ANALYZING FIRM PERFORMANCE IN THE THAI PROPERTY-LIABILITY INSURANCE INDUSTRY

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Introduction

Insurance was first introduced into Thailand in the early 1900s. In 1939, all foreign insurance companies left Thailand following the outbreak of the Second World War. In 1949, American International Assurance, a subsidiary of AIG, was the first foreign company to return to Thailand after the cessation of hostilities. In Thailand, property-liability insurance policies are classified as fire insurance, hull and cargo insurance, automobile insurance and miscellaneous insurance.

Although in 2003 the Thai non-life insurance sector is very crowded with 72 direct insurers (66 domestic and 5 foreign insurers, 6 health insurers and 2 reinsurers) the Thai property-liability insurance market is quite concentrated. The concentration ratio of the top four firms between 1998 and 2005 was approximately 36 percent. Viriyah Insurance, concentrating on automobile insurance, has had a highest market share and recently had a 13.47 % market share. The non-life insurance written premium in 2005 was 115.1 billion baht (approximately US$2.86 billion). The non-life insurance penetration ratio (premiums to GDP) was 1.62 % in 2005 (Swiss Re, 2006). Non-life insurance density (premiums per capita) was US$44.4 per capita in 2005 (Swiss Re, 2006). For comparison, the US non-life insurance penetration was 5.01% of GDP and non-life insurance density was US$2,122 per capita (Swiss Re, 2006). For the next 10 years from now the non-life growth rate is expected to be 10.2% annually (Swiss Re, 2004).

The Thai insurance market has long been protected from international participation, limiting foreign shareholdings in domestic companies to a maximum of 15 percent and restricting newly licensed insurance companies according to the Non-life and Life Insurance Act in 1983. However, Thailand is a member of the World Trade Organization (WTO) and is committed to liberalization of its insurance industry in accordance with General Agreement in Trade and Services (GATS). As a result, since 1992, Thailand has progressively liberalized its insurance market.

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In 1992, the limited foreign equity restriction was increased to 25 percent by the Non-Life and Life Insurance Act of 1992. In 1997, after a 15-year restriction on new licenses, 28 new insurance companies--12 life and 16 non-life insurance companies--received an approval to operate. In addition, to favor further liberalization, Thailand planned to increase the foreign ownership limit to 49 percent and finally remove remaining foreign ownership restrictions. Recently the Thai insurance market has been forced to be more liberalized by the Free Trade Agreement (FTA) which Thailand has with many countries, especially the USA. Therefore, the internationalization of the Thai insurance industry may be finally inevitable. The emergence of new firms both domestically and internationally are expected to bring pressure on all firms in the industry to increase operational efficiency.

Consistent with economic theory, it predicts that in long-run competitive equilibrium the price of a good or service will equal the minimum average costs associated with the most efficient production technology. Therefore, competition of businesses is expected to put heavy pressure on insurance firms to increase operational efficiency. Any deviation from cost-minimizing or profit-maximizing strategies and inefficient technologies will force firms out of the market, in the long run. Foreign insurers may directly bring new and better management techniques, know-how, skills, training procedures, and technology to the domestic market and may indirectly enhance domestic insurer efficiency by stimulating competition in the domestic market. The overall direct and indirect effect of liberalization is a reduction in insurer overhead expenses and/or an increase in insurer businesses and services.

Efficiency of operations requires firms to (1) select an output mix that fully exploits economies of scale and (2) select an input mix that minimizes usage (technical efficiency) and uses the best combination (allocative efficiency). Efficient insurance markets are better at allocating resources and at enhancing consumer choice and value than are inefficient markets.

Potential cost savings arising from *overall or cost* efficiency in the insurance industry are important to both firm managers and regulators. Information about the size of such efficiencies is important because it may assists regulators and insurance companies since the worst practice, relative to the best practice, may not be able to survive in the long run. As a result, if the problem is detected early, the adverse economic impact caused by financially inefficient insurance companies on economic welfare can be minimized.

