

Transmission of the Subprime Crisis to the Thai Economy via an

International Trade Channel

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1. Introduction

The menace of the subprime crisis in the United States started at the beginning of 2007, when more than 100 mortgage-lending companies went bankrupt. The crisis has been considered the worst financial catastrophe since the Great Depression. Its effect has led to a sharp contraction in global trade and caused a worldwide recession. The crisis was triggered by a skyrocketing rise in delinquencies and foreclosures in subprime mortgages, which refer to a type of mortgage both targeting borrowers with low credit ratings and possessing a higher interest rate than characterizes the normal 'prime rate'.¹ The main cause of subprime delinquencies came from the burst bubble in the US housing market following the peak in housing prices in mid-2006.² The effect of subprime mortgage loans on the financial sector and on the overall economy was amplified by mortgage-backed securitization (MBS) and collateralized debt obligations (CDO), complex derivatives backed by mortgage lending. The high delinquency and charge-off rates of subprime loans decreased the value of these derivatives dramatically to almost zero. As a result, financial institutions and hedge funds with high exposure relative to these securities had a massive writedown on their assets; liquidity in the money market dried up as the financial sector faced a crisis of confidence; and some financial institutions and funds such as Lehman Brothers, AIG, and Bear Stearns were short of liquidity and went bankrupt or needed emergency loans from the government. The subprime-related losses brought about a significant

¹ Borrowers who have a FICO score below 640 or a security with a rating of C- or below.

 $^{^{2}}$ The S&P/Case-Shiller Home Price Index in the third quarter of 2008 fell 16.6% in comparison with the same period in the previous year.

decrease in financial institutions' credit ratings and assets. Consequently, there has been a huge contraction of both consumer and business loans in the US economy.

As the subprime crisis has spread, the Dow Jones indexes plunged to an 11-year low in March 2008. The reduction in the stock index has affected consumers and business sectors significantly because the capital market is a significant reflection of household and private sources of wealth accumulation. Therefore, private consumption has contracted for the first time since 1990. The Philly Fed Factory index reached an 18year low about the time when the unemployment rate soared to 10.1% in October 2009, indicating a contraction in US production. Accordingly, the US economy experienced a recession in the fourth quarter of 2008, with its GDP contracting by 6.2%, and experienced a decline in economic growth till the third quarter of 2009.

Due to strong financial and economic linkages between the United States and the rest of the world as well as the massive size of the country's economy, the US subprime crisis has been transmitted worldwide. The three major transmission channels of the crisis consist of financial linkages, capital markets, and international trade. The first victim of the crisis was the European Union owing to its close financial and trade relationship with the United States. EU financial institutions suffered massive writedowns from the subprime-related assets and a dry-out in liquidity. Besides, EU exports to the United States have dramatically declined since 2008, again owing to the US recession. Japan has also been hit severely by the crisis, mainly through trade linkages with the United States. Hence, both the European Union and Japan followed the United States into economic recessions in late 2008. The recession in G3 entities—the United States, the European Union, and Japan inevitably affected East Asian economies because of the extremely close networks among them, with G3 having a share of 28% of East Asian total trade. Apart from direct trade channels, the crisis caused a severe drop in indirect trade through the intra-regional trade in parts and components. Most of the industrial production in East Asia, namely, automobiles and related parts, computers and parts, and electronic and electrical appliances, are in forms of the international production network (IPN), where production is fragmented into several stages and operates in various countries, according to countries' comparative advantages. The IPNs in the East Asian region have led to huge intra-industry trade in parts and components, accounting for about 62.9% of total intra-industry trade in manufacturing products.³ Therefore, a decrease in the demand for final goods in the G3 entities (identified above) resulted in a drop in the export of parts and components in East Asia via the IPN channel.

Similar to East Asian countries, the Thai economy depends heavily on exports, which account for 64% of its GDP. Besides, about 33% of Thailand's total exports heads toward a G3 destination. Thailand has played a vital role in the ASEAN IPN as a major production base regarding the assembly of parts and components. Because 28% of its total exports are parts and components serving these types of networks, Thailand has high exposure to G3 economies via both direct and indirect trade and has experienced severe effects from the subprime crisis. Thailand's exports dropped by 14.2% in 2009, with a 20.7% reduction in exports heading for a G3 destination. Consequently, industrial production and private consumption decreased by 5.2% and 2.5% respectively. The Thai economy moved into a recession beginning in the fourth

³ Authukorala and Kohpaiboon (2009).

quarter of 2008. These pieces of evidence support the assertion that the subprime crisis has transmitted itself into the Thai economy, with international trade being the most important channel.

The subprime crisis has shown that the Thai economy is vulnerable to external shocks owing to Thailand's high foreign exposure. Thus, Thailand should use reform to strengthen the Thai economy against possible future crises. Therefore, this paper aims to draw lessons from the subprime crisis that Thailand experienced. The paper also identifies factors contributing to the resilience of firms and industries in facing the global crisis and identifies policy implications from such factors in order to help both alleviate the effects of such crises and to strengthen Thai firms and industries in withstanding these crises.

2. Methodology

This paper uses both quantitative and qualitative methods complementarily to study the effects of the subprime crisis on the Thai economy and the possible transmission channels therein, concentrating on international-trade linkages. The quantitative tools help estimate the magnitudes of the subprime effect on Thai macroeconomic variables while the qualitative tools exhibit their advantages in the in-depth analysis at industry and firm levels.

The conceptual framework of this study is shown in Figure 1.

Figure 1: Conceptual Framework



2.1 Quantitative Method

A quantitative method functions, in this paper, to measure numerical effects of the global financial crisis on several macroeconomic variables, namely, trade volumes, consumption, production, and employment. Backward and forward linkages among production sectors are also considered here.

In this regard, the current paper uses the Global Trade Analysis Project (GTAP) model to estimate the effects of the recession in the G3 entities on macroeconomic variables in Thailand. The GTAP model is a computable general equilibrium model covering 113 economic regions around the world. It can simulate the numerical effect of one country's shock on other countries through an international trade linkage, regarding both the demand for intermediate goods and the demand for final goods.

The study uses, as well, the Input-Output table⁴ to evaluate backward and forward linkages among production sectors in Thailand in order to identify transmission channels among industries. Also, backward and forward linkages allow us to measure the accumulative effect of a decline in production caused by related industries, tracing losses in the distribution of production among workers and entrepreneurs.

Even though a quantitative method is advantageous for numerically identifying the subprime effect on economic variables, one important drawback is that this method cannot explain why some firms or industries suffer more severely than others and how the subprime crisis affects firms and industries at the micro level. Therefore, a qualitative method helps this paper complement the results from a quantitative analysis.

2.2 Qualitative Method

Regarding the mentioned weak point of quantitative tools, the qualitative method helps implement the in-depth study here of subprime effects' characteristics and how the effects spread at industry and firm levels. Moreover, the method is able to investigate factors causing the vulnerability and resilience of industries and firms in the face of the subprime crisis. Qualitative tools in the study concern fundamental analysis and foreign exposure. The current study uses fundamental analysis to study the above aspects. The factors to be considered are competitiveness, flexibility, and financial-statement analysis. Competitiveness allows firms to expand their market share and create their own loyal consumer bases, which would protect the firms from

⁴ The Input-Output table shows relationships among production, input demands, and distribution of goods and services among producers and consumers. The Thai Input-Output table is provided by the National Economic and Social Development Board (NESDB). The version used in this study dates from 2000.

sales fluctuation during times of crisis. Flexibility helps firms to revise their marketing, production, and operation strategies and, in turn, to alleviate the effects of a given crisis. Finally, financial-statement analysis informs us of firms' financial position and operating efficiency.

The current study deals with foreign exposure to study the levels at which firms and industries suffer from the subprime crisis. Since the ongoing crisis originated from abroad, foreign exposure has determined the vulnerability of firms and industries relative to external shocks.

Next, this paper illustrates the importance of each factor in the context of the following domains.

Competitiveness

Competitiveness refers to the ability of firms to maintain and expand their market shares and profits. Highly competitive firms possess high profitability and loyal customer bases. Therefore, such firms would experience lower fluctuation in sales according to economic situations and business cycles. Important competitive factors accounting for high levels of resistance to a crisis are (1) value-added creation, (2) a firm's competitiveness strategy, (3) a firm's productivity, (4) a firm's research and development, and (5) external supporting factors including government policies.

Flexibility

Flexibility allows firms to adjust their operations or strategies to a new business environment without incurring a high cost. The more flexibility a firm has, the more immune the firm is from crises. Crucial factors determining firms' flexibility during a crisis include (1) the ability to revise marketing strategies, (2) output flexibility, (3) the ability to adjust production processes and employment, (4) the management of input and inventories, and (5) flexible treatment of sources of fund.

The flexibility in marketing strategies, output, and production processes allows firms to adjust their inventory level, launch new products or revise existing products, maintain and expand their market shares during a crisis, while the flexibility in employment and management of input and inventories lets firms manage their operating costs more efficiently. In addition, the flexibility in sources of fund ensures that firms have sufficient liquidity for business operation.

Financial-statement Analysis

Firms' performance and financial status can be evaluated through their financialstatement analyses. The financial ratios reveal firms' financial position and the likelihood of firms' survival when facing a crisis, including liquidity, sources of funds, and operating efficiency. This study considers three categories of financial ratios to study firms' fundamental characteristics, namely, liquidity ratios, efficiency and profitability ratios, and financial-leverage ratios.

In order to consider a fundamental condition of each industry, this study compares financial ratios with one another. As for firm-level analysis, the ratios are compared with the industry mean and/or median for determining the performance of each firm relative to the overall industry.

The paper also takes into account characteristics of firms, namely, firm size and ownership, in order to find any correlation between these characteristics and the impact level of the crisis. Financial ratios used in this study are shown in Table 1.

Types of Ratios	Details
Liquidity Ratios	Current ratio
	Quick ratio
	Accounts receivable turnover ratio
	Inventory turnover ratio
Efficiency and Profitability	Asset turnover ratio
Ratios	Fixed asset turnover ratio
	Return on assets ratio
	Gross profit margin
	Operating profit margin
	Net profit margin
Financial Leverage Ratios	Total debt to total asset ratio
	Interest coverage ratio
	Long-term debt to total asset ratio

Table 1: Financial ratios used in this study

First of all, liquidity is the most important factor to determine the survival of firms under crisis. Thus, liquidity ratios are considered in the study. The ratios depict firms' ability to meet their short-term liabilities. High liquidity ratios ensure that firms have sufficient working capital in operating their business and coping with unanticipated events including additional investment and cost adjustments.

Efficiency and profitability ratios show firms' operating efficiency and their profit performance. Efficiency ratios illustrate how productive firms use their assets, whereas profitability ratios reveal the ability of firms to generate markups from their sales. Firms that operate efficiently have a high profit margin, which alleviates liquidity shortages from sales fluctuations in the crisis period. Therefore, high efficiency and profitability act as a cushion from the crisis impact.

Financial leverage ratios indicate the financial solvency of firms. These ratios show the financial structure of the firms and their dependency on debt financing. Under a crisis situation, highly leveraged firms have a higher chance of bankruptcy. Also, financial institutions are overly cautious and conservative during a crisis since some firms, especially the highly leveraged ones, have a higher chance of bankruptcy or default. Therefore, the institutions are unlikely to extend credit or roll over existing loans to firms, even ones with good performance. Consequently, highly leveraged firms encounter credit difficulties during a crisis, and this encounter might obstruct the firms' business operations and might lead to insufficient liquidity.

Foreign Exposure

While fundamental analysis sheds light on industries' and firms' resistance to crisis, high foreign exposure determines the impact level they might encounter when a crisis originates from abroad. In studying the foreign exposure of industries, the current study uses two frameworks: an international production network (IPN) and a global value chain (GVC). Two concepts explain the fragmentation of business activities insofar as producers can benefit from the lower cost of resources, economies of scale, and lower trade costs.

GVC refers to a sequence of linked value-added activities of a product, stemming from design and creation to distribution and customer support. Activities in the GVC are dispersed to various countries so that each location can benefit from cost advantages.

