40.0	20.0	20.0	0.0	40.0	40.0	20.0	0.0	40.0	30.0	20.0	22.5
Pipeline transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services auxiliary to all modes of transport	0.0	25.0	25.0	12.5	0.0	25.0	25.0	12.5	0.0	25.0	25.0	12.5	15.6
Other transport services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services not included elsewhere	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
ALL SECTORS	**7.8**	**37.7**	**35.4**	**21.3**	**10.8**	**40.4**	**37.2**	**20.4**	**9.3**	**39.1**	**36.3**	**20.9**	**26.4**

ENDNOTES

[1] The Act defines "foreigners" as (1) a natural person whose nationality is non-Thai; (2) a juristic person not registered in Thailand; (3) a juristic person registered in Thailand with the following characteristics: (a) a juristic person with at least one-half of its share capital or registered capital held by persons under (1) or (2), (b) a limited partnership or a registered ordinary partnership whose managing partner or manager is a person under (1); and (4) a juristic person registered in Thailand with at least one-half of whose share capital or registered capital is owned by persons under (1), (2) or (3).

[2] Such as in the construction sector, except for (a) construction rendering basic services to the public in public utilities or transport requiring special

tools, tools, machinery, technology or construction expertise, with a foreign minimum capital of Baht 500 million or more, and (b) other categories of construction as prescribed by the ministerial regulations.

[3] Such as civil engineers concerned with design and calculation, systemization, analysis, planning, testing, construction supervision, or consulting services (excluding work requiring specialized techniques), architecture concerning the design, drawing, cost estimation or consulting services, tour guides, and legal service providers.

[4] There shall be three types of license as follows: (1) Type One License: being a license granted to the telecommunications business operator who operates without having his or her own network for telecommunications services which are deemed appropriate to be fully liberalized. The Commission shall grant a license once notified by a person who intends to operate such business; (2) Type Two License: being a license granted to the telecommunications business operator who *operates with or without his or her own network* for telecommunications services intended for *a limited group of people*, or services with no significant impacts on free and fair competition or on public interest and consumers. The Commission shall grant a license once a person who intends to operate such a business has completely fulfilled the standard criteria prescribed in advance in notification of the Commission; and (3) Type Three License: being a license granted to the telecommunications business operator who *operates with his or her own network* for telecommunications services intended for *the general public*, or services which may cause a significant impact on free and fair competition or on public interest, or a service which requires special consumer protection. A person who intends to operate such a business can commence operations only after he or she is approved and granted a license by the Commission.

REFERENCES

Chedtha Intaravitak, and Somkiat Tangkitvanich. 2010. Have FTAs created or diverted trade? a case study of Thailand. Paper presented at the International Conference on "the Taiwan-China ECFA: Building a New Partnership for Southeast Asian Economic Integration," organized by the Chung-Hua Institution for Economic Research, August 26–27, Taipei.

Hoekman, Bernard. 1996. "Assessing the General Agreement on Trade in Services." Pp.88-124 in *The Uruguay Round and the Developing Countries*, W. Martin and L.A. Winters (eds.), Cambridge: Cambridge University Press.

Pramuan Bunkanwanicha, and Yupana Wiwattanakantang. 2006. "Big Business Owners and Politics: Investigating the Economic Incentives of Holding Top Office." CEI Working Paper Series 2006-10, Center for Economic Institutions, Institute of Economic Research, Hitotsubashi University.

Sally, Razeen. 2005. Thailand's new FTAs and its trade policies post-Asian crisis: an Assessment. Proceedings of international conference, From WTO to Bilateral FTAs. August 29, Bangkok.

Somkiat Tangkitvanich, and Taratorn Ratananarumitsorn. 2005. Assessing the Impacts of Telecommunication Liberalization. WTO Watch Project.

Investment in Pollution Abatement Technology in Response to Community Protests: Lessons from Map Ta Phut Industrial Estate

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Kannika Thampanishvong
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1. INTRODUCTION

In Thailand, industrial expansion is often considered vital for national development. As a consequence, during the past few decades, Thai government administrations have focused intensive promotion efforts on attracting investors to set up factories in this country. Among the many industrial estates that have been established in Thailand, Map Ta Phut Industrial Estate has received considerable attention from different parties. Since its establishment in 1988, Map Ta Phut Industrial Estate has served as an important industrial hub for the production of petrochemicals, chemical products, iron, and other metals, as well as for refining petroleum. According to the Industrial Estate Authority of Thailand, the development of industrial clusters in Map Ta Phut and other industrial estates has contributed to increasing the efficiency and strength of the country's competitiveness in global markets.

Regardless of their contributions to national development, the rapid development of the industrial sector and the establishment of industrial clusters, particularly in Map Ta Phut, have given rise to a number of environmental problems and have created a health crisis. It has been claimed that emissions of volatile organic compounds (VOCs) and gaseous toxic substances, such as nitrogen dioxide and sulphur dioxide, from plants in the industrial estate are the cause of illnesses, such as respiratory diseases and cancer, among people who live in close proximity to the industrial area. The occurrence of these problems has resulted in resentment among the local residents and the general public. Given the existence of the National Environmental Quality Act of 1992, the Factories Act of 1992, the Public Health Act of 1992, the Hazardous Substances Act of 1992 and other regulations,[1] it may be asked, how could this type of problem have been allowed to arise? Moreover, since this problem has already emerged, what can the communities of people living near the plants do about these issues and what will be the response of the plants concerned?