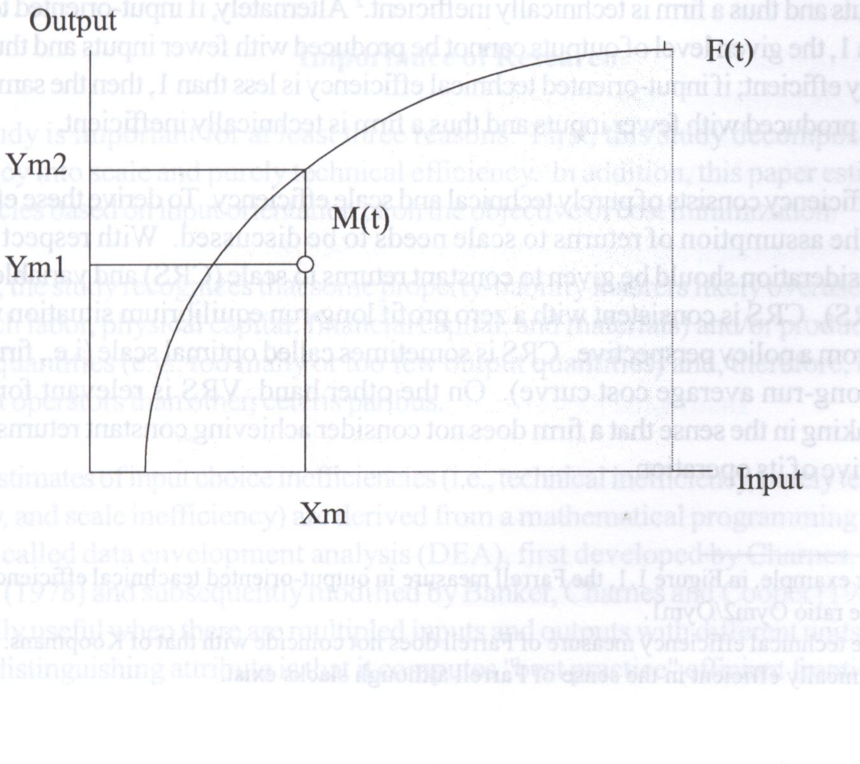
In addition, to be able to pinpoint more precisely how an insurer is inefficient (e.g., excessive input usage and wrong output quantities production) and the absolute size of the inefficiency (technical, purely technical and scale) can lead insurers to adopt a less costly alternative conduct. This assists insurers in operating more efficiently and in competing domestically and internationally. With increased competition, insurers have greater motivation to generate new and innovative products, to be more responsive to customer needs and desires, to offer better and broader range of quality goods and services, and to seek less costly means of marketing to and servicing customers.

Efficiency Concepts

In efficiency analysis, the production function is interpreted not only as a relationship between inputs and outputs, but also as the frontier of a set called production set. A point lying on the frontier is characteristically one that corresponds to the maximum achievable quantity of the output for any given level of input. Production functions, F(t), therefore show the maximum amount of inputs required to achieve the given output levels.

Figure 1.1, a production set (shaded) and production frontier (in bold) are represented in the case of one input and one output. A distinction then naturally follows between productive activities in the production set. Every productive activity lying on the frontier is defined as fully efficient while those lying below are considered to be inefficient. If firm M is operating at point (xm,ym1), it could operate more efficiently by moving to the frontier; i.e., be adopting state-of-the-art technology, to point (x_m,y_{m2}).

Figure 1.1
The Production Frontier for a Single Input-Single Output Firm



Efficiency Measurement
Modern efficiency measurement begins with Farrell (1957) who extended the work initiated by Koopmans (1951) and Debreu (1951). Farrell (1957) measured operating efficiency, as reciprocals of distance functions providing a radial measure of the distance, by a comparison between observed and optimal values of its output and input. Efficiency can refer to the proficiency with which inputs to the production process are converted to outputs of the process, in which case it is referred to as technical (or total) efficiency. Farrell (1957) first provided a partial decomposition of cost or overall efficiency into technical and allocative efficiency.

Overall or cost inefficiency measures the equi-proportionate reduction in costs which could have been attained had a production unit been both technically and allocatively efficient. Price or allocative efficiency refers to the ability to combine inputs and outputs in optimal proportions in light of prevailing prices. Thus the allocative inefficiency measure gives the proportionate reduction in costs if the optimal combination of inputs had been utilized.
Technical efficiency reflects the ability of a firm to avoid waste by producing maximal output as input usage allows. It can be measured by the ratio of maximum potential to observed output obtainable from the given input.[1] Alternatively, technical efficiency of a production unit refers to the minimal deployment of inputs, given the productive technology. Technical efficiency also can be measured by the ratio of minimum potential to observed input required to produce the given output. In these two types of orientation, the optimum is defined in terms of production possibilities. If output-oriented technical efficiency is 1, the given level of inputs cannot be employed to produce higher outputs and thus a firm is technically efficient; if output-oriented technical efficiency is greater than 1, then the same input level can be used to generate higher outputs and thus a firm is technically inefficient.[2] Alternately, if input-oriented technical efficiency is 1, the given level of outputs cannot be produced with fewer inputs and thus a firm is technically efficient; if input-oriented technical efficiency is less than 1, then the same output level can be produced with fewer inputs and thus a firm is technically inefficient.