In contrast, an IPN concentrates only on production and on dispersion and linkages in several countries. The occurrence of IPNs can cause intra-industry trade in parts and components. The IPNs in East Asia are driven mainly by foreign direct investment (FDI) from G3 entities' multinational corporations (MNCs), with Japan being the most important source of FDI in the region. The appreciation of the Japanese Yen

against the US dollar in the 1980s⁵ motivated Japanese firms to find alternative production bases having comparatively lower production costs. The relocation of production bases has resulted in continuous flows of direct investment into developing countries in East Asia. In contrast, the United States and the European Union have started to establish their own production networks in the region since the fall of asset prices during the Asian financial crisis in 1997. The phenomenon is sometimes called "FDI firesales" according to Krugman (1998).

China has played a vital role as the site of assembly bases for the East Asian IPNs since the country's economic reforms in 1978 under the assertion of the "socialism with Chinese characteristics" policy, which has allowed FDI in special economic zones. The main products in the zones' assembly bases are computers and their parts, electrical appliances, and automobiles and their parts—the G3 entities being the zones' most important trading partners. Consequently, China has been the main destination of intra-regional trade in parts and components. In the G3 markets, the recession stemming from the subprime crisis brought about a reduction in final export demand from China; the demand for parts and components from other countries in East Asia decreased accordingly. Hence, the IPNs might be a transmission channel of the subprime crisis involving indirect-trade effects.

Similar to other countries in the region, Thailand is a part of IPNs through FDI from the United States and Japan, mainly in automobiles and their parts, computers and their parts, and electronic and electrical appliances. These industries require skilled and intensive labor, an area in which Thailand has an advantage over its neighboring

⁵ In 1985, the US, the UK, France, West Germany (at that time), and Japan signed the Plaza Accord, which resulted in an appreciation of the Japanese Yen and the German Deutsche Mark against the US dollar in order to reduce the US trade deficit.

countries. The role of Thailand in these IPNs is to comprise assembly bases and production bases for parts and components.

With the effects of the subprime crisis transmitting to Thailand, exports fell sharply in electronics (-13.1%), automotive products and parts (-27.7%), and electrical appliances (-13.8%), all of which are parts of the IPNs there. Therefore, the IPN is a suitable tool for studying the transmission of the crisis to Thailand.

GVC is another important tool to consider the indirect-trade effects of the crisis on the Thai economy. Many industries might not take the form of an IPN. However, their activities are still connected with the rest of the world because different activities in the GVC take place in various countries. Powerful examples of these industries are the gem-and-jewelry industry and the wood-furniture industry.

To analyze the effects of the subprime crisis at a micro level, the current study has selected four industries as case studies for an in-depth analysis. These industries are (1) hard disk drives and related components, (2) automobiles and related parts, (3) gems and jewelry, and (4) processed seafood. Foreign exposure is the most important criterion in industry selection since it determines the level of impact that each industry has experienced from the subprime crisis. All industries selected here are among Thailand's main exporting industries, accounting for about 25% of its total exports. On the other hand, these four industries have different types of foreign exposure according to the proportion of foreign ownership, the degree of export dependency, and the participation in IPNs. These different characteristics allow for a comparison across industries to determine factors responsible for crisis resistance and vulnerability.

The production of (1) hard disk drives and related components and (2) automobiles and related parts take the form of IPNs where Thailand serves as both a group of main assembly bases and a group of production bases for parts or components. Foreign direct investment from MNCs plays a crucial role in these two industries where all assembly and a majority of 1st-tier firms are subsidiaries of MNCs. However, 2nd-tier and 3rd-tier producers in the industry covering automobiles and related parts are Thai SMEs whereas most firms in the hard disk drive industry are foreign.

About 75% of hard disk drive outputs are exported as intermediate goods where China is the most important trading partner of the Thai industry. In contrast, the industry covering automobiles and related parts depends on both domestic and foreign markets in almost the same proportion. Also, exports from the industry consist of both final and intermediate goods.

Unlike firms in the previous two industries, the majority of firms in gems and jewelry and processed seafood are Thai owned, and most of the activities in their GVCs take place in Thailand. For the gems and jewelry industry, most entrepreneurs are small or medium sized. Their products are luxurious goods and income elastic, which make the industry vulnerable to the direct effects stemming from the crisis. In a different vein, the processed seafood industry consists mainly of medium and large entrepreneurs. Moreover, the industry's products are considered to be necessary goods, which tend to be relatively unresponsive to crises.

Each of the four industries has suffered from the effects of the subprime crisis in varying characteristics and to varying degrees. This study compares and contrasts the characteristics of each industry to identify their influence on impact levels stemming from the crisis and to determine which characteristics assist firms in enduring the impact from the crisis.

3. Quantitative Analysis

The released data reveal that Thailand's "export share"—by destination to the G3 entities (again, the United States, the European Union, and Japan)—has been continuously decreasing since the year 2002. While these destinations together accounted for 52.4% of Thailand's total exports in 2000, the proportion dropped significantly to 38.4% in 2007. At first glance, it would now seem that Thailand is less dependent on the G3 economies. An immediate conclusion drawn from this figure would be that these markets are no longer Thailand's biggest buyers. Thus, the impact from the global slowdown, led by the US subprime crisis, may be insignificant to the Thai economy.



Figure 2: Total exports share by destination

Source: Ministry of Commerce

In fact, international trade among countries could be both *directly* and *indirectly* linked. The direct trade relationship refers to transactions of finished products sold for final consumption. For example, a can of tuna exported by Thailand to the United States exemplifies direct trade transactions between the two countries. In contrast, indirect linkages between the two economies occur when the exporting country sells intermediate goods, such as raw materials, to a third country. Then these intermediate inputs are put together and subsequently shipped to the final destination for final use. In fact, given the growing complexities and complications arising from such international supply chains, indirect linkages between an exporting country and the end-user importing country may involve many other economies on the production line. As reported by local authorities, raw data on "exports by destination" could not portray the true patterns of the trade linkages. Using production and linkage structures from world data, Manprasert and Cheewatrakoolpong (2009) showed that the total exposure of the Thai economy to the G3 economies were as high as 45.7% in 2007. These economies remain the main sources of external demand for the output of Thai markets regarding both direct and indirect linkages. The economic crisis in the United States, the European Union, and Japan will eventually be transmitted to Thailand.

It seems that, Thailand's export demands have continued to drive from the G3 economies. This pattern also seems to apply to other ASEAN countries as well—where each country imports and re-exports parts of intermediate goods and where finished products are assembled along an international production line within the region. The world's biggest consumers appear to be unchanged, and the final destinations of produced goods are mainly the G3 countries. Therefore, the *level* of total trade exposure did not change much but what has changed is the *pattern* of the

relationship. Recent studies from the Bank of Thailand⁶ show that international trade will still be the main source of economic growth for the Thai economy; therefore, we should better understand the crisis transmission that takes place through international trade channels.

The objective of this paper's quantitative study is to examine, in the context of international trade channels, transmission patterns of the external crisis to the Thai economy. Another goal of this paper is to identify domestic production activities that are vulnerable to the global business cycle. The ultimate goal of the study is to find risky sectors and ones that should be categorized in a high-priority group when the global crisis erupts. The analysis will extensively use data from the Global Trade Analysis Project (GTAP) and the Input-Output Table of Thailand.

Although the original GTAP model rests on the setup that replicates transactions in the world economy, the model's primary objective is to evaluate impacts from freetrade policy. This may not fit well with our objectives in the study. Therefore, we extracted data from the original GTAP and built the GTAP-L, which would employ a similar structure yet with some modification. Extensions include the following: (1) separation of direct and indirect effects stemming from an economic slowdown in external economies. In this case, direct impact refers to the outcome stemming from a decrease in G3 demand for finished goods produced in Thailand, whilst indirect impact includes consequences from indirect-trade linkages and from incomemultiplier effects in other economies. (2) Under a general-equilibrium setup in the GTAP, a serious problem could arise when the research focuses on both income and substitution effects together. Trade diversions may exhibit themselves as result of

⁶ Chaipat Poonpatpibul, et al. (2009).

decreased import demand from one trading counterpart rather than spread out the decreased demand from the income effect among countries. Because the main objective of the current study is to evaluate impacts stemming from the ongoing crisis rather than free-trade policy, the GTAP-L will capture only results from the income effect.

To identify how important a sector is, the current study used three criteria: first, since production activities are interrelated, a sector is crucial if it could easily disperse effects to other sectors. By exploiting information from the Input-Output Table of Thailand, we calculated the levels of backward linkages to measure the total multiplying effect that each production sector could translate into the economy as a whole. Second, a sector is also important if it uses a large proportion of domestic resources. In this case, a majority of local producers will be affected. Third, a sector should be ranked in high priority if it generates a large amount of value-added progress, especially regarding the income of the economy.

The study found that macroeconomic variables, particularly those related to international-trade transactions, will be affected to a larger degree than the variables pertaining to private consumption and domestic investment. Negative growth in imports appears to be more severe than export growth. This contrast reflects the production structure of the Thai economy wherein a large proportion of raw materials and capital goods are imported for the production process in export-oriented industries. Combing effects from the slowdown in intermediate input requirements with domestic income effects, which pull down imports for consumption goods, negative import growth turns out to be substantial. Our analysis of the pattern of external-crisis transmission has revealed that Thailand's international trade will be affected mainly through *indirect* linkages rather than a direct relationship. More important is our finding that a larger part of the indirect impact rests on a decrease in demand for intermediate goods (*e.g.*, not from the income effect in other countries). Therefore, indirect-trade linkages play a significant role in explaining changes in the Thai economy's international-trade transactions.

	Tatal	Diment	Indirect Effects		
Variables	Effects Effects		Indirect-trade linkages	Multiplier effects	
GDP	-7.77%	-4.33%	-3.44%		
Export	-8.34%	-3.66%	-4.24%	-0.44%	
Import	-11.21%	-4.46%	-6.38%	-0.37%	
Gross output					
(inc. intermediate)	-6.42%	-1.16%	-5.26%		
Private consumption	-7.77%	-4.33%	-3.44%		
Unskilled workers	-5.82%	-0.83%	-4.99%		
Skilled workers	-6.27%	-0.55%	-5.72%		
Capital	-6.73%	-0.93%	-5.80%		

Table 2: Simulation results for macroeconomic variables

Note: Results indicate percentage growth subtracted from the long-term growth rate.

The simulation results also show that a decline in gross output will be induced by indirect impacts through indirect international linkages. This implies that Thailand produces a significant amount of intermediate goods for export. On the other hand, private consumption expenditures will be dragged down directly in the global slowdown. Given this incidence, the effect from the external crisis on domestic consumption could be immediate. The factor of production that will be affected the most is capital goods, whereas private investment will post a larger decline than that of skilled and unskilled labor employment, respectively. Most skilled laborers are employed in manufacturing industries whereas unskilled ones work in agriculture. Agricultural and food-related products are less sensitive to income changes; therefore, the latter workforce will be less affected by the external-demand shocks.

Industry-wise, export activities that will be impacted the most are those that are both pro-cyclical to global business cycles and highly income sensitive such as service sectors. Natural-resource sectors are hugely affected by the crisis because of further slowdowns in the demand of intermediate markets. When considering the pattern of the crisis transmission, we found that effects through indirect channels will be ample in sectors used mainly in intermediate production activities. These sectors are agricultural and natural resources. On the other hand, the effect on food industries will be transmitted through direct linkages because the products are imported by the G3 for final consumption.

Table 3:	Effects	on ex	xport	growth	by	major	sectors
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	Total	Dimont	Indirect Effects		
Sectors	Effects	Effects	Indirect-trade linkages	Multiplier effects	
Agriculture	-4.60%	-0.89%	-3.38%	-0.33%	
Natural resources	-9.04%	-2.14%	-6.55%	-0.35%	
Food	-6.20%	-3.14%	-2.23%	-0.83%	
Manufacturing	-8.54%	-3.70%	-4.48%	-0.36%	
Services	-9.14%	-4.23%	-4.33%	-0.58%	
Total	-8.34%	-3.66%	-4.24%	-0.44%	

Note: Results indicate percentage growth subtracted from the long-term growth rate.

Import growth will slow down significantly in the sectors where Thai producers need inputs from abroad. These inputs are raw materials, machinery, and technology. In contrast, small changes in import growth are found in production sectors that are inelastic to income and less affected by declining export production activities, including agricultural and food-processing industries. Apart from service sectors, the cause of a decrease in Thailand's import demands comes mainly from G3 economies' indirect effect. The particular relationship means that Thailand has also imported numbers of intermediate goods for its production exported to the G3 markets.