Despite the existence of industrial and environmental regulatory bodies and the different Acts that spell out various regulations and set standards to control pollution, the emissions released by many industrial plants have continued to exceed permissible levels. This situation is due to the fact that the industrial and environmental agencies responsible did not strictly enforce the industrial and environmental standards. In particular, they neglected to take action against those industrial plants that failed to live up to established standards.

In view of the problems that have already emerged, including the increased incidence of illness, some residents in the Map Ta Phut area filed complaints with the provincial administrative court concerning the pollution. Their purpose was to seek the court's

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protection for their rights. They also wanted the Map Ta Phut area to be declared a pollution control zone. Some local residents organized community protests in their effort to seek compensation and resettlement. In 2009, the court ruled in favor of the residents, ordering the National Environment Board to designate areas around Map Ta Phut as a pollution control zone.

Providing the public with only monetary compensation, treatment and rehabilitation, even in a fair and thorough manner, is not enough to solve the pollution problems at the Map Ta Phut Industrial Estate and the negative impacts those problems have had on the environment and the communities' quality of life. The industrial plants need to take serious action to ensure that the quality of water and air is improved to an acceptable level by reducing the emission of air and water pollutants, as well as the disposal of solid and industrial waste according to, if not better than, the legal requirements.[2] To reduce the amount of toxic substances and wastewater produced by each plant, the operators must be ready to invest in advanced abatement technology to reduce those pollutants. This is the focus of this paper.

The real options approach has been used extensively in studies on power plants in the United States with regard to the decision to retrofit power plants with flue gas desulfurization (FGD) (Halkos 1993). The FGD method is also known as scrubbing. It involves the installation of a scrubber, that is, equipment that helps remove sulphur dioxide from the exhaust before it is released into the air (Dixit and Pindyck 1994; Trigeogis 1996; Schwartz and Trigeorgis 2001). The installation of scrubber equipment clearly requires the operators of power plants to make an irreversible investment at a time when the future prices for the power they produce cannot be known with certainty (Hunter and Mitchell 1999; Insley 2003; Löfgren et al. 2008; Tuthill 2008).

In this paper, we study a plant's response to community protests which were triggered by the pollution problem caused by the plant's industrial activities. Provided that there is uncertainty over the future costs and benefits of an investment in abatement technology, that the plant's investment is irreversible, and that there is some leeway about the timing of the investment, real options analysis affords an appropriate framework for studying the investment decision. In particular, the present study shows how the interaction of pressure resulting from the community's protests, uncertainty and irreversibility affects the optimal timing for the plant's operators to invest in abatement technology.

Most of the papers that exist in the literature related to this topic use the real options approach to examine the decision to make an irreversible investment in a large capital project involving uncertain costs and/or benefits to ensure that the plant operators can comply with various air quality regulations.[3] In this paper, we use the real options approach to study the optimal time for an industrial plant to invest in abatement technology in response to community protests. As discussed

previously, even though several pollution control regulations and standards exist in Thailand, such as the National Environmental Quality Act of 1992 and the Factories Act of 1992, without strict enforcement, industrial plants do not live up to such standards. Only when the communities affected started to protest, file complaints about the pollution and demand compensation did the operators of the industrial plants realize that they could no longer neglect the pollution problems that resulted from their production activities. Resolution of those problems in the Map Ta Phut area would necessitate that the industrial plants take initiatives to reduce their emissions of air and water pollutants. It is at this point where investment in advanced abatement technology can contribute to the resolution of such problems.

The paper is structured as follows. After the introductory section, we introduce our analytical framework in section 2. In particular, we describe how the industrial plant's investment problem can be treated as an optimal stopping time problem and discuss how the model could be solved. In Section 3 we present the numerical results. Section 4 is devoted to the implications of our findings for policy purposes, while Section 5 concludes the study.

2. THE MODEL

2.1 The Environment

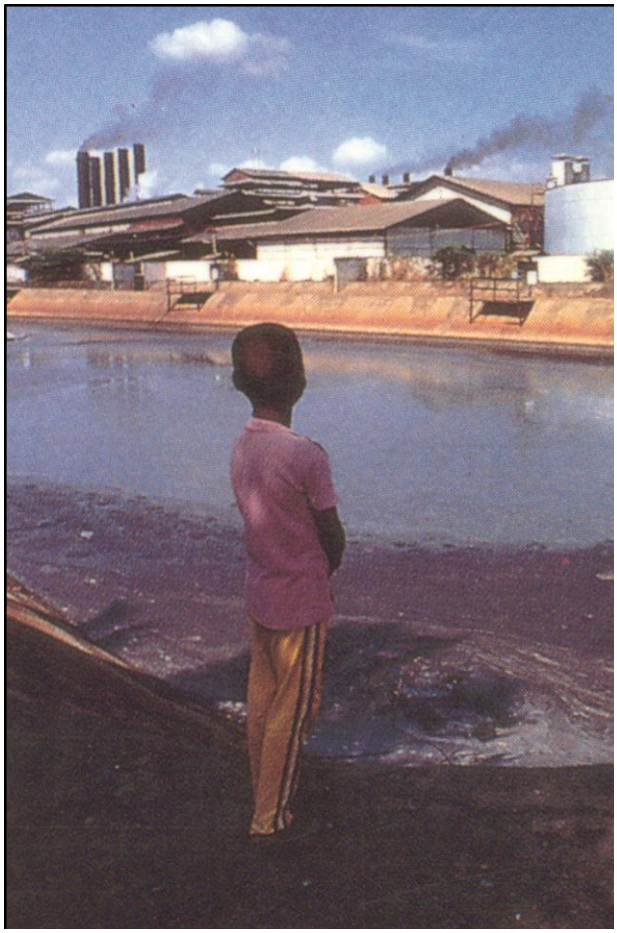
Consider an industrial plant which manufactures an output, $x(t)$, where $x(t) > 0$. We simplify our analysis by assuming that the production of $x(t)$ requires only physical capital, $K(t, x(t))$. Suppose that the plant's production of output at period t, $x(t)$, follows the stochastic differential equation below:

