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Costs to Employers and Efficiencies

In the Texas Workers' Compensation System

Texas Department of Insurance
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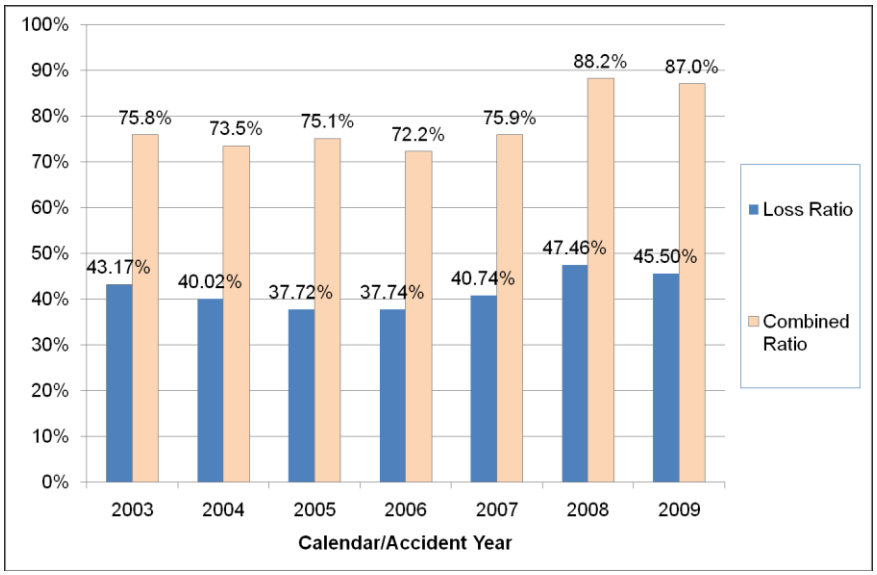
1. Background

In assessing the performance of workers' compensation system, it is important to evaluate the total costs to employers in relation to the benefits the system delivers. The degree of efficiency based on a cost-benefit analysis also indicates how likely employers will choose to participate in the workers' compensation system.

The insurance industry's performance is often measured by the loss and combined ratios. The loss ratio is the relationship between premium collected and the losses incurred (amounts already paid out plus amounts set aside to cover future payments) by the insurance companies. The combined ratio is similar to the loss ratio, except that it compares the premiums collected with both the losses and expenses incurred by the insurance company. Figure 1 shows these two ratios on an accident year basis. A loss ratio of 43 percent means that 43 percent of the premium is paid out as benefits and adjustment expenses while a 75 percent combined ratio means that 75 percent of the premium is either paid out as benefits or used as operating expenses. The remaining premiums are gross underwriting profits before taxes and dividends. Therefore, loss and combined ratios indicate something about the profitability of the insurance industry.

Figure 1: Loss ratio and combined ratio, 2003-2009



Source: *Setting the standard: an analysis of the impact of the 2005 legislative reforms on the Texas workers' compensation system, 2010 results*, Texas Department of Insurance, p. 8, 2010.

However, loss and combined ratios are not adequate indicators of the industry's economic efficiency. For example, if benefits and expenses are increased at the same rate as the premium, the combined ratio and the profit rate may remain the same but the larger scale is often an indication of an increasing inefficiency. If the combined ratio stays the same but losses decrease while expenses increase, then the operational efficiency actually becomes worse. In addition, these ratios only deal with underwriting service, ignoring investment activities which are often significant economic functions of the insurance industry. In fact, profits for insurance carriers in the U.S. mainly come from investment gains while underwriting profits are often negative. Investment gains are made by use of capital funds available for investment, and these funds mainly come from premiums, which are held as various forms of reserves and later converted into profits and surplus. The economic performance and efficiency of the insurance industry are greatly affected by investment functions.