Table 4:	Effects	on	import	growth	by	major	sectors
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	Total	Dimont	Indirect Effects		
Sectors	Effects	Effects	Indirect-trade linkages	Multiplier effects	
Agriculture	-8.71%	-2.76%	-5.51%	-0.44%	
Natural resources	-13.50%	-4.05%	-9.45%	0.00%	
Food	-8.79%	-3.24%	-4.66%	-0.89%	
Manufacturing	-11.21%	-4.52%	-6.43%	-0.26%	
Services	-9.66%	-5.01%	-3.39%	-1.26%	
Total	-11.21%	-4.46%	-6.38%	-0.37%	

Note: Results indicate percentage growth subtracted from the long-term growth rate.

Production activities will precipitously drop in manufacturing and service sectors while effects will be less pronounced in food, natural-resource, and agricultural sectors. Worthy of note is that a reduction in all activities is derived chiefly from indirect linkages between Thailand and countries of crisis. This finding confirms to us that most of the production activities in Thailand are hindered by the economic stances taken in the G3 economies through indirect-trade linkages. Results from the simulation scenario suggest that agricultural sectors are relatively less sensitive to external shocks than are the manufacturing and service sectors. Particularly in manufacturing, economic activities seem to strongly respond to the economic stances taken in the global business cycle. In terms of employment, the category of unskilled labor is less sensitive than is that of skilled labor. This finding in fact further supports the assertion that agricultural-related sectors could absorb economic shocks from foreign economies relatively well.

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Sectors	Total Effects	Direct Effects	Indirect Effects
Agriculture	-2.86%	-0.10%	-2.76%
Natural resources	-4.58%	-0.16%	-4.42%
Food	-5.50%	-1.51%	-3.99%
Manufacturing	-6.97%	-1.82%	-5.15%
Services	-6.42%	-0.46%	-5.96%
Total	-6.42%	-1.16%	-5.26%

Note: Results indicate percentage growth subtracted from the long-term growth rate.

Employing the input-output analysis, the current study focuses on precise sectors and further examines relative importance across production sectors. The Input-Output Table of Thailand was obtained from the National Economic and Social Development Board (NESDB), and was then regrouped so that it would represent 100 sectors covering all the major production activities in the economy. The main objective of the analysis is to identify domestic production activities that are risky to the global business cycle. There are two non-exclusive characteristics of interest. The first one is the degree of the adverse impact. The second property concerns the degree to which a sector could propagate its impact to other sectors. Production sectors have a substantial level of backward linkages to other sectors, and input comes mostly from domestic sellers; this kind of sector should be placed on a watch list. Moreover, a sector that generates sizeable value-added benefits, especially in employee compensation involving a household's purchasing power, could, in fact, multiply the effect further to the "domestic demand"-side of the economy. Therefore, these high value-added sectors are also highly important.

According to these properties, all production sectors then are classified into two groups. The sectors in each group are significantly affected by the global business cycle yet bear distinct consequences for different parts of the economy. The first group consists of production sectors, which are highly affected by external demand shocks, and these effects could significantly propagate to other production sectors in the domestic economy. The second group consists of highly affected sectors and also involves a large proportion of workers' income.

In essence, the input-output table showed us that, recently, Thailand has had 26 production sectors (out of 100 sectors) hugely affected by the economic slowdown in the G3 economies. These sectors involve, for example, restaurants, hotels, machinery, automobiles, metals, and plastics. Out of all the production sectors, there are 35 that seem to be highly backward linked to other industries. These sectors include iron and steel, tapioca milling, motorcycles and bicycles, home-and-building construction, plastics, and animal feed. Therefore, there are 7 production sectors that both have reeled from the crisis and, at the same time, have been able to transmit either depressed demand or depressed supply, in significant ways, to other sectors. These important sectors involve, for instance, apparel, land-transportation services, and plastics.

The second group of production sectors both suffering from the economic downturn and substantially involving consumers' income comprises 9 sectors, including apparel, electrical industrial machinery and appliances, hotels, and other services (chiefly repairs and personal services). When an external crisis erupts, a large part of the consumer income effect from these industries could translate into a further depression of domestic demand.

All in all, our quantitative study shows that external shocks from decreasing international-trade transactions will have unequal impacts on macroeconomic variables in the Thai economy. And let us note an important finding: the simulation confirms that *indirect linkages* between Thailand and other countries are crucial for understanding the crisis-transmission patterns as they emerge through international-trade channels. The indirect relationship significantly defines a pattern of export, import, and production activities characteristic of the present Thai economy.

4. Hard Disk Drive Industry

The hard disk drive (HDD) has become an important part of computers and consumer electronics. With the expansion of the demand for computers, especially laptops and consumer-electronics goods, the demand for HDDs continues to grow accordingly. Continuous growth in electronics and electrical appliances and the demand for higher storage capacity ensure that an HDD industry will have prominent growth in the future.

In Thailand, the HDD plays a crucial role in the export of computers and related parts, an industry that has generated the highest export revenues in Thailand for the last 13 years. The HDD accounts for 87% of the industry's exports. In 2008, Thai HDD exports surpassed the corresponding exports from China and Singapore, making Thailand the top HDD exporter in the world.

4.1 Industry Characteristics

The HDD industry has been relocating itself from Singapore to Thailand since the early 1980s because wages tend to be higher and labor tends to be scarcer in Singapore than in Thailand. With relative political stability during that period and with an investment-promotion policy launched before similar policies in neighboring countries, Thailand has helped convince four leading HDD assemblers—Seagate, Western Digital, Hitachi Global Storage Technology, and Fujitsu⁷—to set up their production bases in the country. Consequently, parts-and-components suppliers have followed the assembly firms and have established their own production bases in Thailand in order to lower logistics costs.

Since the success of HDD businesses requires technological advancement, most activities in HDD GVC are carried out by MNCs and their subsidiaries. The activities in the GVC taking place in Thailand involve parts-and-components production and HDD assembly, most of which are carried out by MNCs. Thai entrepreneurs have little direct involvement in the GVC because of technological limitations. Production and assembly bases in Thailand have been set up to benefit from low labor costs, low logistic costs, and high investment-promotion incentives. Other important activities in the GVC apart from production and assembly, namely, R&D, product design, and distribution, take place outside Thailand and under the control of MNCs.

Being a part of the IPN, Thailand hosts HDD production and assembly bases and specializes in the production of 2.5" HDDs for laptops and consumer-electronics goods. Parts and components produced in Thailand have been used mainly for assembly within the country while the rest are exported to assembly bases in China and Malaysia. Most of the parts and components are produced in Thailand using imported raw materials. Only some components, such as media platters and printed circuit boards, are imported from Malaysia, which is an IPN production base for these components.

⁷ In 2009, Toshiba bought out HDD operations from Fujitsu, including its operations in Thailand.

The effects of the subprime crisis on the HDD industry can be divided into three categories: (1) a drop in sales, (2) access to sources of funds, and (3) exchange-rate fluctuation.

The effects of the subprime crisis started to hit the HDD industry in the third quarter of 2008, when sales orders and production dropped sharply. In the first quarter of 2009, the industrial-output index of the HDD industry decreased by 19%, the most dramatic contraction since 2003. Consequently, HDD exports had substantially declined by 30-50% during the fourth quarter of 2008 and the first quarter of 2009. However, the industry experienced a sudden rebound in sales orders in the second quarter of 2009 owing to the recent excessive reduction in production, inventory restocking, and a recovery in the electronics and electrical appliances industry. Overall, the export of HDD grew 4.3% in 2009 in terms of quantities.

The firms in the HDD industry rely on retained earnings and financial support from parent companies as their main sources of funds. With strong financial positions of parent companies in spite of the subprime crisis, most firms in the industry rarely encounter any difficulty in financing their businesses.

As for exchange-rate volatility, most firms in the industry employ several measures to hedge their positions from the exchange-rate risk. These measures include using forward contracts, using foreign-currency denominated accounts in trading, or holding export revenues in a regional office account in Singapore. Only some SME firms are vulnerable to exchange-rate fluctuation insofar as they have limited knowledge regarding hedging instruments.

4.3 Fundamental Analysis

For the current study, we analyzed fundamental factors of the HDD industry by using the framework mentioned in the previous sections. The results of the fundamental analysis are presented as follow.

Competitiveness

For analyzing the competitiveness of the HDD industry, this paper divides the competitiveness into two levels: firm-level competitiveness and country-level competitiveness.

Competitiveness of HDD-industry firms

Most of the firms in the HDD industry are subsidiaries of the leading MNCs, with the world market share around 83% in 2008. They have clear competitive strategies and vigorous R&D activities that enable firms to establish their own loyal-customer bases. Examples of such strategies are vertical integration, technological leadership, integration of latest trends, or a focus on particular market segments such as HDDs for consumer-electronics goods. Apart from competitive strategies, R&D activities play a crucial role in a firm's competitiveness since the product is technology-oriented.

Competitiveness of Thailand as a production base

In the 1980s, while MNCs were planning their relocation from Singapore to Thailand, the latter was among the first countries in the region to offer privileges from its investment-promotion policy. Boasting political stability at that time,⁸ Thailand successfully attracted assembly firms to relocate from other regions and to set up their production bases on its own soil.

Thailand has adhered to several factors enhancing its competitiveness as a production base. These factors are productivity, process R&D, and external supporting factors from the government.

High productivity is a very important factor for HDD production. With its advantages in both skilled labor and process R&D, Thailand has strength in production efficiency. Also, with parts-and-components manufacturers relocating to Thailand, the country has a cluster of suppliers that provide a timely manner of delivery and a reduction in lead time, suitable for the assemblers' just-in-time production system.

Supporting policies from the government also strengthen Thai HDD firms' competitiveness in the industry. The Hard Disk Drive Institute (HDDI) is a leading agency that provides training for workers in the industry and that conducts R&D activities in corporations with related entrepreneurs and universities in the area of process R&D. Moreover, the National Electronic and Computer Technology Center (NECTEC) has been assigned the responsibility of drafting and implementing the HDD-industry master plan, which presents a clear direction for industry development.

However, the attractiveness of Thailand's political stability and the attractiveness of Thailand's investment-promotion policy have significantly diminished lately as neighboring countries have initiated aggressive investment-promotion policies

⁸ Political situations in neighboring countries at that time were distinctly unattractive for FDI. For example, the Philippines faced political instability that led to a revolution in 1986 while Indonesia had to deal with the May 1998 riots.

providing considerable incentives to MNCs and as political instability, starting in the late 2000s, has contaminated both the investment climate and investors' confidence.

Flexibility

To consider how flexibility contributes to firms' resistance against crisis, this study divides the types of firms into two categories, namely, assembly firms and parts-andcomponents manufacturers.

Assembly firms are highly flexible in production processes and input-and-inventory management. With the just-in-time system, firms need not hold considerable levels of inputs and inventories. As a result, firms can respond—with low adjustment costs—to a change in demand due to economic fluctuation more quickly than would otherwise be the case. The burden of holding input is passed on to suppliers instead.

Nevertheless, all HDD products have a positive correlation with business cycles where the products' response levels are similar. Therefore, it is difficult for assembly firms to diversify their products. And therefore, the firms have less output flexibility.

Parts-and-components manufacturers have a higher degree of flexibility in output than is the case with assembly firms—a trend reflecting the strong possibility that parts and components, once produced, can be used in different industries such as automobiles and electronics and electrical appliances. These industry sectors' varied responses to business fluctuations allow the firms, therein, to shift their production toward products that are expected to be most resilient to a given economic crisis.

However, parts and components manufacturers are less flexible in input-andinventory management because of the passed on effect from assemblers, as mentioned earlier. Also, the fact that almost all raw materials are imported brings about a higher lead time for manufacturers. As a result, they cannot adjust their production or input orders promptly. The firms then encounter a significant cost from the need to hold inventories when assembly firms massively cut back on their orders.

Both assemblers and parts manufacturers can lay off their employees when there is a reduction in sales orders due to the practice of subcontract employment. Nonetheless, when sales orders rebound, it is difficult for these employers to rehire workers because of labor shortages in the industry, especially at the operational level.

Since most of the firms in the HDD industry are MNC subsidiaries, they have a high degree of flexibility when it comes to accessing sources of funds: the subsidiaries can depend on their parent companies, retained earnings, or bank credit.

Financial-statement analysis

Liquidity Ratios

HDD firms have high liquidity as shown by their current and quick ratios. Also, the quick ratios of the industry are close to the current ones; in other words, the majority of the current assets that firms possess are likely cash and the like. However, assembly firms appear to have higher current and quick ratios than their manufacturer counterparts, indicating their stronger liquidity status.