$$dx(t) = \left(K\big(t, x(t)\big) - \delta x(t)\right) dt + \sigma x(t) dW(t),$$
$$x(0) = x_0, \qquad (1)$$

where $\delta > 0$ is the rate of depreciation, σ is an uncertainty parameter, and $W(t)$ is a Wiener process, which represents an uncertainty that could affect the plant's production.

We suppose also that the price of the output, $x(t)$, is denoted by p_b, where $p_b > 0$. The relationship between $K(t, x(t))$ and $x(t)$ can be described by the equation $K(t, x(t)) = \alpha x(t)$, where $\alpha < p_b$. We assume that, with the use of existing technology, the production of $x(t)$ generates some pollution, which could take the form of noise pollution, water pollution etc., as by-products of production, and such forms of pollution are emitted into the area occupied by the local community. The pollution which is the result of the plant's production processes is assumed to cause damage–both direct and indirect–to the people who are living in close proximity to the plant. In this context, the direct damage corresponds to the damage to the residents' physical well-being, which could include illness or discomfort, while the indirect damage is associated with damage to the residents' personal belongings, real property or crops. As discussed in the introduction, in the midst of such a situation, the residents could express their dissatisfaction with the plant's actions by participating in various forms of collective action, including community protests, blockage of roads or the factory itself, and backlash. By obstructing the factory and interrupting the operations of the plant, we assume that the community protests impose some adverse effects on the production of $x(t)$.

Formally, to model the impact of the community protest on the plant, we capture the impact of the protests on the plant's production, $x(t)$, through a state equation. In the midst of the community protests, the production of the plant follows the path depicted in the differential equation below:



$$dx(t) = \big(\alpha x(t) - \delta x(t) - \beta x^2(t)\big)dt + \sigma x(t) dW(t),$$
$$x(0) = x_0,$$

where the term $-\beta x^2(t)$ captures the impact of the protests on production. If $\mu = \alpha - \delta$, this differential equation can be rewritten as:

$$dx(t) = \big(\mu - \beta x(t)\big)x(t)dt + \sigma x(t) dW(t),$$
$$x(0) = x_0, \qquad (2)$$

How could the operators of the plant deal with the protesters? In practice, we can observe that plants can deal with protesters in a number of ways. For instance, when the damage caused by the by-products of the production process is not very great and the number of residents affected is relatively small, the industrial plants may choose to make lump-sum payments to compensate the injured parties. Other plants might choose to clean up the pollution or the contaminated areas to eliminate the cause of the protests; however, this approach would help the plants tackle such problem only temporarily. In other words, only the pollution that resulted from production in the past would be cleaned up. Pollution that would be emitted into the local environment in the form of by-products of the plants' current and future production would necessitate that the plants take similar action repeatedly in the future. Alternatively, some plants might try to get around the problem in a very short-sighted way by diverting the drainage of wastes and chemicals, but this may affect other villages that are close by. Such a course of action does not tackle the problem directly; in the near future, the residents in such nearby villages who become affected by the plants' actions might initiate similar kinds of protests, demanding that the plants take some serious action to solve the problem.

With these different ways of addressing the problem in mind, in this paper, we restrict our attention to the plant making a sunk investment in abatement technology, which would reduce the emission of pollutants into the local environment.[4] Suppose that the sunk cost to be incurred by the plant's operators if they invest in abatement technology is represented by I, where $I = I_1 x + I_0$, $I_1 > 0$ and $I_0 > 0$; they would then face an irreversible investment problem. Before the plant's operators decide to make the investment, they face the following problem:

$$\max_\tau E\{\int_0^\tau e^{-rt} p_b\, x(t)dt + e^{-r\tau}(V_a(x(\tau)) - I(x(\tau)))\}, \qquad (3)$$

subject to equation (2), where r denotes the discount rate, τ is the time that the operators require to invest in the abatement technology, $I(x(\tau))$ is the cost incurred in making the investment and $V_a(x(\tau))$ is the plant's value function after the operators have invested in the abatement technology.