Technical efficiency consists of purely technical and scale efficiency. To derive these efficiency measures, the assumption of returns to scale needs to be discussed. With respect to scale returns, consideration should be given to constant returns to scale (CRS) and variable returns to scale (VRS). CRS is consistent with a zero profit long-run equilibrium situation which is important from a policy perspective. CRS is sometimes called optimal scale (i.e., firms operate on the long-run average cost curve). On the other hand, VRS is relevant for private decision making in the sense that a firm does not consider achieving constant returns to scale as an objective of its operation.

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[1] For example, in Figure 1.1, the Farrell measure in output-oriented teachnical efficiency of M(t) is given by the ratio Oym2/Oym1.

[2] The technical efficiency measure of Farrell does not coincide with that of Koopmans. Observations are technically efficient in the sense of Farrell although slacks exist.

Based on scale returns, technical efficiency can be decomposed into purely technical and scale efficiency. *Purely technical efficiency* is calculated as the largest proportionate output increase relative to the VRS that allows for a backward-bending production frontier and thus forms the convex production set (Fukuyama, 1997). Purely technical efficiency indicates how close a firm is to operating at the VRS technology. *Scale efficiency*, referred to also as output efficiency, exists because firms produce the optimizing output level. Similar to technical efficiency, purely technical and scale efficiency take a value of 1 if they are efficient; otherwise the value is less than 1.

A relation among these efficiency measures can be shown as the technical efficiency decomposition:

Technical efficiency (TE) = Purely technical efficiency (PTE) Scale efficiency (SE) (1.1)

which states that technical efficiency is a composite of scale and purely technical efficiency. The decomposition into purely technical and scale efficiency is used to determine sources of technical efficiency.

Purpose of the Study

The purpose of this study is to determine Thai property-liability insurer efficiencies (e.g., technical efficiency, purely technical efficiency, and scale efficiency) from 1998 (after liberalization) until the most recent year of the availability of data.

Importance of Research

This study is important for at least three reasons. First, this study decomposes technical efficiency into scale and purely technical efficiency. In addition, this paper estimates these efficiencies based on input orientation or on the objective of cost minimization.

Second, the study recognizes that some property-liability insurers likely overuse inputs (e.g., too much labor, physical capital, financial capital, and materials) and/or produce the wrong output quantities (e.g., too many or too few output quantities) and, therefore, they are less efficient operators than other, ceteris paribus.

Third, estimates of input choice inefficiencies (i.e., technical inefficiency, purely technical inefficiency, and scale inefficiency) are derived from a mathematical programming framework, usually called data envelopment analysis (DEA), first developed by Charnes, Cooper and Rhodes (1978) and subsequently modified by Banker, Charnes and Cooper (1984). DEA is especially useful when there are multipled inputs and outputs with different units of measure. DEA's distinguishing attribute is that it computes "best practice" efficient frontiers based on convex contributions of firms in the industry. Therefore, DEA provides relative rather than absolute efficiency measures. Since a theoretically efficient firm's cost structure is not fully known, relative rather than absolute efficiency measures may be more useful for empirical purposes.

Since DEA focuses principally on technological aspects of the production correspondences, it provides a particularly convenient method for decomposing technical efficiency into purely technical efficiency and scale efficiency. The technical and scale efficiency can be estimated without requiring estimates of input and output prices.

This research expands the body of knowledge related to efficiency of the property-liability insurance industry in developing countries. Despite the importance of the efficiency of a country's property-casualty insurance market, not many studies have examined this issue especially in developing countries. In addition, little work has been done as to whether insurance industries operate efficiently at the individual firm level. In examining efficiency, the work of Farrell (1957) stands out. He stated

> The problem of measuring the productive efficiency of an industry is important to both the economic theorist and the economic policy maker. If the theoretical arguments as to the relative efficiency of different economic systems are to be subjected to empirical testing, it is essential to be able to make some actual measurements of efficiency. Equally, if economic planning is to concern itself with particular industries, it is important to know how far a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources.