Efficiency and Profitability Ratios

Overall, firms in the HDD industry operate efficiently but have low markups. Most firms benefit from economies of scales resulting in low operating costs and high assetturnover ratios. In contrast, these same firms have low profit margins because of fierce price competition. Parts manufacturers have a higher markup than assemblers because the former produce products of greater variation than do the latter and because the former's products can be used in various industries. As a result, parts manufacturers have more market power over price setting.

Financial Leverage Ratios

Most firms in the industry exhibit low debt dependency as seen by the low value of the total-debt-to-total-assets ratio. Also, assemblers hold no long-term debt whereas parts manufacturers have a low ratio of long-term debt to total assets, indicating that most debt held by firms is short-term debt in the form of accounts payable and working capital.

4.4 Foreign exposure

The HDD industry has a high degree of foreign exposure that can be divided into three channels: export dependency, IPN, and exchange-rate fluctuation.

The industry is export-oriented leading to high direct exposure to external shocks. Also, the industry is fully integrated with East Asia's IPNs, which act as a transmission channel of the indirect-trade effect from G3 economies to the industry itself. Finally, most of the raw materials must be imported. As a result, the firms in the industry are vulnerable to exchange-rate risk.

4.5 Summary

HDD is a growing industry and has generated high export revenues for Thailand over the past 13 years. With consumer electronics goods becoming an essential part of daily life, the demand for HDD will continuously rise. The subprime crisis has affected the industry through foreign exposure. Its direct impact comes from the highexport-dependency nature of the industry. The IPN also transmits indirect effects of the crisis to the firms that operate within the same network and that include assemblers and parts manufacturers in Thailand.

The effects of the subprime crisis have, so far, been short-lived owing to a quick rebound in electronics and electrical appliances and to strong sales of laptops during the crisis. In addition, the industry has strong fundamental factors such as high productivity and clear competitive strategies. It also possesses a high degree of flexibility in production processes, input and inventory management, and employment. These factors have contributed to the alleviation of the subprime effects.

However, Thailand's lack of skilled labor, political instability, and second-tier investment-promotion policy compared with the corresponding policies of neighboring countries pose a threat to the Thailand-based industry in the future. These factors might influence MNCs to relocate their production bases to countries that offer a better investment climate.

5. The Automobile and Related Parts Industry

Automobiles and automotive parts constitute one of the industries possessing a global network of production and sales. Also, the industry consists of a handful of MNCs from the United States, Europe, and Japan. In the United States, the automobile and related parts industry was the first real-sector industry to suffer severe effects from the subprime crisis. General Motors and Chrysler, two of the "Big Three" in the US automotive industry, filed for bankruptcy right after the crisis grew to epidemic proportions in the US economy. Toyota, as well, suffered losses for the first time in

70 years in 2008. In Europe, Peugeot experienced a significant loss while Renault and Fiat reported a sharp drop in their profits.

Thailand is one of the important production bases of automobiles and automotive parts in Asia. The industry has played a crucial role in Thailand's economic growth owing to the industry's backward and forward linkages. Automobiles and automotive parts have been the second-most important export industry in terms of revenue since 2004. Initially, the establishment of a Thai production base was for import substitution. However, after the 1997 Asian financial crisis, the industry shifted its orientation toward exports because domestic demand was shrinking and because economies of scale offered considerable gains.

Being a part of an IPN and exhibiting export dependency, the automotive industry in Thailand has sustained severe effects from the subprime crisis. Both domestic sales and exports plummeted, bringing about huge worker layoffs. In addition, such negative effects have had repercussions for industries that have backward and forward linkages with the industry.

5.1 Characteristics of Industry

Automotive-production bases have been set up in Thailand since the 1960s. At that time, the only related activity in Thailand was automotive assembly with the import of complete knock down (CKD) parts. In the 1970s, Thailand's industrial policy aimed for import substitution and set local content requirements for the assembly of passenger cars, trucks, and buses. This policy led to a withdrawal of US and European assemblers because of the high cost of production deriving from diseconomies of scale. However, the Plaza Accord in 1987 led to an appreciation of the Japanese Yen against the US dollar, causing Japanese MNCs—regardless of whether they were assemblers or parts manufacturers—to relocate their production to Thailand in order to benefit from lower costs of production.

Thailand liberalized its automotive industry in the early 1990s, allowing for new registration of car-assembly plants and for the launch of automotive-industry investment promotions for the first time since the policy had been suspended 25 years earlier.⁹ After the 1997 Asian financial crisis, the industry became export oriented because the 1997 crisis had severely weakened domestic demand. MNCs from the United States and Europe benefited from the so-called 'FDI firesales' and the government policy that allowed 100% foreign ownership for the establishment of Thailand-based production bases. The product champion of Thailand's automotive industry has been the one-ton pickup truck.

Most of the activities in the industry's GVC are carried out in Thailand, including the production of parts and components, assembly, and domestic retails. Only product design, R&D activities, and distribution in the export destinations are currently operated by MNCs' headquarters. Nevertheless, some assemblers and parts manufacturers have started to set up technical centers in Thailand to conduct R&D activities for the minor revision of new models and for further work in parts and components.

The most important activity of the automotive GVC in Thailand is production. Thailand is one of the most crucial production bases for parts and components, as well as for assembly, in the IPNs encompassing Japanese and US MNCs. The production

⁹ The government suspended the investment promotion, believing (at that time) that many firms had already received these types of promotions.

of 1-ton pickup trucks in Thailand is the largest production base in the East Asian region, serving both domestic and export markets and leading to economies of scale and production efficiency. Assemblers, especially Japanese firms, depend heavily on parts and components produced in Thailand with the exception of some complicated parts, such as electrical systems or electrical-controlled parts, that have to be imported from parent companies. The main export destinations are ASEAN, Oceania, and the Middle East.

For European MNCs, Thailand is a production base for passenger cars that serve mainly the domestic market and some ASEAN countries for particular models. Unlike Japanese and US counterparts, imported CKD parts and components are required for EU firms instead of those produced by firms within the East Asian IPNs because the high prices of EU cars have kept East Asian market shares of total car sales small.

5.2 Effects of the Subprime Crisis

An automotive industry is affected by the subprime crisis via three main channels, namely, (1) a decline in sales, (2) access to sources of funds, (3) exchange-rate fluctuation.

The subprime crisis severely affected both domestic and export markets in Thailand. The production of passenger cars and pickup trucks declined 21.5% and 31.1% respectively in 2009. Automotive exports dropped 28.4% while auto parts decreased by 27.9% accordingly.

Sales in the domestic market also suffered from financial institutions' credit restrictions because most of the domestic sales depended on bank credit, which dried

up during the subprime crisis. Financial institutions also raised the down-payment from 15% to 20-25%, dramatically distorting buyers' decision to buy new cars.

A decrease in automotive sales and production also affected parts-and-components manufacturers. Original equipment manufacturing (OEM) suppliers, providing parts and components for assemblers, suffered more severely than replacement-part suppliers or REM suppliers. This contrast reflects the counter-cyclical nature of replacement parts: consumers choose to use existing cars rather than purchase new ones in the face of an economic crisis; hence, the demand for replacement parts increases.

Regarding access to sources of funds, most subsidiaries of MNCs depend on their retained earnings and on investment from parent companies. However, the subprime crisis has seriously affected MNCs, especially ones in US IPNs. As a result, some subsidiaries have had to rely more on domestic bank lending and retained earnings. US subsidiaries have been hit the hardest since some of their parent companies have had to file for bankruptcy. Hence, financial support from the parent companies has been cut down, and the subsidiaries need to seek funds from domestic financial institutions, which were severely restricted during the height of the crisis up until now.

The effects of sources of funds on Thai firms vary according to the firms' size. SME firms, which are the second- and third-tier suppliers, have experienced difficulty in accessing funds because financial institutions have considered the automotive industry a high risk one. However, the crisis has had smaller effects on large Thai firms in the first tier of suppliers than on the second and third tiers because the former type of firm
has greater flexibility in finding sources of funds than is the case with the latter type of firm; the large first-tier Thai firms, indeed, are listed in the Thai stock market.

As for the exchange-rate risk, most assembly firms and first-tier producers employ hedging instruments; hence, the effects of exchange-rate fluctuation are mitigated. Entrepreneurs in the second and third tiers, mainly small- and medium-size Thai firms, are more vulnerable to exchange-rate risk since raw materials have to be imported. Nevertheless, these firms rarely hedge their positions since the costs associated with these instruments are elevated.

5.3 Fundamental Analysis

Fundamental factors determining industry's competitiveness are presented as follows.

Competitiveness

The competitiveness of the automotive industry can be divided into two levels: a firm level and a country level.

Competitiveness of the industry's firms

For assemblers, all firms in the industry are leading MNCs, which have clear competitive strategies, high productivity, and vigorous R&D activities. The firms use competitive strategies to differentiate their products and marketing positions from their rivals' and to establish their own customer bases. Examples of market strategies are luxurious cars, lower maintenance costs, or environmental-friendly technology and energy efficiency. These MNCs also have an efficient production system ranging from high technology, the just-in-time approach, and the kanban system to quality-control systems, which lead to high productivity. Furthermore, firms concentrate on

R&D activities in order to develop new products and technology (such as cleanenergy automobiles) that serve a change in customer demands.

As for parts-and-components manufacturers, they emphasize product quality, competitive pricing, and timely delivery to assemblers in order to serve the just-in-time production system.

Competitiveness of Thailand as a production base

Several government policies have increased the competitiveness of the industry. The government's decision to liberalize the automotive industry in the 1990s, and the government's subsequent investment-promotion policies, have encouraged MNCs from Japan, the United States, and Europe to set up their assembly and production bases in Thailand. A free-trade agreement with Australia also induced MNCs to further their use of Thailand as a site of production bases for export while a free-trade agreement with Japan (JTEPA) would lower the tariffs of imported parts and components. The expansion of export markets deriving from the free-trade agreements, together with Thailand's sizable domestic market, enabled the Thai industry to benefit from economies of scale. In addition to the skilled labor employed in the industry, these factors have contributed to the high productivity of the industry as a production base.

Furthermore, the government launched its automotive-industry master plan, which would identify strategic directions in industry development, focusing on eco cars as the second product champion. The industry has received a further injection of strength from a cluster of parts-and-components suppliers who have located themselves close to the assemblers to reduce lead times and logistics costs. In addition, several MNCs have started to set up technical centers in Thailand to conduct R&D activities in parts and components and have undertaken minor revisions of new models to suit regional demand—actions that will help increase the industry's competitiveness in the long run.

Nevertheless, the current political conflict has threatened the industry's competitiveness by lowering investors' confidence. With the ASEAN free-trade agreement (AFTA) coming into force, MNCs may relocate their production bases to other countries within the region. In addition, conflict among government ministries regarding policy directions, especially regarding energy policy, obstructs the long-term planning and investment of the industry's firms.

Flexibility

To consider firms' flexibility in alleviating the impact of the subprime crisis, this study distinguishes between two types of firms—assemblers and parts manufacturers.

Assembly firms are flexible in the areas of marketing strategies and of production processes. At the peak of the current economic crisis, these firms sought to increase sales orders by launching several marketing campaigns that would rest on such approaches as sales discounts, attractive credit terms, limited-edition products, or the application of database-stored customer information to improvements in after-sale services. Assembly firms are also flexible in production processes because of the justin-time system. Nonetheless, these firms have less output flexibility because the design-and-development process of new products requires a long period and because all automotive products constitute a similarly mannered response to a given business cycle. Parts-and-components manufacturers possess a high degree of flexibility in marketing strategies and output. The firms have options to serve OEM (pro-cyclical) or REM (counter-cyclical) markets. Also, their products can be sold in various industries such as the automotive industry and the electronics and electrical appliances industry.

Using subcontractors at the operational level allows both assemblers and parts manufacturers to have a greater level of flexibility in employment since the subcontractors can be laid off in response to a drop in sales orders. However, some firms encounter difficulties in rehiring laborers to fulfill the rebounded orders.

Regarding flexibility in harnessing sources of funds, subsidiaries of MNCs are more flexible than Thai firms because the former can seek financial support from both parent companies and domestic financial institutions, with the exception of situations where parent companies have filed for bankruptcy. Thai SMEs are less flexible than MNCs when it comes to harnessing sources of funds because Thai SMEs have to rely on bank lending, which has been severely restricted during the crisis. In contrast, large Thai companies can, alternatively, raise funds from the stock market.