What happens after the plant's operators invest in the abatement technology? After they have invested in the abatement technology, we assume that the residents stop protesting since the level of pollution emitted by the plant would decline substantially to a level that is no longer hazardous to those residents. As a consequence, protesting no longer would have any adverse impact on the plant's production, that is, $\beta = 0$. In this sense, the abatement technology investment would be beneficial for the plant. However, the plant would incur a cost, $C(t, x(t))$, for maintaining the new abatement facility. Since it is not rational for the operators of the plant to bear the entire burden of a major increase in costs alone, they would want to pass on this additional cost to the final consumers who purchase the plant's products by raising the price of such products. It follows that $p_a > p_b$, where p_a denotes the new price of the plant's products. After investing in the abatement technology, the present value of the plant's profits is given by:

$$E\{\int_{\tau}^{\infty} e^{-rt}(p_a\, x(t) - C\big(t, x(t)\big))dt\}, \tag{4}$$

and the plant's production of output, $x(t)$, now follows the stochastic differential equation below:

$$dx(t) = \mu x(t)dt + \sigma x(t)dW(t). \tag{5}$$

We assume that $C(t, x(t))$ is linear in $x(t)$, or formally, $C(t, x(t)) = Cx(t)$, where $0 < C < p_a$. Since equation (1) has a Markovian structure, it follows that the optimal stopping time problem takes the form of:

$$\tau = inf_{t \geq 0}\{x(t) = x^*\}, \tag{6}$$

where x^* is the output threshold. The problem of finding the optimal time for this particular plant to invest in the abatement technology is essentially equivalent to finding the output threshold, x^*. It is important to note that equation (2) follows a geometric mean reversion (GMR) process, and each moment has been derived according to the method indicated in Ewald and Yand (2007). The dynamic of equation (2) is tied to the mean reversion level (μ/β) and β, a parameter which captures how fast the economy reacts to the disturbance from (μ/β). Equation (5), however, follows a geometric Brownian motion (GBM) process. It is commonly known that the GBM process is unbounded. The following are some properties of the GMR and GBM processes. Both of these processes are non-negative; moreover, they have the property that, once they reach 0, they remain there. Interpreting that property in the context of our analysis would indicate that the plant has entered into bankruptcy.

2.2 Solving the Model

We begin by solving system (4) subject to (5), which characterizes a situation after the abatement technology has already been installed by the plant's operators. To solve the model, we apply the Hamilton-Jacobi-Bellman (HJB) equation for system (4) subject to (5) as follows:

$$rV_a(x) = (p_a - C)x + \frac{\sigma^2 x^2}{2}V_a''(x) + \mu x V_a'(x), \tag{7}$$

where $V_a(x)$ is the value function for the plant after the abatement technology investment has been made.

The solution for equation (7) takes the form of $A_1x^2 + A_2x + A_3$. By substituting the solution into equation (6), we obtain $A_1 = A_3 = 0$ and $A_2 = \frac{p_a - C}{r - \mu}$. It is crucial to note that our analysis is based on the condition that $r > \mu$. This condition requires that the discount rate, r, be sufficiently large to guarantee that the value function, $V_a(x)$, exists. If $r \leq \mu$, the value function, $V_a(x)$, would not exist since the integration may be infinity. The reason is that the plant's instantaneous profit function, $(p_a - C)x$, would be increasing in x and equation (5) is unbounded.[5] Therefore, it is important that we suppose that the discount rate is sufficiently large to ensure that the value function of the plant is a finite number.

Next, we proceed with an analysis of the situation before the plant's operators invested in the abatement technology. This corresponds to system (3) subject to (2). The HJB equation for this system is as follows:

$$rV_b(x) = p_b x + \frac{\sigma^2 x^2}{2}V_b''(x) + (\mu - \beta x)xV_b'(x), \tag{8}$$

where $V_b(x)$ is the plant's value function before the investment was made in the abatement technology.

The free boundary conditions are:

$$V_b(x^*) = V_a(x^*) - (I_1x^* + I_0), \tag{9}$$

and

$$V_b'(x^*) = V_a'(x^*) - I_1, \tag{10}$$

where conditions (9) and (10) are called, respectively, the "value-matching" condition and the "smooth-pasting" condition. The value-matching condition requires that, at the time when the plant operators invest in the abatement technology, their payoff needs to be equal to its payoff from investing in the abatement technology net of the sunk cost that they incur from such an investment, $I(x^*)$. The smooth-pasting condition ensures the continuity of the slopes of $V_b(x^*)$ at x^*.

Moreover, since both instantaneous profit functions are 0 at $x = 0$, we obtain the third condition:

$$V_b(0) = 0. \tag{11}$$

Note that, when $p_b = 0$, according to Dixit and Pindyck (1994), the solution takes the form of $hx^{\theta}H(x)$, where h is a constant and θ is given by an appropriate positive number. $H(x)$ is a solution to Kummer's M function. On the contrary, when $p_b \neq 0$, equation (8) is non-homogeneous and the variation of parameters leads us to the solution of the form: $h(x)x^{\theta}H(x)$, for some $h(x)$. It becomes evident that the problem becomes more complicated to solve. However, we take advantage of condition (11) and apply the shooting method. The idea underlying this method for solving a boundary value