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Insurance Review of Literature on Efficiency

Using traditional approach to measure the operating result of the property-liability insurance industry, the high loss ratio indicates lower profitability and thus efficiency. Financial ratio approach is also frequently used to assess the efficiency of the company. A higher expense ratio and lower return on equity or lower return on invested asset ratio show inefficiency. The literature on property-liability insurance efficiency is less developed than that on banking efficiency. The pioneering property-liability insurance cost literature typically focused exclusively on scale and scope economies (Allen, 1974; Doherty, 1981; Hammond, Melander and Shilling, 1971; Joskow, 1973; Suret, 1991, and Quirin, Halpern, Kalymon, Mathewson, and Walters, 1974). Some recent studies of insurance cost functions primarily focused on efficiency (Berger, Cummins, and Weiss, 1997; Boonyasai, Grace, and Skipper, 2004; Cummins and Weiss, 1993; Cummins and Weiss, 2001; Cummins, Weiss, and Zi, 1999; Leverty, Lin, and Zhou, 2004; Weiss, 1991, and Wolff, 1991). With the rapid evolution of frontier efficiency methodologies, interest in analysis of cost efficiency of insurers has grown rapidly but still focus mainly on a single and developed country (see Cummins and Weiss, 1998).

A limited study has focused on developing insurer efficiency. Boonyasai, Grace and Skipper (2004) use DEA to examine the effect of liberalization and deregulation on the efficiency of four life insurance markets: Korea, the Philippines, Taiwan, and Thailand. Jeng and Lai (2003) and Leverty, Lin, and Zhou (2004) analyze efficiency of the Chinese insurance industry.

Methodology

This research uses data envelopment analysis (DEA), a mathematical programming approach. DEA imposes somewhat less structure on the optimization problems; i.e., neither functional form of technology nor inefficiency assumptions is required. In addition, the mathematical programming method does not require a large data set to estimate the coefficient of a cost or revenue function. Therefore, DEA is able to handle relatively small sample size which is suitable for the Thai property-liability insurance market. Additionally DEA allows for convenient decomposition of technical efficiency (TE) into purely technical efficiency (PTE) and scale efficiency (SE) as described above.

DEA is a non-parametric method that compares each firm in the industry to a "best-practice" efficient frontier formed by as a convex combination of the most efficient firms in the sample group. DEA is appropriately named since it truly envelops the entire data set making no accommodation for random noise outside the control of decision making unit's (DMU's). DEA uses a standard linear programming technique to pinpoint peer groups of efficient firms for each firm or decision making unit (DMU) being evaluated. A firm is fully efficient having efficiency score equal to 1.0 if it lies on the frontier and inefficient having efficiency score less than 1 if it is not on the frontier, which means that its inputs could be used less comparing to another efficient firm or firms.

DEA has been widely used to measure efficiency for financial institutions (see Berger and Humphrey, 1997). DEA methodology is widely utilized and it is also extensively outlined in insurance studies; e.g., Boonyasai, Grace, and Skipper, 2004; Cummins and Zi, 1998; Cummins and Weiss, and Zi, 1999; Cummins, Tennyson, and Weiss, 1999: Cummins and Weiss, 2001: Cummins and Nini, 2002; Jeng and Lai, 2003; and Leverty, Lin, and Zhou, 2004). This study therefore adopts DEA to analyze the Thai property-liability insurance industry for many reasons as stated above.

Data and Measurements of Outputs and Inputs

The data used in this study are drawn from the annual reports filed by insurers in Thailand. Data were collected as from 1998 until 2003-the most recent year of availability of data. Not all firms in the population can be used due to data irregularity and restrictions required by the methodology used in this paper. Thus companies are eliminated if the integrity of the data is questionable or if the methodology does not accommodate negative figures. For example, firms with negative financial capital are excluded.[3] Inappropriate data are adjusted. For example, negative summation of loss incurred and loss adjustment expenses are truncated at zero.

For each year, the number of firms in the Thai property-liability insurance samples is shown in Table 1. All financial statements in the annual report are reported in the local currency-Baht (THB).

Table 1: Number of the Thai Property-Liability Insurance Firms Used As Sample

Year	1998	1999	2000	2001	2002	2003	1998-2003
# of firms	72	69	69	70	67	66	413

Inputs

Usually, inputs are easier to identify and measure relative to outputs in the insurance industry since the units of measurement tend to be tangible or at least directly observable. In addition, insurance inputs, unlike outputs, tend to be similar for life and property-liability insurance companies. Thus the same input definitions are used for both types of insurers. Cost studies in insurance most commonly employ three inputs (Cummins, Tennyson, and Weiss, 1999; Cummins, Turchetti, and Weiss, 1996; Cummins and Weiss, 1993; Cummins and Zi, 1998; Gardner and Grace, 1993; Grace and Timme, 1992; Leverty, Lin, and Zhou, 2994; and Weiss, 1986). This study categorizes inputs of a property and liability insurance company into labor, business services and materials (including physical capital), and capital, following previous literature.