Financial-statement Analysis

Liquidity Ratios

Thai firms in the automotive industry have high current and quick ratios, indicating the firms' high liquidity status. Moreover, a comparison across "firm types" reveals that the firms have high inventory-turnover ratios, which ensure the firms' liquidity after purchases of inputs and materials. Assembly firms have higher current and quick ratios than parts manufacturers. As for parts manufacturers, large companies have the highest liquidity status.

Efficiency and Profitability Ratios

Overall, the industry has high markups even though it generally faces high operating costs. For assemblers, Japanese firms have attained the highest net-profit rate while US firms are the most efficient with the lowest operating costs. European firms perform the worst, with negative net profit, which might stem from diseconomies of scale.

Parts manufacturers have higher operating costs than their assemblers' counterparts, particularly Thai SMEs. The problem comes from diseconomies of scale due to the parts manufacturers' inappropriate sizes of production.

Financial-leverage Ratios

Parts manufacturers, especially Thai firms, are highly leveraged as shown by high total-debt-to-total-asset ratios. Usually, firms exhibiting poor performance depend on debt financing more than firms exhibiting acceptable or impressive performances, and poorly performing firms also have low interest-coverage ratios, implying high leverage and default risks.

In contrast, assemblers depend less on debt financing than do parts manufacturers. US firms hold no long-term debt while European firms have the highest long-term debt-to-total-asset ratios among assemblers. However, a change in policy from the US parent companies could mean that the firms have to broaden their reliance on debt financing from domestic financial institutions.

5.4 Foreign Exposure

The automotive industry must contend with three channels of foreign exposure, namely, export dependency, membership in an IPN, and exchange-rate risk.

Although the industry is export-oriented, around half of the cars produced are sold in the domestic market; hence, the industry has less export dependency than the HDD industry. Nevertheless, the automotive industry experiences a high degree of indirect trade effects through trading in parts and components within a single IPN. Moreover, the bankruptcy of a subsidiary's parent company would likely severely disrupt the subsidiary's business operations, especially in terms of financial support. In addition, raw materials for parts and components, particularly steel, have to be imported, thereby exposing manufacturers to exchange-rate risks.

5.5 Summary

The Thai automotive industry plays a significant role in generating export revenues. With its deep backward and forward integration, many Thai firms—especially SMEs—participate in the industry's GVC. With high foreign exposure, the industry faces severe effects stemming from the subprime crisis, a scenario similar to the one characterizing automotive industries in other countries. Sales in domestic and export markets have dropped sharply. The industry also has encountered indirect trade effects through the IPN, as seen by a reduction in parts-and-components trade. And foreign ownership has acted as a transmission channel for the crisis-based effects, as the subsidiaries cannot rely on financial support from bankrupted parent companies.

From the perspective of fundamental analysis, the Thai automotive industry possesses several positive factors such as high productivity, support from government policies, and flexibility in production processes and in employment. These factors help the industry to withstand the negative effects of the crisis.

Nevertheless, political instability and conflict over government policies are disadvantages afflicting the industry. With the AFTA coming into force, the industry faces a relocation threat from MNCs' production bases that are setting up shop in other countries within the region.

6. The Gem and Jewelry Industry

The gem and jewelry industry is one of the most important in Thailand. It has generated significant export revenues over the past years. Moreover, the industry is labor intensive and employs around 1 million workers, both formal and informal ones. Most of the firms in the industry are Thai-owned SMEs, which carry out such activities in the GVC as gem enhancement, cutting, and jewelry manufacturing. As a result, the industry is very important to the Thai economy. The most crucial activity yielding the highest value-added numbers in the industry's GVC is gem enhancement through heat treatment. The technique has been developed through trial-and-error processes and has received international recognition as a shining example of Thai know-how.

The industry depends heavily on exports accounting for 80% of the industry's total production: G3 markets constitute the main destinations. Therefore, the gem and jewelry industry is vulnerable to subprime-crisis effects mainly because of this industry's high foreign exposure. In addition, the effects of the crisis can be transmitted to other activities in the GVC operated in Thailand and, indeed, to the

employment of the industry's firms. Hence, it is crucial to study the effects of the subprime crisis on the gem and jewelry industry.

6.1 Characteristics of the industry

In the past, Thailand was a major exporter in colored stones because the country possessed both plentiful mineral resources and the enhancement techniques necessary to improve the quality of rough stones. Nowadays, Thailand's abundant resources have been depleted. Therefore, it must depend on imports of rough stones from other countries such as Burma, Madagascar, and Mozambique, out of which the stones are illegally smuggled owing to the aforementioned countries' export-restriction policies. Thailand has highly skilled labor, especially in cutting colored stones and, subsequently, in cutting diamonds. Jewelry manufacturing is an activity that benefits from the variety of gems available within the country.

The industry's GVC-based activities taking place in Thailand are chiefly gem enhancement and jewelry production. As for gem enhancement, Thai entrepreneurs possess a unique heat-treatment technique and exceptional polishing and cutting skills, which add substantial value. Jewelry production is another vital activity in the GVC. Most of the jewelry entrepreneurs are OEM producers, relying on customers' design. However, some producers manage to become original design manufacturers (ODMs), which offer their own product design to their consumers. This ability enables ODMs to create higher value-added benefits than is the case with the manufacturers' OEM counterparts.

6.2 Effects of the Subprime Crisis

The impact of the subprime crisis on the gem and jewelry industry can be divided into four categories: (1) effects on sales, (2) access to sources of funds, (3) fluctuations in exchange rates and precious-metal prices, and (4) effects on firms' liquidity.

The industry's exports suffered a massive drop following the onset of the subprime crisis. In 2009, the export of diamonds, colored stones, and finished jewelry decreased by 25%, 23%, and 12% respectively. In contrast, the export of unwrought gold increased by 67% because of an upward trend in gold prices throughout world markets and (on a similar but not identical note) because of an increase in the global demand for gold investment. Exports in imitation and silver jewelry also grew, by 7% and 11% respectively between 2008 and 2009, because the two types of products are giffen goods in the industry, at least in relative terms. They are less expensive than other types of jewelry and, yet, have fashionable designs, bringing about higher demand during the crisis.

As for access to sources of funds, most firms in the industry depend on owners' wealth. This is because the value of their products and the value of the inputs are difficult for parties outside the industry to evaluate. Besides, there are no organizations whose function would be to set up reference prices for the products in the industry. Therefore, it is difficult to know the value of firms' total assets and performance. Also, the gem-enhancement process carries significant risk in that rough stones may turn out to be worthless. As a result, financial institutions regard the gem and jewelry industry as a high-risk one and rarely approve credit loans to the industry's firms unless they use other assets as collaterals. Even worse, the subprime

crisis has forced banks to refrain from almost all credit extensions to the industry, causing some firms to fall into liquidity crises and bankruptcy.

Exchange-rate fluctuation has affected the industry's firms, particularly SMEs, since most of them do not use hedging instruments owing to their high fees and to SMEs' limited risk-management knowledge. Moreover, inputs such as rough stones are illegally smuggled into the country, leaving firms no proper documents required for the purchase of such instruments.

Volatility in the price of precious metals is another crucial effects stemming from the subprime crisis. In that precious metals such as gold and silver are an alternative investment instead of a financial security (according to mainstream thought), their prices dramatically increased during the current crisis and exhibited a sudden drop in accordance with a decrease in oil prices. Firms in the industry are exposed to price fluctuations because hedging instruments are not available in Thailand. Also, most entrepreneurs lack sufficient knowledge regarding the application of hedging instruments to fluctuations in metal prices. Nevertheless, some firms try to limit their exposure by ordering precious metals only upon receipt of a customer order or upon placing an order, themselves, from intermediaries.

The subprime crisis has severely affected firms' liquidity status, especially that of gem entrepreneurs. Both a sharp drop in sales and inaccessibility to bank credit have deteriorated firms' liquidity position. In addition, inefficient inventory management has worsened the firms' liquidity problems. A significant drop in exports has increased firms' inventories and product prices, in turn, reducing the value of inventories. Moreover, gem entrepreneurs face a monopsony market of Indian buyers

insofar as most gem entrepreneurs lack marketing skills and depend on middlemen for product sales. Monopsony by Indian middlemen forces the Thai firms to sell their products at a very low price. These factors have driven firms into liquidity crises, resulting in a shutdown of some firms.

6.3 Fundamental Analysis

The fundamental analysis of the gem and jewelry industry regarding its competitiveness, flexibility, and financial-statement analysis is presented as follows.

Competitiveness

Competitiveness of the firms in the industry arises from their ability to create high value-added products. Gem entrepreneurs possess a heat-treatment technique to enhance the quality and color of rough stones. Together with exceptional polishing and cutting skills, these factors considerably increase the value of rough stones. In addition, some jewelry entrepreneurs have started to feature their own designs and their own brands, both of which could further increase the value-added nature of—and the markups to—their products.

Nevertheless, the firms in the industry, especially gem entrepreneurs, lack competitive strategies. The problems are attributable to a lack of marketing skills and a language barrier preventing the firms from expanding their market shares abroad. In addition, gem and jewelry firms have low productivity due to their labor dependency, which imposes limitations on quality control and the speed of production. This low productivity also prevents firms from producing sophisticated products requiring high technological machines such as gold jewelries.

Flexibility

The gem entrepreneurs are inflexible in their marketing strategies, as well as in their management of output, input, and inventory. Regarding marketing strategies, most of the firms concentrate on production, so they rarely adjust their marketing to suit a change in an economic situation. Insufficient language skills also impede the expansion of customer bases abroad. Regarding output flexibility, products of most firms, particularly those of gem entrepreneurs, are not diversified and lend themselves to similarly mannered business-cycle responses. In contrast, ODM jewelry firms have a higher degree of flexibility in output than gem entrepreneurs have because the former can effectively launch new products with their own design. Therefore, the impact of the crisis on ODM jewelry firms is less severe than on gem entrepreneurs.

However, both gem firms and jewelry firms are inflexible when it comes to harnessing sources of funds, and this is so for the reasons mentioned earlier. Together with inventory mismanagement, these factors have resulted in a severe liquidity problem during the crisis.

Jewelry firms, especially medium- and large-size ones, have a higher degree of flexibility in marketing strategies and output. Firms can launch new products that better serve consumers' demand in times of economic crisis and that feature, for example, product designs using less precious metal, shifts in production to imitation jewelry, or a pursuit of aggressive marketing strategies to preserve and expand existing customer bases. However, both gem firms and jewelry firms are inflexible in acquiring sources of funds, and the subsequent severe liquidity problems that one would anticipate have, indeed, surfaced during the current crisis.

Financial-statement Analysis

Liquidity Ratios

The firms in the gems and jewelry industry have high current ratios but low quick ratios. In addition, the firms have low account and inventory-turnover ratios, implying that the firms have substantial inventories on average and require a long period to sell their products. These problems put a strain on the firms' liquidity position. Moreover, liquidity performance varies greatly across the firms. Even for the same firm, liquidity ratios fluctuate drastically over time.

Efficiency and Profitability Ratios

The analysis of financial ratios finds that the industry operates inefficiently due to its high operating costs, as seen by a gap between gross-profit and net-profit ratios. Diseconomies of scale and inventory mismanagement also contribute to the inefficiency and low profitability. Foreign firms, including joint-venture firms, manage to have higher profitability rates than exclusively Thai firms. Similar to liquidity, profitability varies across the Thai firms in the industry. Even for the same firm, profitability fluctuates over time, reflecting a riskiness that the industry experiences.

Financial-leverage Ratio

The industry has a high ratio of total debt to total assets, but its long-term debt is low, which means that most of the debt held by firms is short-term and amounts to "accounts payable." Jewelry firms depend on debt financing more than do gem entrepreneurs, so the former entities have greater access to bank credit than do their gem counterparts. The firms exhibiting poor performances depend heavily on debt, implying a high default risk.

6.4 Foreign Exposure

The industry has a high degree of foreign exposure through a direct trade channel, with 80% of its product being exported. Moreover, the major export destinations are G3 markets, which account for about 25% of the industry's total exports. These Thai firms also depend on imported inputs such as precious metals and rough stones, leading to high exposure to fluctuations in exchange rates and metal prices. Also, the products of the industry are luxury goods, which are income elastic. As a result, demand for the firms' products has experienced a sharp drop during the crisis.

In contrast to the HDD and automotive industries, the gem and jewelry industry does not suffer indirect-trade effects since most of the activities in the GVC occur in the country. Therefore, the current economic crisis has wrought only direct effects on the industry, through export dependency.