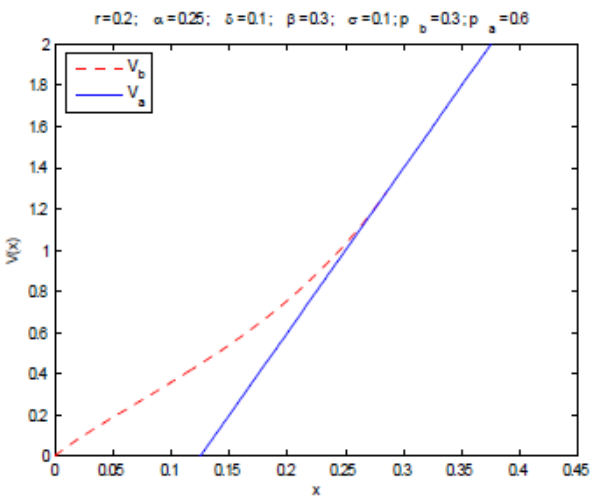
problem is to reduce it to the solution of an initial value problem. Therefore, we first choose x and suppose that it is the optimal stopping time. We then apply the shooting method together with the boundary equations (9) and (11) to solve equation (8), and test whether or not the solution satisfies condition (10). If condition (10) is not satisfied, we then give a small ε and move x to $x+\varepsilon$ and repeat the procedure until we find x^*. This completes the description of how the problem of optimal stopping time could be solved. In Section 3, we present the numerical results.

3. THE NUMERICAL RESULTS

In this section, we present the numerical results of the model discussed in the previous section. When choosing the values of parameters to be used in our numerical simulations, we need to ensure that the following condition, $(\alpha-\delta)\beta \geq \sigma^2$, is satisfied in order to ensure that the process is non-negative.

Figure 1 plots the value function, $V(x)$, as a function of output, x, using the following parameter values: $r=0.2$, $\alpha=0.25$, $\delta=0.1$, $\beta=0.3$, $\sigma=0.1$, $C=0.1$, $I_1=2$, $I_0=1$, $p_b=0.3$, and $p_a=0.6$. The solid line in the figure represents the plant's value function after the investment has been made in the abatement technology, V_a, while the dash line represents the plant's value function before that investment. This figure shows that it is optimal for the plant's operators to invest in the abatement technology at $x^*=0.2848$. If they make the investment before x^* is reached, it would not be worthwhile to do so; on the contrary, if the plant's operators choose to further delay investing in these facilities, they would forego some benefits.

Figure 1: The Firm's Value Function and the Threshold

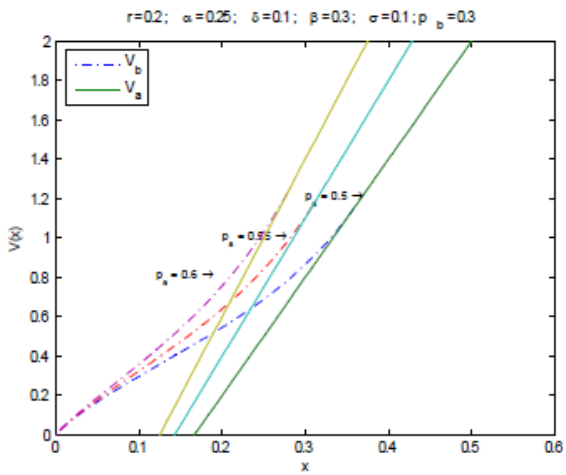


There are several parameters in the model that could affect the plant's value function, $V(x)$, and thus the threshold, x^*. In what follows, we examine how V_b, V_a and x^* are affected by changes in the values of the following parameters: (i) the price of the plant's product after the investment has been made in the abatement

technology, p_a; (ii) the impact of the protests on the plant's production, β; (iii) the volatility parameter, σ; (iv) the sunk costs from investment in the abatement technology, I_0 and I_1; and (v) the cost of maintaining the abatement technology, C.

We begin by examining how changes in the parameter p_a affect its value function and the threshold. Figure 2 depicts the results of our numerical simulations on $V(x)$ and x^* for three different values of p_a, namely 0.5, 0.55 and 0.6. It is clear from the figure that, the higher is p_a, the smaller will be x^*. The interpretation for this result is that, if the price of the plant's product can be increased in order to pass on to consumers the additional costs incurred as a result of the investment in the abatement technology, this would shorten the time the plant's operators have to wait to accumulate sufficient capital to cover the high cost of investing in the abatement technology.

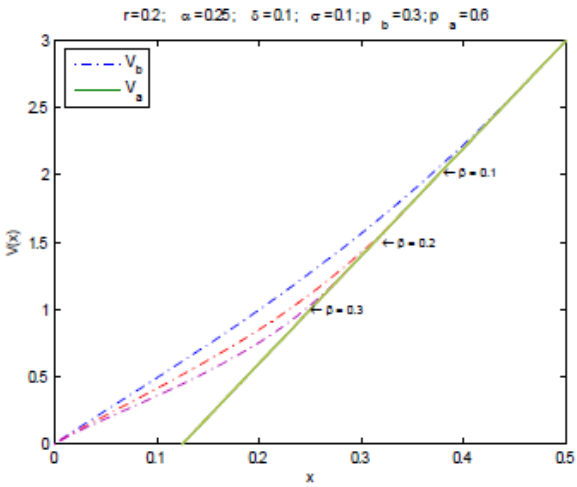
Figure 2: How the Firm's Value Function and the Threshold Are Affected by Changes in p_a



Next, we examine how the plant's value function and the threshold change when we allow for a variation in β. In Figure 3, we conduct numerical simulations on $V(x)$ and x^* using three different values of β, namely 0.1, 0.2, and 0.3. It is evident from the figure that, if protests by the people living in communities near the plant impose a larger adverse impact on the plant's