Labor input consists of the company's employees, agents and brokers. Agents and brokers are primarily responsible for marketing the insurers' product while employee labor includes all management and clerical workers. Labor input volume for employees and agents for each

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[3] Fifteen of 428 observations had negative capital and surplus during 1998-2003.

company is obtained by summing all wages, salaries and benefits provided to all employees and commissions and benefits paid to agents and brokers.

Capital can be grouped into financial equity capital and debt capital following previous efficiency literature. Financial equity capital is considered an important input in the theory of the firm and financial institutions studies (McAllister and McManus, 1993; Berger, Cummins, and Weiss, 1997; Hughes and Mester, 1998, and Hughes, Mester, and Moon, 2001). Additionally, besides satisfying regulatory requirements, financial equity capital is a crucial input in insurance in reducing firm's insolvency risks (Cummins and Danzon, 1997). This is because insurers must maintain equity capital to ensure policyholders that they will receive payment even if experience is below expectations. More capital implies a higher probability that losses will be paid if losses are higher than expected. As a result, financial capital more closely represents the real capital used in producing output. The volume of financial capital is easily calculated by estimating capital and surplus.

Debt capital for insurers is mainly comprised of funds borrowed from policyholders. The rationale for the segmentation of capital into debt capital is that insurers raise debt capital by issuing policies and then transform this debt capital into invested assets (Leverty, Lin, and Zhou, 2004) For property-liability insurers, debt capital is defined as the combination of loss reserves and unearned premium reserves.

Outputs

Insurance is a method of spreading, over time and over a wider body of individuals and organizations, the financial losses arising from the occurrence of some types of uncertain events. Insurers are analogous to other financial firms in that their outputs consist mainly of services that are primarily intangible. Three principal alternative methods have been used to measure outputs in the financial services sector: 1) the asset approach, 2) the user cost approach, and 3) the value-added approach (see Berger and Humphrey, 1992). Under the asset approach, financial service firms are considered merely as financial intermediaries, raising funds from one group of decision makers, transforming the balance-sheet liabilities into assets, and paying out and receiving interest to cover the time value of the funds used in this capacity. Intermediation is the important function for most insurers, however, ignoring insurance outputs is likely to overlook important distinctions among insurers. Therefore, the asset approach is considered inappropriate as a method to measure insurance output.

The user cost approach determines whether a financial product is an output on the basis of its net contribution to the financial sectors revenues. The product is considered to be a financial output if the financial returns on an asset exceed the opportunity cost of funds or if the financial costs of a liability are less than the opportunity costs. It is otherwise considered to be a financial input. This approach is theoretically sound. However, it requires accurate data on product revenues and opportunity costs which are not easily obtained.

Consistent with most of the recent banking and insurance literature, the value-added approach is adopted here to measure insurer outputs. The value-added approach differs from the asset and user cost approaches in that it considers all asset and liability categories to have some output attributes rather than distinguishing inputs from outputs in a mutually exclusive way. The categories having substantial value added, as judged using operating cost allocations, are employed as important outputs. Others are treated as unimportant outputs, intermediate products, or inputs, depending on the characteristics of the specific category. The following discussion focuses only on the value-added approach.

Operating expense allocations identify three principal services that insurers provide (Cummins and Weiss, 2001):

1) *Risk-Pooling and Risk-Bearing Services*

The main function of insurance is to resolve risk and uncertainty. Insurance provides a mechanism through which consumers and businesses exposed to losses can engage in risk reduction through the diversification effect of pooling. Insurers collect in advance premiums from their customers and redistribute most of the funds to those policyholders who sustain losses. The actuarial, underwriting, and related expenses incurred in operating the risk pool are a principal component of value added in the insurance industry. In addition, the equity capital that insurers hold also create value-added by increasing economic security as a result of the cushion it provides against unexpected losses and investment shocks.

2) *Financial Intermediation Services*

Insurers issue insurance policies, debt contracts, and invest the funds until the benefits or claims are paid. In return, interest credits are made directly to policyholder accounts to reflect investment income and compensate for the opportunity cost of the funds held by the insurer. That is the policyholders receive a discount in the premiums they pay. The borrowed funds are invested primarily in marketable securities such as privately placed bonds and structured securities. For property-liability insurers, financial intermediationation is a somewhat incidental function resulting from the collection of premiums in advance of claims payments to minimize contract enforcement costs. However, for life insurers, financial intermediation is a principle function, accomplished through the sale of asset accumulation products such as annuities. The net interest margin between the rate of return earned on assets and the rate credited to policyholders is the value-added of the intermediation function.