Another way to measure the efficiency of the industry is to calculate the average cost paid by customers. The annual cost that a Texas employer incurs to obtain workers' compensation coverage is the average premium per $100 payroll, which has decreased significantly in the last few years, from $2.85 in 2003 to $1.47 in 2009. Decreasing medical and indemnity costs and the number of claims have played an important role in falling premium rates. Despite these decreases, however, Texas is still ranked as the 12th most expensive state in the nation in terms of premiums paid by employers in the 2010 Oregon DCBS study on premium ranking, worsening from 17th in 2008. Relatively, Texas WC premiums decreased at a lower rate than those of other states. At the same time, according to an estimate by the National Academy of Social Insurance, in 2008 Texas's workers' compensation benefits per $100 of covered wages are among the lowest in the nation at 43 cents compared to the national average of 97 cents.[1] Essentially, benefits are decreasing, but premiums are decreasing at a slower rate. While the loss or benefit component decreased substantially in the last ten years (as will be discussed in Figure 2 below), the expense portion of the total cost did not change greatly. As a result, the share of expenses in the premium has grown substantially. In terms of administrative

[1] Only District of Columbia is lower at 23 cents of benefits per $100 covered payroll. See "Workers' compensation: benefits, coverage, and costs, 2008" by National Academy of Social Insurance, pp. 28-29, Washington, D.C., September 2010.

efficiency, it may be argued that the system has become less efficient. It may be that the decreasing benefits are offset by increases in administration (e.g. utilization reviews) or the gains in less claims and payouts have not been translated to reduced administrative expenses. When the share of expenses grows, it implies that more of the premium dollar is spent on transactions than on benefits. For payers (employers), a high level of transaction or administration costs reduces the incentive to outsource (subscribe to WC system) and increases the incentive to either provide solution internally or to forgo participation in the system. But a more definitive analysis requires a more detailed look at premiums and expenses.

Another issue with the average premium calculated by previous studies is the limitation with the data. For example, the above financial data excludes all policies that are developed under a large deductible plan ($100,000 deductible or higher). Large deductible plans are popular, especially among large employers who account for 50% of total Texas payroll. One objective of this study is to estimate the average premium cost of all policies including large deductible plans. Total costs to employers not only include premiums paid to insurers but also out-of-pocket expenses due to deductible plans as well as other expenses related to worksite safety, return to work, and other associated programs. However, there is scant data on these employer expenses, but including deductible plan expenses is the first step toward estimating the total costs.

This study further reviews underwriting and general expenses and investment gains associated with funds attributable to premiums. We first analyze benefits and expenses incurred in the risk management process. Benefit components—medical and indemnity benefits paid to injured employees and care providers—have been reviewed frequently, but these account for less than half of the premium and about a third of the net income before taxes (premiums plus investment gains) in Texas. Therefore, this report focuses more on the other components of the expenses including general expenses and other operating costs.

Finally, this study attempts to quantify some measurements of economic efficiency of the insurance companies operating in the Texas workers' compensation market. If we have such measurements, it is possible to give a quantifiable statement such as "the

industry can reduce 10 percent of its input expenses" or "the industry has gained 5 percent technical efficiency in the last 5 years." However, there are some methodological and data difficulties in such measurements. For one thing, many efficiency and productivity studies use a parametric model to estimate technical efficiency. A parametric form of production function (such as the Cobb-Douglas function) may be a reasonable approximation for manufacturing industries, but it is found to be problematic for service industries such as insurance. For this reason, this report utilizes a non-parametric method called Data Envelopment Analysis. However, non-parametric methods assume that the underlying data used for estimation has no measurement error, and their estimation results are only valid in the context of the observations used in the study. Despite these limitations, we have access to a set of very reliable and complete data, and we report the first result of non-parametric efficiency measurements of the workers' compensation insurance carriers in Texas.

This report is organized as follows. In Section 2, we analyze cost components of the workers' compensation premiums. Beginning with the manual rate offered in a policy, we investigate the type and size of all credit and debit components (premium discounts and additions), which results in the standard premium remitted by the insured. This provides us with the revenue-side of the insurance risk management. Section 3 investigates expense components of the gross revenue received by the insurers and the investment gains from premium-funded reserves and policyholder surplus. Section 4 estimates economic efficiencies in the workers' compensation insurance. Section 5 provides summary and conclusions.

2. Employers' Costs in the Texas Workers' Compensation System

Workers' compensation is a state-regulated insurance system that provides covered employees with income and medical benefits if they are injured on the job or have a work-related injury or illness. Except in cases of gross negligence, workers' compensation insurance limits an employer's liability if an employee brings suit against the employer for damages. Texas employers may choose whether or not to maintain workers' compensation insurance. However, government agencies and public institutions are required to provide workers' compensation insurance while also requiring such coverage from private employers who do business with them. Employers who choose to have insurance may: [2]

- purchase workers' compensation insurance policies from private insurance companies; or
- self-insure, either through the Certified Self Insurance program administered by the TDI Division of Workers' Compensation or the Group Self Insurance program approved by the Texas Department of Insurance. Self-insured employers have the same rights and responsibilities as employers who buy policies from private insurance companies.