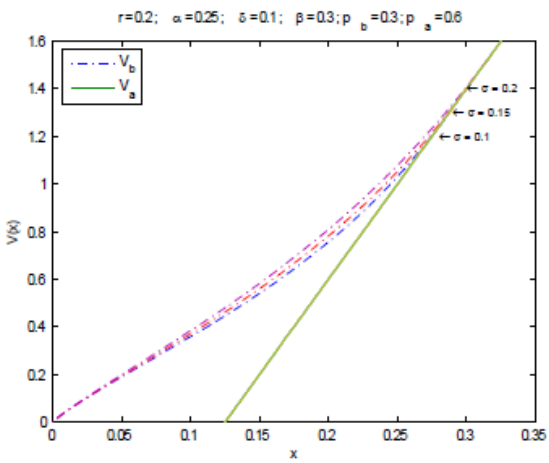
production, the plant's operators would try their best to ensure that the protests subside as quickly as possible by investing in the abatement technology earlier. Therefore, the larger is β, the smaller will be the threshold x^*.

Figure 3: How the Firm's Value Function and the Threshold Are Affected by Changes in β



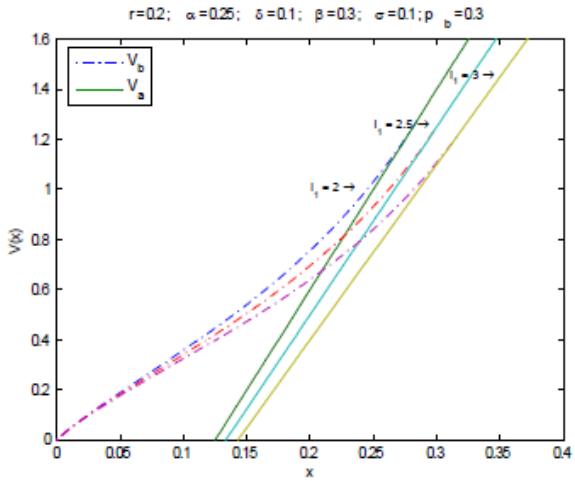
In Figure 4, we present the results from our simulations on $V(x)$ and x^* with three different values of σ. It is clear from the figure that x^* is increasing in σ, which implies that the plant's operators need to wait longer before investing in the abatement technology. This result is intuitive as the more uncertain are the future costs and benefits from investment in the abatement technology, the more should the plant's operators have the incentive to delay their investment.

Figure 4: How the Firm's Value Function and the Threshold Are Affected by Changes in σ



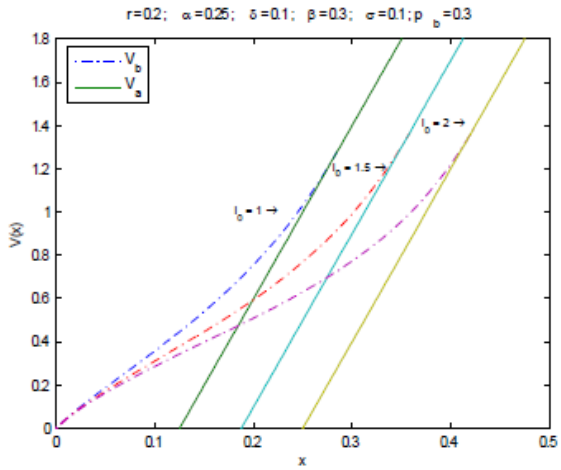
In what follows, we examine how the changes in the costs associated with the abatement technology affect the decision of the plant's operators to make the investment and affect its value function. Figure 5 shows how an increase in the sunk cost, I_1, affects $V(x)$ and x^*. It is clear from the figure that a larger I_1 causes x^* to be higher. This indicates that the plant's operators would tend to delay their investment in the abatement technology if the sunk cost involved in such an investment is high.

Figure 5: How the Firm's Value Function and the Threshold Are Affected by Changes in I_1



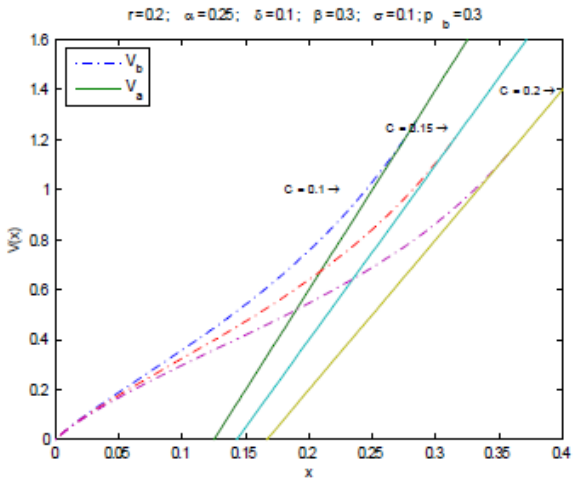
In Figure 6, we show how a variation in the value of I_0 affects the threshold and the plant's value function. The figure clearly shows that an increase in I_0 leads to a higher x^*. This result is again intuitive. If the plant's operators realize that the sunk cost is higher, they should have the incentive to delay the investment.

Figure 6: How the Firm's Value Function and the Threshold Are Affected by Changes in I_0



Last but not least, we show in Figure 7 how an increase in the maintenance cost, C, affects $V(x)$ and x^*. From the figure, it is quite obvious that, if the cost of maintaining the abatement technology is high, the plant's operators would have the incentive to wait longer in order to ensure that they have enough capital to maintain the technology. It is important to note that the plant's value function at x^*, $V(x^*)$, changes slightly compared with the changes in the threshold, x^*.