3) *Real Financial Services Relating to Insured Losses*

Insurers provide a variety of real services for policyholders including the design of risk management programs; e.g., risk surveys and recommendations regarding coverage, deductibles and policy limits, loss prevention, financial planning, the provision of legal defense in liability disputes. By contracting with insurers to provide these services, policyholders can take advantage of insurers' specialized expertise to reduce costs associated with insurable risks.

The third approach to measuring output - the value-added approach - is the most appropriate method for studying insurance efficiency. The value-added approach considers all asset and liability categories to have some output characteristics rather than distinguishing inputs from outputs in a mutually exclusive way. The categories having significant value-added, as judged using operating cost allocations, are employed as important outputs. Others are treated as unimportant outputs, intermediate products, or inputs, depending on the characteristics of the specific acting under consideration.

In defining measures for property-liability insurance output in this study following the previous study using the most common proxy for the quantity of risk-pooling and real insurance services is the present value of real losses incurred (Berger, Cummins, and Weiss, 1997; Cummins, Weiss, and Zi, 1999; Cummins and Weiss, 2001; and Leverty, Lin, and Zhou, 2004). Losses incurred are defined as the losses that are expected to be paid as a result of providing insurance coverage during a particular period of time. The objective of risk-pooling is to collect funds from the policyholder pool and redistribute them to those who incur losses. Therefore, proxying output by the amount of losses incurred is appropriate. In addition, the use of losses incurred is consistent with the economic theory of insurance--risk averse agents subject to random shocks to wealth are willing to pay more than the expected value of loss in the process of exchange for transferring risk to the insurance company. Losses and loss adjustment expenses are also excellent proxies for the quantity of real services provided by insurers, since the amount of claims settlement and risk management services are also highly correlated with loss aggregates.

To capture the different types of services provided by the main types of property-liability, this study defines separate output measures as automobile insurance, fire insurance, marine and transportation insurance, and miscellaneous insurance losses and loss adjustment expenses as imposed by the data and lines of business practice in the Thai property-liability insurance industry.

In addition to the risk-bearing and real insurance services, the intermediation of function of borrowing from policyholders and investing the funds in marketable securities will be considered in this study. Consistent with recent insurance efficiency studies (e.g., Berger, Cummins and Weiss, 1997; Cummins, Weiss, and Zi, 1999; Cummins and Weiss, 2001; and Leverty, Lin, and Zhou, 2004), this study employs total invested assets for each year as proxy measure.

Empirical Results

This study analyzes performance of Thai property-liability insurers, from 1998 to 2003, in terms of their total efficiency, purely technical efficiency and scale efficiency. A set of linear programming calculates the within-year input-oriented total efficiency. This section presents empirical results of the efficiency of the Thai property-liability insurance industry.

Total Efficiency

Here, we examine the Thai property-liability insurance efficiency. We employed the computed technical or total efficiency (TE), purely technical efficiency (PTE) and scale efficiency (SE) estimates (one for each sample firm) between 1998 and 2003.

The estimated TE, PTE and SE are reported in Table 2. For total efficiency, the results show that the mean efficiency values of the Thai property-liability insurance industry for each year during 1998 to 2003 are 0.816, 0.808, 0.798, 0.804, 0.808, and 0.854, respectively. The average TE during 1998-2003 is 0.815. This means that the average firm is 81.5% as efficient as the most efficient firm. An inefficient in total efficiency was due to an inability of the average firm to keep pace with the best-practice property-liability insurers (purely technical efficiency) as well as to loss in scale efficiency.

Table 2: Means of Efficiency for the Thai Property-Liability Insurance Industry, 1998-2003

Year	TE Total Efficiency	PTE Purely Technical Efficiency	SE Scale Efficiency
1998	0.816	0.868	0.931
1999	0.808	0.877	0.920
2000	0.798	0.881	0.904
2001	0.804	0.879	0.916
2002	0.808	0.902	0.897
2003	0.854	0.914	0.935
Mean	**0.815**	**0.887**	**0.917**

The mean PTE values for each year of the Thai property-liability insurance business during 1998-2003 are 0.868, 0.877, 0.881, 0.879, 0.902, and 0.914, respectively. The average PTE during 1998-2003 is 0.887. That is the average firm is efficiently 88.7% able to catch up with the best-practice or the average firm loses ground 11.3% and is further behind the best-practice property-liability insurer during such a period. Two possibilities could explain this result. First, the average firm could be in decline. A second possibility is that the best-practice firm could be becoming more efficient quicker than the average firm.