6.5 Summary

The importance of Thailand's gem and jewelry industry to the Thai economy is firmly rooted in the industry's high export revenues, wide-scale employment, and considerable involvement in Thai-owned SMEs. Prior to the subprime crisis, the industry experienced persistent problems such as difficulty in attaining bank credit, a lack of marketing skills, inefficient inventory management, and a lack of product design and brand creation. The industry also has had high foreign exposure through export dependency. These factors help explain the devastating effects that the subprime crisis has had on the industry. The severity of the effects has led to massive layoffs of formal and informal employees while some firms in the industry have had to shut down their businesses.

7. Processed-seafood Industry

Processed food as a product constitutes an important industry for the Thai economy. The industry has added significant value to output from the agricultural sector, which is the core sector of Thailand, employing 39% of the country's labor force. Also, processed food accounts for 13% of Thailand's total exports, generating high revenues in the country. The most important product in this category is processed seafood, with frozen and processed shrimp and canned tuna having the highest share. Thailand is the world's biggest exporter of these two products, and the main export destinations are the United States, the European Union, and Japan. As a result, the industry has been highly exposed to the subprime crisis. Nevertheless, the current economic crisis has only slightly affected the exports of the two products. Therefore, we have selected these products for analysis in the present study, and are examining in particular both the effects of the crisis on the products and the products' characteristics contributing to the industry's apparently effective resistance against the impacts of the crisis.

7.1 Characteristics of the Industry

Processed shrimps and canned tuna generate significant export revenues and have gained international recognition for their high standards of production and quality. Most of the GVC's activities underlying these products occur in Thailand, extending from research and development, product design, and preparation of raw materials (but not necessarily the harvesting of raw materials) to cooking, seasoning, and packaging. However, the two products differ from each other regarding their evolution from raw material to distributed processed product.

As for processed shrimp, the harvesting of almost all the raw materials takes place in the form of domestic farming. However, the distribution of final products is carried out mostly by foreign firms since most manufacturers in the industry are OEM producers and do not have their own product brands. Nevertheless, recently some firms have been trying to establish brand identity in order to create their own customer base and to enhance the value-added quality of their product.

In contrast, canned tuna depends on imported raw materials since Thai fishery vessels are not capable of participating in deep-water fishing. Regarding distribution of the tuna products, some firms in the industry possess their own brand names, which enable these firms to exercise control over distribution channels; tuna firms that lack brand identity still rely on local distributors for the shipment of tuna products to market destinations. The current study divides the effects of the subprime crisis on the industries into three categories, namely, sales effect, accessibility of sources of funds, and exchange-rate fluctuation.

Both processed shrimp and canned tuna, as industry sectors, have endured relatively mild negative effects stemming from the subprime crisis in comparison with other industries. Processed-shrimp producers' exports increased by 8.9% in 2009. Even though the global demand for the product decreased in 2008, Thailand has faced the opposite trend. This curious state of affairs reflects Thai entrepreneurs' solid reputation for being producers of high-quality products. In addition, Thailand's main rivals such as Indonesia and Vietnam have suffered from setbacks: the former has had to contend with epidemics afflicting shrimp, and the latter suffered from a natural environmental disaster, both of which severely curtailed the countries' respective bounties from the seas.

As for canned tuna, in 2009, its export value for Thailand dropped by 13.9% while the quantities increased by 5.6%. This drop in the export value resulted from a downward trend of raw materials in the world market following a continuous decrease in oil prices. Also, the nature of tuna products is, in general, reflective of a homogeneous good, resulting in fierce price competition, especially during economic crises.

Regarding access to funding sources, both shrimp-processing firms and tunaprocessing firms, being mainly large- and medium-size Thai companies, depend on several sources of funds ranging from owners' wealth, retained earnings, and bank loans to the stock market. Therefore, most firms have encountered no financing difficulty during the crisis. Also, financial institutions consider the processed-seafood industry a low-risk one. The subprime crisis, thus, has affected only a handful of SMEs, chiefly those possessing a narrow variety of funding sources.

Exchange-rate fluctuation has had a serious impact on firms' profitability owing to the processed seafood's low-markup nature. Large companies in the industry protect themselves from exchange-rate risk by using hedging instruments. SME firms rarely employ such tools because of the expensive fees associated with position hedging and because of the firms' limited understanding of the instruments.

7.3 Fundamental Analysis

Below, we present our fundamental analysis of processed shrimps and canned tuna in terms of competitiveness, flexibility, and financial-statement analysis.

Competitiveness

The firms in these sectors acquire their competitiveness through value-added creation and R&D activities. The firms always implement extensive R&D activities to create new products with higher value added, particularly in the form of ready-to-eat or ready-to-cook meals and attractive packaging. Nevertheless, the processed shrimp industry offers more product varieties than canned tuna.

In addition, process R&D is continuously evolving. Some firms in the processedshrimp industry have attained such high levels of technological advancement in shrimp farming that the firms have access to yields all year round, hence, eliminating the seasonal variation in raw materials. These two sectors also employ several competitive strategies attributed to their competitiveness. Examples of these strategies include vertical integration, concentration on niche markets, brand creation, and expansion of the domestic market's shares.

Firms in these industrial sectors have high productivity due to the Thai firms' skilled labor, process R&D, and technological advancements in production processes.

However, the main threat to the industry's competitiveness is domestic-labor scarcity due to unattractive working conditions. As a result, the entrepreneurs rely mainly on Burmese immigrants. In contrast, the central Thai government's policy related to immigrants imposes a quota defining the maximum number of foreign laborers that Thai firms may hire, and the corresponding illegal-immigrant registration process is complicated. These problems are the main contributors to the industry's labor shortage.

Flexibility

The two industrial sectors are flexible in their marketing strategies, their output strategies, and their use of funding sources. Firms have been able to adapt their marketing strategies to the current economic downturn by altering their distribution channel from restaurant chains to retailers such as supermarkets. In addition, the export destinations of the two products differ greatly from one another, encompassing several regions around the world. The firms, particularly in the processed-shrimp sector, have a keen ability to adjust their output by increasing product varieties, by producing economy-sized products, or by offering various choices of quality.

The two industrial sectors, especially large firms therein, have a high degree of flexibility regarding their respective funding sources, since they can rely on the stock market, bank lending, and owners' wealth. Moreover, financial institutions regard processed seafood as a low-risk industry, in this general impression enables firms to get approval for bank credit, even in times of economic crisis.

Nevertheless, the processed-shrimp and canned-tuna sectors suffer from a certain inflexibility in both production processes and employment. There is typically a seasonal variation in quantities of raw materials. Also, the industrial sectors face labor shortages. These factors impede quick adjustments to production changes and employment changes that, themselves, might arise in response to changes in economic conditions.

Financial-statement Analysis

Liquidity Ratios

The firms in the two sectors have exhibited good liquidity performance, as seen by current ratios. However, a gap between current and quick ratios reveals that some current assets are inventories. This is because firms need to hold stocks of raw materials as a result of seasonal variation in quantities. Together with low inventory-turnover ratios, firms may face liquidity risks by holding large inventories. Large firms have the highest current and quick ratios, but the firms' account-turnover ratios are low. This pattern might imply that large companies can handle a longer credit period on behalf of their clients than can small companies because of the former's stronger liquidity position.

Efficiency and Profitability Ratios

The two sectors have low profitability, as seen by their net-profit rates. They also have high operating costs and low asset-turnover ratios, reflecting these firms' inefficiency in operations, inefficiency in asset utilization, and diseconomies of scale. Large companies have the highest profitability and the lowest operating costs due to their proper sizes of production. In contrast, Thai SMEs face operation inefficiencies.

Financial-leverage Ratios

Most firms in the industries depend more on debt financing than on equity, as shown by the total-debt-to-total-asset ratios. Most of the debts are short-term ones. Also, many firms—because of their low markups—have low interest-coverage ratios. On the other hand, large firms depend less on debt financing than do SME firms because the former type of company has more variation in sources of funds.

Although the industries are highly leveraged, strong liquidity positions might ensure that the default risk of the firms is still low.

7.4 Foreign Exposure

The sectors suffer from the direct impact of foreign exposure through high export dependency, where about 90% of total production is exported. However, the products of these industries are necessary goods; therefore, the impact from the subprime crisis is at par. Exchange-rate fluctuation is another channel through which the economic crisis, originating abroad, has transmitted itself to Thailand, and the two sectors are export oriented; and canned tuna also depends on imported raw materials. However, most firms employ hedging instruments with the exception of some small- and medium-size firms.

7.5 Summary

Thailand is the world's top exporter of both processed shrimp and canned tuna. These products have generated significant export revenues. Most of the firms in the industrial sectors are Thai-owned, and almost all activities in their GVCs occur in the country.

The sectors have high foreign exposure stemming from export dependency. However, the two sectors have strong fundamental factors such as value-added creation, R&D activities, high productivity, and flexibility in marketing strategies and output. In addition, the products of the sectors are necessary goods with low income elasticity of demand. Therefore, firms in the business of creating processed shrimp and canned tuna have suffered lower levels of setbacks stemming from the subprime crisis than firms in other industries.

Nonetheless, since the two industrial sectors are labor-intensive, the labor shortage poses a significant threat to the sectors insofar as the leading firms might relocate their production to neighboring countries abundant in labor.

8. Comparative Analysis of Fundamental Factors and Foreign Exposure

This section compares the results of the fundamental analyses from the previous sections across the four industries in order to identify the certifiable characteristics of industries and firms that help them to withstand the impact of the subprime crisis. The

comparative analysis is carried out at two levels: at an industry level and at a firm level.

8.1 Comparative Analysis at an Industry Level

Competitiveness

The four sampled industries differ from one another regarding competitiveness. The competitiveness of the HDD and automotive industries come from their production processes, characterized by high productivity. The gem and jewelry industry derives its competitiveness from related firms' use of skilled labor and from the firms' unique gem-enhancement process. As for the processed-seafood industry, its product quality and its varieties of product contribute to the industry's high degree of competitiveness. The HDD and automobiles and automotive parts industries have a high degree of competitiveness as production bases for MNCs. The factors that contribute to the competitiveness are high productivity and supportive external factors. Advancements in process R&D and the presence of skilled labor play a crucial role in enhancing these industries' productivity. Supportive external factors in the form of investment-promotion policies have attracted firms, whether assemblers or parts manufacturers, to relocate their production bases to Thailand and to form a strong cluster of suppliers in the country.

The automobiles and automotive parts industry generates higher value-added benefits than does the HDD industry because the former operates more GVC-based activities in Thailand than does the HDD counterpart. In addition, MNCs in the Thai automobiles industry have started working with Thai entrepreneurs in undertaking parts-and-components R&D activities and have made minor revisions to new car models; in contrast, Thailand's HDD industry can boast no significant product R&D activity.

As for gems and jewelry, the industry was once considered to be highly competitive owing to Thailand's abundant reserves of rough stones, highly skilled labor, and a unique gem enhancement technique. However, the industry has started to lose grasp of its competitiveness as a result of depletions in natural resources, low productivity, and a lack of firm-based design and marketing strategies. It should be noted, as well, that rival countries have been carefully studying and duplicating the gemenhancement-through-heat treatment.

The processed-seafood industry is distinctive for its high productivity, its product R&D, and its creation of value-added benefits. These factors result in a high degree of competitiveness for the industry. Product R&D allows firms to create and launch new products with higher and higher value-added benefits that meet consumers' demand and that establish a loyal customer base. The R&D activities also strengthen the variety of products, which helps firms to diversify markets. Also, the industry practices process R&D and integrates the results into production processes. The technological advancements in production together with Thailand's skilled labor has contributed to the industry's high productivity.

Factors that contribute to the four industries' competitiveness are summarized in Table 6.

HDD	Automobiles and Automotive Parts	Gem and Jewelry	Processed Seafood (Processed Shrimp and Canned Tuna)
-high productivity -process R&D	-high productivity -the relocating of R&D activities to Thailand -value-added creation	-skilled labor -value-added creation and design (for ODM) -problems with marketing strategies and design	-value-added creation -competitive strategies -high productivity

Table 6: Factors that influence the competitiveness of the four industries

Flexibility

Regarding the flexibility of industries, it is divided into three groups, namely, (1) flexibility in marketing strategies and output, (2) flexibility in production processes, employment, and inventory management, and (3) flexibility in sources of funds.