Figure 7: How the Firm's Value Function and the Threshold Are Affected by Changes in C



What do we learn from the above results? Our results show that the impact from the community protests, the uncertainty about, and the costs associated with, the investment in expensive abatement technology, all affect the industrial plant's timing of investment in the abatement technology. First, we find that the greater is the adverse impact caused by the community protests on the industrial plant's production, the more would the plant's operators try their best to ensure that such protests subside as quickly as possible by investing earlier in the abatement technology. Second, the more uncertain are the future costs and benefits of the investment in abatement technology, the greater would be the incentive for the plant's operators to delay their investment in that technology. This result is consistent with the findings in the literature on irreversible investment under conditions of uncertainty (Dixit and Pindyck, 1994). Lastly, from this analysis we find that the sunk costs which would have to be incurred as a result of such an investment and the costs of maintaining the abatement technology also play a crucial role in determining the optimal timing for the operators' decision. In particular, the high costs associated with investing in the technology could cause the plant's operators to delay their investment. Those findings provide room for policy intervention by government agencies.

4. POLICY DISCUSSION

Thailand's Environmental Quality Act was designed to serve as a key instrument in addressing environmental issues.[6] The Act established national standards for environmental effluents and emissions and laid down liability provision and penalties for violations of those standards. Moreover, an environment fund was created under the Act to help polluting firms to control or eliminate pollutants. In addition, Section 59 of the Act empowers the National Environment Board to publish a notification designating a certain locality as a pollution control area.

Despite the existence of the Act as the legal instrument for controlling pollution and addressing environmental issues, large amounts of toxic substances and pollution are still being released by different industrial plants, causing serious health problems, particularly among communities near industrial estates. In taking the case of the Map Ta Phut Industrial Estate as an example, it can be seen that the rapid industrial development in that area gave rise to a number of environmental problems and has created a health crisis as the emissions of VOCs, nitrogen dioxide and sulphur dioxide from the plants in the industrial estate have been identified as the cause of illness among people who live in close proximity to the industrial area. The occurrence of these problems has resulted in resentment among the local residents and the general public. What are the reasons behind such alarming environmental issues? In this paper, we argue that the problem could be due to the interaction between industrial plants' own incentives, the absence of punitive sanctions in the prescription of environmental quality standards under the Act and its poor enforcement.

With regard to industrial firms' incentives, the results of our analysis show that the sunk costs that the plants would incur in making an investment in abatement technology and the costs of maintaining the system play a crucial role in explaining why some industrial plants find it optimal to postpone making an investment in abatement technology. Delaying investment in abatement technology is possible because there has been no strict enforcement of the industrial and environmental standards set forth in the Environmental Quality Act, as the responsible industrial and environmental agencies neglect to take the necessary action against the plants that fail to meet the standards. Our numerical results clearly show that, in general, the high costs associated with investment in such technology could cause the plants to delay making such an investment. Therefore, we should not allow the operators of industrial plants to wait until communities start protesting before they start taking some serious action to protect the environment, i.e., lowering or eliminating the amount of pollution or toxic substances released into the environment. In light of our findings there is room for policy intervention by the government agencies concerned.

To encourage industrial plants in Thailand to take serious action to stem the pollution that results from their

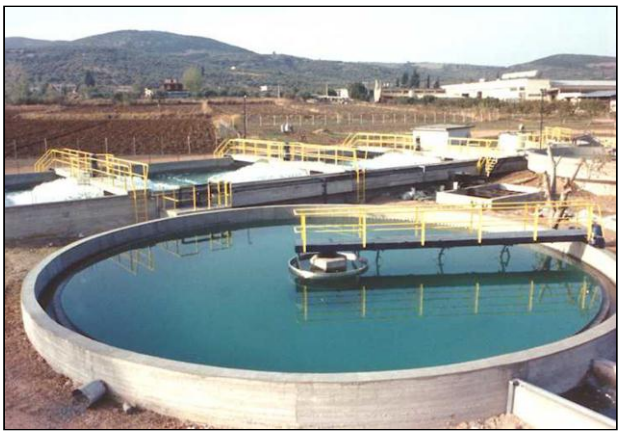
actions, first, the agencies concerned must strictly enforce the country's industrial and environmental standards. A recently enacted pollution tax law is designed to put pressure on the operators of industrial plants in Thailand to reduce pollution. It levies such taxes in accordance with the volume of plant emissions, taking into account all toxic emissions into the air and water. With strict enforcement of the law and monitoring of emissions, all industrial plants will have to regularly check and evaluate the volume of their emissions because, if they are found to be over the limit, they would be taxed, so they must get themselves ready to invest in advanced technology to reduce such emissions.

Once the environmental law is strictly enforced, the government could consider offering some financial support to these plants so that they could afford to purchase such expensive equipment. The financial support could take various forms, such as loans dedicated to enabling the purchase of abatement technology. According to the Ministry of Industry,[7] the Thai government could use some portion of the total pollution taxes collected as a result of enforcing the pollution tax law, in order to provide low-interest loans to factories so that they could meet the environmental standards. If this plan materializes, the availability of low-interest loans would help ease the factories' financial constraints.