Turning the issue to scale efficiency, during 1998-2003 it has an each year industry average of 0.931, 0.920, 0.904, 0.916, 0.897, and 0.935, respectively. The 6-year average SE is 0.917. This means that the average firm is not operating at constant returns to scale. The evidence of scale inefficiency could be expected given the way Thailand regulated property-liability insurance prices. With regulated prices above marginal cost, "big" firms arguably had incentives to produce more than the optimal quantity to gain or protect market share. "Small" firms could not expand their quantity produced to capture high market share. Table 3 results are consistent with this view. The evidence shows that many firms operated at decreasing and increasing returns to scale. If firms are trying to grow, they may sacrifice short-run efficiency costs for long-run market share. This could explain why firms lost scale efficiency.

Table 3 (Panel A) displays the returns to scale exhibited in the Thai property-liability insurance industry. The result indicates that majority of property-casualty insurance firms operated at decreasing returns to scale (DRS). This is not to be expected with liberalization, first occurring in 1992 and secondly occurring in 1997, of the Thai insurance market. Liberalization was expected to generate a competitive market that forced firms to compete and operate at the minimum of their long run average costs. However, liberalization in Thailand is related only to market access not followed by deregulation. Thailand still remains one of the more highly tariffed non-life insurance markets in Asia. At present almost all classes of insurance product including automobile insurance, having 60% market share of total non-life premium volume, and fire insurance are subject to tariff. Pricing flexibility exists but in most cases still requires prior approval from the regulator (Chan and Lawson, 2005). Therefore, still quite a number of firms operated at increasing and decreasing returns to scale. Table 3 (Panel B) exhibits that foreign firms are more likely to have constant returns to scale (CRS) and less likely to operate at decreasing and increasing returns to scale (IRS) while the majority of domestic firms operated at decreasing returns to scale.

Table 3: Panel A: Description of Returns to Scale for the Thai Property-Liability Insurance Industry, 1998-2003

Returns to Scale	1998		1999		2000		2001		2002		2003	
	# of firms	% of firms	# of firms	% of firms	% of firms	# of firms	# of firms	% of firms	# of firms	% of firms	# of firms	% of firms
CRS	26	36%	20	29%	24	35%	19	27%	20	30%	21	32%
DRS	26	36%	37	54%	29	42%	30	43%	31	46%	37	56%
IRS	20	28%	12	17%	16	23%	21	30%	16	24%	8	12%

Table 3: Panel B: Description of Returns to Scale for the Domestic and Foreign Thai Property-Liability Insurance Industry, 1998-2003

Returns to Scale	All Firms		Domestic Firms		Foreign Firms	
	No. of firms	% of firms	No. of firms	% of firms	No. of firms	% of firms
CRS	130	31.5%	108	28%	22	73.3%
DRS	190	46%	186	49%	4	13.3%
IRS	93	22.5%	89	23%	4	13.3%

Table 4: Panel A to Panel F show the TE, PTE, and SE for the domestic and foreign property-liability insurers separated for each year during 1998-2003. In addition, in Table 4 (Panel A to Panel F) also report the T-Test of difference between domestic and foreign property-liability insurance efficiencies. The result shows that there are statistically significant differences between domestic and foreign efficiency (TE, PTE, and SE).

Table 4: Panel A: Summary Statistics of Efficiency and T-Test of Significant Difference between Domestic and Foreign Property-Liability Insurance Efficiencies in 1998

Efficiency	All Firms		Domestic Firms		Foreign Firms		T-Test
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	(P-Value)
TE	0.816	0.200	0.805	0.202	0.958	0.094	-3.14 (0.016)**
PTE	0.868	0.154	0.860	0.156	0.975	0.056	-3.66 (0.004)***
SE	0.931	0.136	0.927	0.140	0.980	0.044	-2.05 (0.063)*

Note: TE is total technical efficiency; PTE is purely technical efficiency; and SE is scale efficiency
*** Significant at 1% level; ** Significant at 5% level; Significant at 10% level

Table 4: Panel B: Summary Statistics of Efficiency and T-Test of Significant Difference between Domestic and Foreign Property-Liability Insurance Efficiencies in 1999

Efficiency	All Firms		Domestic Firms		Foreign Firms		T-Test (P-Value)
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
TE	0.808	0.180	0.803	0.181	0.864	0.167	-0.78 (0.472)
PTE	0.877	0.159	0.867	0.161	1.000	0.000	-6.62 (0.000)***
SE	0.920	0.095	0.924	0.088	0.864	0.167	0.80 (0.468)