Flexibility in marketing strategies and output

The automotive and processed-seafood industries have a high degree of flexibility in their respective marketing strategies. The two industries have diversified export destinations and, moreover, can launch new marketing campaigns or revise their existing marketing strategies (e.g., promotional strategies) to alleviate the economic downturn's negative effects on sales.

Parts manufacturers of the HDD and automotive industries are flexible in output, as their products can serve several industries that respond differently to economic conditions. Moreover, processed-seafood and jewelry firms sell diverse types and diverse qualities of product with varying degrees of income elasticity.

Flexibility in production processes, employment, and inventory management

HDD and automotive assemblers have an advantage from flexibility in production processes and inventory management because of the assemblers' ability to exploit the just-in-time production system. Meanwhile, parts manufacturers are inflexible in these areas because the assemblers pass on the impact of a decrease in sales orders to suppliers. The gem and jewelry industry is also inflexible in inventory management, resulting in a liquidity problem of the firms in the industry.

With the exception of the processed-seafood industry, the remaining three industries can easily lay off laborers in response to a reduction in production because of the practice of using either subcontracted workers or informal employment. Nevertheless, when sales orders rebound, the HDD and automotive industries have difficulty in rehiring workers at the operational level. The gem and jewelry industry faces a similar problem due to insufficient labor possessing required skills.

The processed-seafood industry has the least flexibility in employment. This is due to the industry's labor scarcity; thus, it is difficult for the industry to adjust its employment in response to a change in demand.

Flexibility in sources of funds

The HDD, automotive, and processed-seafood industries are flexible in finding and harnessing sources of funds because most firms in these industries occupy strong financial positions. Firms in all three industries can depend on both bank lending and retained earnings. In addition, HDD firms and auto assemblers can attain financial support from their parent companies while some firms in the processed-seafood industry rely on the stock market. Auto-parts manufacturers and gem and jewelry entrepreneurs, especially SME firms, are less flexible when it comes to sources of funding because these private-sector entities face strong restrictions governing financial institutions' credit approval. Table 7 shows aspects of the flexibility of the four industries.

Table 7: Flexibility of the four industries

HDD	Automobiles and Automotive Parts	Gem and Jewelry	Processed Seafood (Processed Shrimp and Canned Tuna)
-flexibility in sources of funds -flexibility in production processes (assemblers) -flexibility in output (parts manufacturers)	-flexibility in marketing strategies, production processes, and sources of funds (assemblers) -flexibility in output (parts manufacturers)	-flexibility in output (jewelry entrepreneurs) -inflexibility in sources of funds	-flexibility in marketing strategies and output -inflexibility in employment

Financial-statement Analysis

Liquidity Ratios

HDD assemblers have the highest liquidity performance, followed by automotive firms as reflected by their current and quick ratios. Firms in the industry encompassing gems and jewelry have a moderate level of liquidity but a high gap between their current and quick ratios, implying that a large proportion of the industry's current assets are inventories, which are relatively illiquid. HDD-parts manufacturers and processed-seafood entrepreneurs have the lowest levels of liquidity among all industries in consideration. However, they have high ratios in inventory turnovers and in accounts-receivable turnovers respectively, thereby preventing the industries from falling into a liquidity crush. It is worth noting that there is a huge difference in liquidity performance among automotive and gem and jewelry firms.

Efficiency and Profitability Ratios

HDD firms and automotive assemblers gain the highest profitability rate due to their low operating costs and economies of scale. Automotive-parts manufacturers and gem and jewelry firms experience high operating costs and low asset turnovers but manage to exhibit reasonably good profitability because these industry exponents' products possess high value-added numbers and markups. The processed-seafood industry has the lowest markups among the four industries owing to the industry's homogeneous goods and price competition.

Financial-leverage Ratios

HDD firms and automotive assemblers have a low proportion of debt financing. Most of the debts are short-term. Also, the industries have high interest coverage ratios, indicating a very low chance of default. The automotive-parts manufacturers and the jewelry entrepreneurs rank as the second-most debt-dependent firms, followed by firms in the processed-seafood industry. The three industries have a moderate fraction of debt financing, but only the firms in the processed-seafood industry have an interest coverage ratio that is lower than the other. However, because the processedseafood industry occupies a strong liquidity position, the default risk of firms therein is still low. Out of the four industries under our consideration, gem entrepreneurs have the highest levels of leverage because of the inflexibility characterizing these entrepreneurs' handling of sources of funding. The financial structure of the gem firms consists of mostly short-term debt. Together with the lower interest coverage ratios, the excessive debt-dependency implies that the gems and jewelry industry has the highest default risk among our sampled industries. Table 8 summarizes our financial-statement analyses of the industries.

Financial	HDD		Automobiles and Automotive Parts		Gem and Jewelry		Processed Seafood
Ratios	Assembler	Parts	Assembler	Parts	Gem	Jewelry	(Processed Shrimp and Canned Tuna)
Liquidity	Good	Moderate	Good	Good	Moderate	Moderate	Moderate
Efficiency and Profitability	Good	Good	Bad	Moderate	Bad	Bad	Bad
Financial Leverage	Good	Good	Good	Moderate	Bad	Moderate	Good

Tabl	le 8:	Summary	of fina	ncial-sta	atement	analy	yses
		- 1					

Foreign Exposure

All four industries are highly export dependent, with G3 markets serving as the industries' main destinations; a significant result of this dependence has been direct trade effects deriving from the subprime crisis. With their production in the form of IPNs, the HDD and automotive industries have suffered from the crisis via an indirect trade channel, as well. Furthermore, some firms in the automotive industry have faced difficulties in gaining access to sources of funds when the firms' parent companies have filed for bankruptcy (a situation requiring the subsidiaries to change their financing policy abruptly, inaugurating a shift from the parent companies' support to domestic financial institutions' support).

Finally, the study finds that the processed-seafood industry has the most diversified export markets and that their products are necessary goods, which leave the subprimecrisis effects at par.

Table 9 presents details on the foreign exposure of each industry.

Table 9: Foreign exposure of the four industries

HDD	Automobiles and Automotive Parts	Gem and Jewelry	Processed Seafood (Processed Shrimp and Canned Tuna)
-high export dependency -participation in an IPN -financial support from parent companies	-dependency on domestic and export markets in almost the same proportion -participation in an IPN -financial support from parent companies -bankruptcy of parent companies disrupting firms' financial policy	-high export dependency with the G3 as main export markets	-high export dependency but markets are diversified

As mentioned earlier, the current study employs fundamental analysis to investigate factors determining industries' resistance to the recent economic downturn. These factors include competitiveness, flexibility, and financial positions. In addition, foreign exposure of industries indicates the vulnerability of industries to external shocks. Combining the results of these two frameworks allows us to determine industries' strength and survival during the time of crisis. From the frameworks, the four industries can be categorized as shown in Table 10.

•

	Strong fundamental factors	Weak fundamental factors
High foreign exposure	HDD	Gem and jewelry
	Automobiles and Automotive	
	Parts	
Low foreign exposure	Processed seafood (Processed	
-	Shrimp and Canned Tuna)	

Both the HDD and automotive industries have strong fundamental factors arising from high productivity, flexibility in production processes and output, a strong liquidity position, and high profitability. However, these two industries also have a high degree of foreign exposure from export dependency and from participation in IPNs. As for the automotive industry, some of the parent companies in the United States have filed for bankruptcy, which inevitably affects their subsidiaries in Thailand, especially via a decrease in financial support.

The two industries faced a severe impact from the subprime crisis at its peak, owing chiefly to their high foreign exposure. Nevertheless, the industries' strong fundamental factors have strengthened the industries' resistance to the crisis.

Processed seafood is another industry with solid fundamental factors due to valueadded creation, high productivity, and flexibility in marketing strategies and output. Although the industry has a high degree of export dependency, its products are income inelastic, a characteristic that limits the level of impact from foreign exposure. As a result, the subprime crisis registered only mild negative effects on the industry.

The gem and jewelry industry possesses weak fundamental factors especially from inflexibility in sources of funds, inventory management, and marketing; these combined inflexibilities result in a fragile financial position. The industry also suffers from high foreign exposure, with export destinations concentrated in G3 countries. Therefore, among the four industries under consideration, the industry encompassing gems and jewelry suffered the highest impact of the crisis.

In conclusion, industries with strong fundamental factors and low foreign exposure face limited impact from the crisis. High foreign exposure leaves industries vulnerable to external shocks. However, if industries have strong fundamental factors, they can withstand the crisis impact. The industries with weak fundamental factors and high foreign exposure are the most fragile ones and experience severe effects of the crisis that might cause some firms in such industries to shut down.

8.2 Comparative analysis at a firm level

In this section, the study identifies important characteristics of firms that have contributed to crisis resistance. To do so, the study employs regression analysis using the data from field surveys of 44 firms in the four sampled industries. We also separate the effects of the subprime crisis into two categories of effects: the effects only on sales and the total effect (the second of which is a combination of all effects on sales, on exchange-rate fluctuation, and on the accessibility of funding sources).

Effects on sales

Table 11 presents the regression results of the relationship between business characteristics and the subprime-crisis effects on sales.

Factors	Coefficient	t-statistic	p-value
Constant	7.135	6.994	0.000
Value-added creation	-0.347	-2.291	0.028
Flexibility in marketing strategies	-0.491	-3.257	0.003
Flexibility in production processes, employment, and	-0.386	-2.070	0.046
inventory management			
Net profit	-0.341	-2.543	0.016
Total-debt-to-total-asset ratio	0.270	2.033	0.050
Foreign exposure	0.372	2.551	0.015
R square		0.659	
Adjusted R square		0.598	
Standard error of the estimate		0.887	

Table 11: Factors associated with the effects on sales

From the regression analysis, business characteristics that are significantly associated

with the effects of the crisis on sales comprise the following elements:

1. Value-added creation

The firms with the ability to imbue their products with high value-added benefits can effectively build brand loyalty among their consumers and can create their own market segmentation, resulting in lower sales fluctuations in the face of an economic crisis akin to the recent financial meltdown.

2. Flexibility in marketing strategies

Firms can revise or launch their own marketing strategies to alleviate the crisis effects. Examples of effective marketing strategies are sales promotion, market diversification, a change in distribution channels, and a launch of new products.

3. Flexibility in production processes, employment, and inventory management

When flexible in production processes, employment, and inventories, firms can easily and promptly alter their production and employment in response to a change in sales orders and, furthermore, can do so with lower adjustment costs. Moreover, firms can shift their production toward products that appear to be relatively buffered from crisis effects.

4. Net profit

Net profit reflects firms' profitability and operational efficiency. The effects of the crisis on sales are more severe for firms with low net profit than for firms with high net profit because the former type of firm has lower markup buffers against sales fluctuations. Also, higher net profit indicates higher market power, which usually comes together with loyal customer bases.

5. Total-debt-to-total-asset ratio

During the crisis, highly leveraged firms have had more difficulty in accessing bank credit; hence, they may have lacked sufficient funding to operate their business or to carry out strategies capable of alleviating the negative effects of the subprime crisis on sales.

6. Foreign exposure

Foreign exposure through both export dependency and IPNs makes firms vulnerable to effects of an economic crisis originating from abroad. Therefore, firms with high foreign exposure are likely to encounter relatively severe effects on sales.

Total effects

Table 12 presents the business characteristics associated with the total effects of the subprime crisis on firms.

Table 12: Factors associated with the total effects

Factors	Coefficient	t-statistic	p-value
Constant	1.546	3.840	0.000
Flexibility in marketing strategies	-0.249	-2.824	0.008
Flexibility in sources of funds	-0.375	-4.683	0.000
Quick ratio	-0.201	2.561	0.015
Foreign exposure	0.228	2.433	0.020
R square		0.672	
Adjusted R square		0.635	
Standard error of the estimate		0.5336	

The following factors are associated with the total effects:

1. Flexibility in sources of funds and quick ratios

Liquidity has always been the most crucial factor in determining the survival of firms under the pressures of an economic crisis. Firms with relatively high flexibility regarding funding sources and quick ratios tend to have strong tolerance of economic crises, as it is harder for these firms to encounter a credit crunch that would force them to shut their doors.

2. Flexibility in marketing strategies

Flexibility in marketing strategies allows firms to change their product composition, diversify market destinations, or launch promotion campaigns, all of which could alleviate the impact of a crisis.