Lastly, provided that there are no provisions in the Act requiring a review of standard values already established, it is proposed therefore that the law be amended so that the standard values that have already been set be reviewed.

5. CONCLUDING REMARKS

In view of the fact that intensive promotion of industrial expansion is vital for Thailand's development, investors have been attracted to set up factories in many parts of the country, especially in industrial estate areas such as Map Ta Phut. However, such promotion has been carried out by government administrations at the expense of strict enforcement of industrial and environmental standards. The industrial and environmental regulatory bodies responsible for enforcement have neglected to take action against industrial plants that fail to comply with the industrial standards and which emit large amounts of pollutants or toxic substances into the environment, at levels that exceed the permissible emission rates. In view of the large quantity of toxic substances being released from industrial complexes over an extended period of time, the level of overall emissions has risen to a dangerous level. The ecosystem cannot absorb additional pollutants without collapsing, and communities living in close proximity to industrial areas are experiencing serious health issues as a result of pollution.



In response to their exposure to toxic chemicals or pollutants released by factories, the residents of communities living near such plants can choose to express their dissatisfaction by taking part in anti-pollution protests. By blocking access to the factories, and lodging complaints with government agencies in an effort to protect their rights and claim compensation, the pressure imposed by the communities could have a detrimental impact on the plants' production. In this paper, we studied the optimal timing for the plants to invest in expensive abatement technology that would help reassure the plants that the threat of protest is reduced.

The results of our analysis show that pressure from community protests, the uncertainty, and the costs associated with investment in expensive abatement technology affect a firm's decision to invest in such abatement technology. We argue the operators of industrial plants should not wait until communities protest before they start taking some serious action to protect the environment, i.e., lowering the amount of pollution or the volume of toxic substances released into the environment. It is crucial that the government agencies concerned intervene.

Our policy recommendations are twofold. First, there must be a strict enforcement of the Environmental Quality Act and the newly enacted pollution tax law. Second, the government could give some financial support to industrial plants so that they could afford to purchase expensive abatement technology. One form of financial support could be loans dedicated to the purchase of such technology.

ENDNOTES

1 For details, see the Pollution Control Department, http://www.pcd.go.th/info_serv/en_reg_envi.html.

2 For details, see Industrial Estate Authority of Thailand, 2011, http://www.ieat.go.th/ieat/index.php?option=com_content&view=article&id=154&Itemid=220 &lang=en

3 Well-known air quality regulations in the United States are the Clean Air Act Amendments of 1990 and the Acid Rain Program. According to Insley (2003), Title IV of the 1990 Clean Air Act Amendments mandated a reduction of 10 million tons (equivalent to 50 percent of the total) in the level of acid rain precursor emissions over those

emitted in 1980 by electricity-generating utilities, particularly sulphur dioxide (SO_2).

4 Given that a new pollution tax law was recently endorsed by all stakeholders at public hearings and has been enacted, industrial plants in Thailand will be subjected to stricter controls on wastewater and air pollution. Thus, in the near future, plants must seriously consider investing in advanced abatement technology to enable them to meet Thailand's environmental standards.

5 The solution for equation (5) is as follows:

$$x(t) = x_0 e^{\left(\mu - \frac{\sigma^2}{2}\right)t + \sigma W(t)}$$

It is well known that $\int_0^\infty e^{f(x)} dx$ does not exist if $f(x)$ is positive.

6 For details, see World Resources Institute, "The Enhancement and Conservation of Environmental Quality Act." Available from http://projects.wri.org/sd-pams-database/thailand/enhancement-and-conservation-environmental-quality-act.

7 See article in *Thailand Business News* (November 9, 2009), available from http://thailand-business-news.com/news/top-stories/5934-new-pollution-tax-law-to-be-enacted-soon.

REFERENCES

Dixit, A., and Pindyck, R. 1994. *Investment under Uncertainty*. Princeton, N.J.: Princeton University Press.

Ewald, C.-O., and Yand, Z. 2007. "Geometric Mean Reversion: Formula for the Equilibrium Density and Analytic Moment Matching." Available from the Social Science Research Network at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=999561.

Halkos, G.E. 1993. "Sulphur Abatement Policy." *Energy Policy*: 1035-1043.

Hunter, G.W., and Mitchell, G.T. 1999. "Options for Polluting Firms: Bankable Permits or Abatement." University of California, Santa Barbara Working Paper WP23-98R. Available from http://www.econ.ucsb.edu/papers/wp23-98R.pdf.

Insley, M.C. 2003. "On the Option to Invest in Pollution Control under a Regime of Tradable Emissions Allowances." *The Canadian Journal of Economics* 36(4): 860-883.

Löfgren, Å, Millock, K., and Nauges, C. 2008. "The Effect of Uncertainty on Pollution Abatement Investments: Measuring Hurdle Rates for Swedish Industry." *Resource and Energy Economics* 30: 475-491.

Schwartz, E., and Trigeorgis, L. 2001. *Real Options and Investment under Uncertainty, Classical Readings and Recent Contributions*. Cambridge, MA: MIT Press.

Trigeorgis, L. 1996. *Real Options, Managerial Flexibility and Strategy in Resource Allocations*. Cambridge, MA: MIT Press.

Tuthill, L. 2008. "Investment in Electricity Generation under Emissions Price Uncertainty: The Plant-Type Decision." *Oxford Institute for Energy Studies* EV 39.

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