Note: TE is total technical efficiency; PTE is purely technical efficiency; and SE is scale efficiency
*** Significant at 1% level; ** Significant at 5% level; Significant at 10% level

Table 4: Panel C: Summary Statistics of Efficiency and T-Test of Significant Difference between Domestic and Foreign Property-Liability Insurance Efficiencies in 2000

Efficiency	All Firms		Domestic Firms		Foreign Firms		T-Test (P-Value)
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
TE	0.798	0.179	0.782	0.176	1.000	0.000	-9.88 (0.000)***
PTE	0.881	0.141	0.872	0.142	1.000	0.000	-7.19 (0.000)***
SE	0.904	0.119	0.896	0.121	1.000	0.000	-6.87 (0.000)***

Note: TE is total technical efficiency; PTE is purely technical efficiency; and SE is scale efficiency
*** Significant at 1% level; ** Significant at 5% level; Significant at 10% level

Table 4: Panel D: Summary Statistics of Efficiency and T-Test of Significant Difference between Domestic and Foreign Property-Liability Insurance Efficiencies in 2001

Efficiency	All Firms		Domestic Firms		Foreign Firms		T-Test (P-Value)
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
TE	0.805	0.166	0.791	0.164	0.983	0.037	-7.34 (0.000)***
PTE	0.879	0.146	0.870	0.148	1.000	0.000	-7.08 (0.000)***
SE	0.916	0.110	0.912	0.113	0.970	0.041	-2.50 (0.031)**

Note: TE is total technical efficiency; PTE is purely technical efficiency; and SE is scale efficiency
*** Significant at 1% level; ** Significant at 5% level; Significant at 10% level

Table 4: Panel E: Summary Statistics of Efficiency of 2002 and T-Test of Significant Difference between Domestic and Foreign Property-Liability Insurance Efficiencies in 2002

Efficiency	All Firms		Domestic Firms		Foreign Firms		T-Test (P-Value)
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
TE	0.808	0.160	0.798	0.158	0.930	0.157	-1.82 (0.129)
PTE	0.902	0.139	0.894	0.142	1.000	0.000	-5.90 (0.000)***
SE	0.897	0.114	0.895	0.111	0.930	0.157	-0.49 (0.647)

Note: TE is total technical efficiency; PTE is purely technical efficiency; and SE is scale efficiency
*** Significant at 1% level; ** Significant at 5% level; Significant at 10% level

Table 4: Panel F: Summary Statistics of Efficiency and T-Test of Significant Difference between Domestic and Foreign Property-Liability Insurance Efficiencies in 2003

Efficiency	All Firms		Domestic Firms		Foreign Firms		T-Test
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	(P-Value)
TE	0.855	0.147	0.843	0.147	1.000	0.000	-8.36 (0.000)***
PTE	0.914	0.138	0.907	0.141	1.000	0.000	-5.15 (0.000)***
SE	0.935	0.077	0.930	0.078	1.000	0.000	-7.11 (0.000)***

Note: TE is total technical efficiency; PTE is purely technical efficiency; and SE is scale efficiency
*** Significant at 1% level; ** Significant at 5% level; Significant at 10% level

Conclusion and Discussion

Overall, the Thai property-liability insurance industry has witnessed that the average firm is 81.5% as efficient as the most efficient firm. An inefficient in total efficiency was due to an inability of the average firm to keep pace with the best-practice property-liability insurers (purely technical efficiency) as well as to loss in scale efficiency. The benefit of liberalization is not clearly shown. This is because Thailand non-life insurance market is still highly regulated. Many lines of business; e.g., automobile insurance and fire insurance are still subject to tariff.

The majority of domestic firms are operated at decreasing returns to scale. On the other hand, the foreign firms are operated at constant returns to scale. Foreign firms try to produce at long run average cost to achieve cost-minimizing objective or achieve profit-maximizing strategy. Recently Thailand has participated in FTAs and thus resulting in a more widely open insurance market. An increase in foreign participation could lead to keener competition; however, the industry should benefit from the capital injection and technical skills and knowledge transfer by foreign participants.

Direction for Future Research

Future research on a longer period of study of the Thai property-liability insurer efficiencies could test the impact of liberalization. The cause of inefficiency whether it comes from purely technical efficiency or scale efficiency along the time frame of the study period should be secured. In addition, the total factor productivity by using Malmquist index to investigate the cause of such results whether it comes from technological change or technical efficiency improvement should be obtained.

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