3. Foreign exposure

The higher the degree of foreign exposure, the more vulnerable a firm becomes to impact from abroad via direct and indirect trade channels. Such higher degrees also lead to financing problems for the firms depending on funding support from the parent companies. Also, the firms encounter higher risk from exchange-rate fluctuation.

Characteristics of a given industry's firm

In the previous section, we consider overall firm characteristics that strengthen firms' resilience to economic crises. In this section, instead, we consider the specific strategies contributed to firms' strengths in each industry.

The HDD industry

Competitive strategies, R&D activities, and flexibility in output and sources of funding are important for HDD firms as they strive to withstand the impact of an economic downturn.

Competitive strategies allow firms to establish both a clear marketing position and loyal customer bases, which bring about lower business-cycle fluctuations. Flexibility in output helps firms to diversify their products in several customer groups hit differently by the crisis. In addition, process R&D increases firms' productivity and lowers the operating costs. Finally, flexibility in sources of funding provides firms with sufficient liquidity to survive a crisis.

Table 13 summarizes characteristics and strategies that firms in the HDD employ.
Characteristics	Strategies
Competitiveness	
Competitive strategies	 vertical integration technological leadership product diversification such as HDDs for personal computers and consumer electronics
R&D	 construction of failure-analysis labs in order to improve production processes process R&D to improve production efficiency cooperation with NECTEC and universities in conducting process R&D the use of automation systems instead of laborers the development of a business model for management, human-resource development, and efficiency improvement the possibility of using materials from domestic suppliers
Flexibility	
Flexibility in output	 production of HDDs for different market segments such as HDDs for servers, desktops, laptops, and consumer electronics production of parts and components that can be used in other industries (e.g., automobiles or electronic and electrical appliances)
Flexibility in sources of funding	 sources of funding from retained earnings and parent companies

Table 13: Characteristics and strategies that strengthen firms in the HDD industry

Automotive industry

As for automotive firms, the factors contributing to their strengths and the factors minimizing the negative subprime-crisis effects on these firms are productivity, flexibility in marketing strategies, and foreign exposure. Flexibility in marketing strategies allows firms to launch promotion campaigns or to diversify export destinations—practices that lessen the impact from a crisis. Foreign exposure also plays an important role therein. For instance, if an IPN or a parent company has taken damaging hits from an economic crisis, then a firm's membership in the IPN or a

firm's subsidiary status in a parent company inevitably weakens that firm's resistance to the crisis.

Table 14 presents strategies that firms in the automobile industry use to strength themselves.

Table 14: Characteristics and strategies that strengthen automotive-industry firms

Characteristics	Strategies
Competitiveness	
Productivity	- the use of automation and robotic systems instead of laborers
Flexibility	
Flexibility in marketing strategies	Assemblers - sale of imported models not previously being sold in the country - customer-geared promotion campaigns such as 1-year of free car insurance or longer interest-free periods - CNG (compressed natural gas) cars Parts manufacturers - production of parts for both OEM and REM markets - production of parts used with various models - production of parts used with various models
Foreign exposure	 reliance on domestic and export markets participation in an IPN that is resilient to crises sources of funds from retained earnings or domestic financial institutions

Gem and jewelry industry

The business characteristics that have alleviated the negative effects of the recent subprime crisis on the gem and jewelry industry can be divided into three groups: marketing factors, production factors, and foreign exposure.

1. Marketing factors

Value-added creation, competitive strategies, R&D, and flexibility in marketing strategies allow firms to create product designs that have high value-added benefits and that better conform to consumer demand. These factors also create their own customer bases and brand loyalty, leading to lower sales fluctuations.

2. Production factors

The production factors comprising productivity, flexibility in input and inventory management, and flexibility in output contribute to firms' strengths. High productivity and flexibility in output result in lower costs of production and higher profitability. Flexibility in input and inventory management lowers the risks of input price fluctuation and of liquidity problems.

3. Foreign exposure

Diversification of export markets can reduce dependency on G3 countries and, hence, can insulate firms from exposure to foreign-generated economic crises.

Table 15 presents the strategies that the industry's firms adopt to better withstand an economic crisis.

Characteristics	Strategies
Competitiveness	
Value-added creation	 gem enhancement by heat treatment cutting and polishing techniques especially cutting for high-end products brand creation attractive packaging sales of special collections of color stones gem and jewelry designs for customers
Competitive strategies	 participation in international fairs consumer-behavior research and the use of such information to design new products creation of a close relationship with consumers improvement in quality to avoid price competition from rival countries possessing lower wages
Productivity	 the use of computer program in cutting the use of machines in producing gold jewelry relocation of production bases to other countries possessing lower wages
R&D	 market-trend research for product-design improvement unique design product design that uses less precious metal
Flexibility	
Flexibility in marketing strategies	 diversification of markets and export destinations various choices of products, especially products with modern designs products of varying quality diverse distribution channels such as retailers, department stores, the Internet, and TV
Flexibility in output	 production of gold and silver jewelry or authentic and imitation jewelry
Flexibility in input and inventory management	 ordering precious metals only upon receipt of customer orders reuse of precious metals held in stock modify inventory into new products adjust input orders and inventories according to market trends diversification of export markets
r oreign exposure	- diversification of export markets

Table 15: Characteristics and strategies that strengthen the firms in the gem and jewelry industry

The process-seafood industry

Processed-seafood firms constitute an industry with low markups; consequently, productivity and flexibility (1) in funding sources and (2) in input and inventory management are crucial factors enabling firms to lower their costs of production and to have sufficient liquidity when conducting business during an economic crisis. Also, by shifting firms' production to income-inelastic products, output flexibility alleviates the negative effects of crises.

Table 16 presents the strategies that help strengthen firms in the processed-seafood industry.

Characteristics	Strategies
Competitiveness	
Productivity	 the use of information technology in management the use of machines instead of laborers process R&D coordination with shrimp farmers regarding the quality standards of input vertical integration so as to control input quality relocation of production bases to other countries to benefit from lower labor costs
Flexibility	
Flexibility in output	 economy-sized products product variety such as ready-to-eat and ready-to-cook products
Flexibility in input and inventory management	 ordering raw materials only upon receipt of customer orders stocking raw materials when their prices drop
Flexibility in sources of funding	 reliance on retained earnings and the stock market

Table 16: Characteristics and strategies that strengthen the firms in the processedseafood industry

Summary

Overall, the important characteristics in alleviating the impact of the recent subprime crisis on Thai firms have been their financial and liquidity positions, their flexibility in marketing strategies, their flexibility in employment, their flexibility in inventories, their high profitability, and their foreign exposure.

Financial and liquidity positions of the firms have determined whether they have had sufficient financial resources to carry on their business and to adjust their marketing strategies and output while endeavoring to lessen the impact of the crisis. Flexibility in employment and production processes has allowed Thai firms to operate more efficiently and has resulted in relatively high profitability. Significant foreign exposure is a crucial factor that has rendered Thai firms more vulnerable to the negative effects of the crisis originating abroad.

Upon considering the important characteristics by industry, we can see that industries differ from one another regarding their respective characteristics' resistance to the crisis. Because the HDD industry in Thailand has been an important production base in the surrounding IPN, the firms in the industry have acquired a high degree of competitiveness in production. As for the automotive industry, which also depends on the Thai domestic market, marketing strategies are additional characteristics that have strengthened the corresponding firms' resistance during the crisis. Next, the firms in the gem and jewelry industry have created business strength by creating value-added benefits through the enhancement of production techniques and through the use of skilled labor. Finally, for the processed-seafood industry, both high productivity and

product variety are important factors enhancing the firms' resilience in dealing with the downturn.

9. Policy implications

This section draws policy implications from the quantitative and qualitative analysis herein to strengthen the Thai economy—and, specifically, its industries and firms—in the event of a future economic crisis. Policy recommendations can be divided into two parts according to the implementation period. The first part deals with the short-term policies serving to reduce the severity of an economic downturn's negative effects. The second part of the policy-recommendation section focuses on strengthening Thai industries in the long run, with the goal of bolstering the industries' resistance to future crises.

9.1 Short-term policies

The aim of short-term policies is to provide industries with relief from the immediate negative effects of an economic downturn, namely, liquidity problems, exchange-rate fluctuation, and layoffs.

1. Provision of liquidity assistance to firms

As mentioned in the previous section, liquidity is a key factor determining firms' survival at the time of crisis. A sharp drop in sales and inaccessibility of bank loans can trigger a liquidity crisis and force firms to shut down their businesses even though the liquidity problems are temporary.

The government should provide a liquidity-assistance program to firms and should offer them—especially SMEs, which have relatively little flexibility in harnessing funding sources—such help as credit guarantees.

2. Reducing exchange-rate fluctuation

Exchange-rate fluctuation can severely affect export-oriented industries, particularly those in which firms have low profit margins or are SMEs. As a result, the government should attempt to stabilize the exchange rate in order to reduce the associated risks to which entrepreneurs are susceptible.

3. Measures to slow down layoffs

Another immediate outcome of an economic crisis is layoffs. Some industries might not be able to decrease their workforce immediately, and other industries may find it difficult to rehire workers when sales orders rebound. Also, there is an additional cost for firms in training new workers, especially for the posts requiring skilled employees.

The government can slow down layoffs by providing direct subsidies or tax incentives to the afflicted firms in order to improve workers' productivity and skills when the sales orders are down.

9.2 Long-term policies

There are several measures that the government can employ to strengthen industries in the long run in the face of possible future crises.

1. The promotion plan for exporting industries

Highly export-dependent industries are vulnerable to economic crises originating from abroad. To increase these industries' resilience in the future, the government should promote exporting industries that can also rely on the Thai domestic market, that have a high degree of a product variety, and that have diversified trading partners. Such industries tend to suffer smaller direct impacts from foreign exposure than do industries that lack these characteristics.

2. Infrastructure improvement

The Thai government can improve the quality and the quantity of infrastructure such as public utilities, communication and transportation systems, and logistics systems, especially rail networks and maritime networks. These will reduce firms' operating costs and lead time. In addition, better infrastructure improves firms' flexibility in production processes and in inventory management as well as increases firms' profitability. Moreover, the improvements will encourage MNCs to relocate or to expand their production base in the country.

3. Education policies serving long-run industry development

Skilled labor has been a crucial factor determining the competitiveness of Thai industries and of Thailand itself. In planning the education policy, the government should closely monitor the industrial sector's labor needs and should design curricula that produce workers possessing skills and knowledge suitable for Thai industries' requirements. Such a policy will also help to reduce labor shortages and unemployment.

4. Attractive investment-promotion policy

Nowadays, Thai investment-promotion policy is less attractive than comparable policies in neighboring countries, is burdened with excessive bureaucracy, and is troubled by conflicting sub-policies and guidelines from different government agencies. The government can improve Thailand's investment-promotion policy by (1) setting up a one-stop service that provides timely and accurate information regarding policy-and-implementation processes, (2) extending the investment-promotion period to prevent the relocation of MNCs, (3) eliminating quantity restrictions, and (4) promoting a transparent tax collecting procedure and better understanding among the related government agencies.

5. Industrial risk-assessment system

During the recent subprime crisis, financial institutions were and remain highly, perhaps even overly, cautious regarding credit approval because these institutions lacked knowledge of firms' true financial status and risks. This problem has contributed to liquidity crises in some firms, even though they have had a sound performance. The asymmetric-information problem can be resolved via the creation of an industrial risk-assessment system. The system allows firms with strong fundamental factors to be able to access bank credit and to alleviate short-term liquidity shortages. The system also helps the government prioritize industries that require governmental financial assistance in the context of a financial meltdown.

6. SMEs' access to hedging instruments

SME firms hardly ever use hedging instruments because the firms typically lack knowledge in risk management, lack access to such instruments, and must incur significant expenses to use the instruments if available. Moreover, to purchase hedging instruments, SME firms must complete several sets of documents whose compliance requirements are extremely difficult to meet.

The government can promote better understanding among entrepreneurs regarding exchange-rate risk management and the availability of hedging instruments by setting up an information center that can guide entrepreneurs with related information procedures. The government can also encourage commercial banks to be more aggressive when employing marketing strategies for hedging instruments. In addition, a reduction in required paperwork might persuade firms to use more hedging instruments.

7. Reducing excessive bureaucracy and red tape

Excessive bureaucracy increases both operating costs and expended time for entrepreneurs. The government can eliminate rigid conformity to redundant rules, excessive regulation, and unnecessary paperwork in order to reduce the red-tape problem. Also, the government can accelerate the process by avoiding the presence of multiple officers or committees in the approval-decision process.

10. References

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