Whether or not an employer offers a workers' compensation insurance coverage can be verified in the TDI's insurance coverage information page at www.tdi.texas.gov/wc/employer/coverage.html.

Employers who elect not to purchase workers' compensation policies are called nonsubscribers, and they forfeit several common-law defenses if sued because of a work-related injury.[3] In addition to forfeiting these legal defenses, a court could order the employer to pay judgments for pain and suffering and punitive damages. If a court

[2] Description comes from the TDI's information page for employers on the Internet, which is at www.tdi.texas.gov/wc/employer/index.html available for more information about Texas workers' compensation system.

[3] Texas employers who do not carry workers' compensation insurance coverage are required to report their non-coverage status and work-related injuries and illnesses to the Texas Department of Insurance, Division of Workers' Compensation (TDI-DWC). Employers are also required to notify their employees if they do not carry workers' compensation insurance. Employers who do carry workers' compensation insurance coverage are required to report any work-related injuries and illnesses to their insurance carrier.

determines that an employer was negligent in any way—even if the employee's negligence played a greater role in causing the injury—the employer will likely be held fully financially responsible. The employer also must pay defense-related legal expenses, such as attorney fees.

Workers' Compensation Costs and Participation Rates

The state of Texas is the only state in the United States where workers' compensation is not mandatory. Given a choice between participating in the Texas workers' compensation system and remaining a nonsubscriber, the majority of Texas employers have consistently opted to participate in the WC system. TDI has surveyed Texas employers and employees eight times since 1993 on the status of WC subscription. Overall, the percentage of Texas employers that subscribe to the WC system increased from 56 percent in 1993 to 68 percent in 2010.[4] Since the participation rate is generally higher for larger employers, the subscription rate in terms of the number of employees was 80 percent in 1993 and 83 percent in 2010. WC subscription rate fluctuates along with changing economic conditions, insurance rates, and other factors. Nevertheless, it is safe to say that about 70 percent of employers and 80 percent of employees in the private sector are participating in the Texas workers' compensation system. If we add government and public employees who are mandatory participants, the WC subscription rate will be still higher.

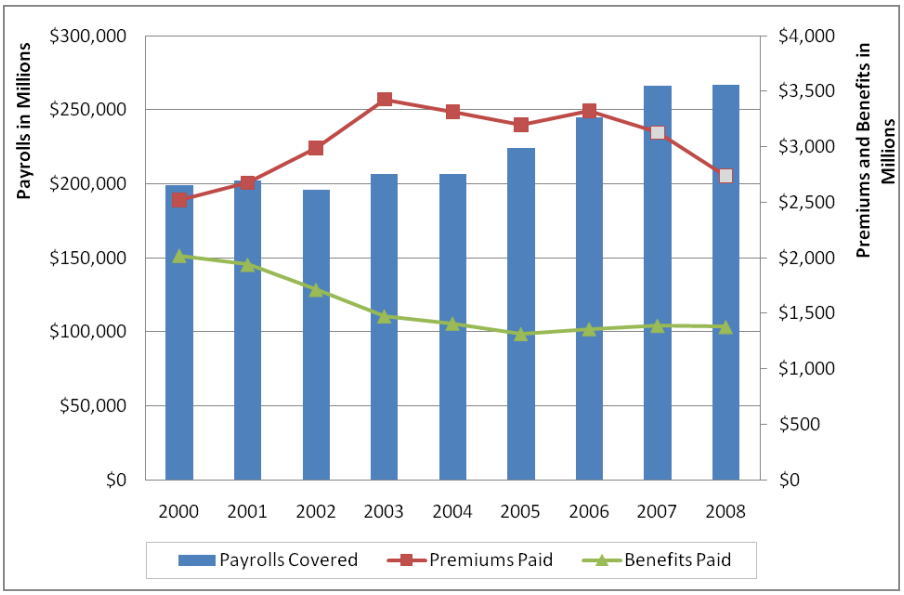
In a system where employers have a choice to opt in or opt out, one of the factors that determine participation is the market incentive determined by the benefit over the cost. Since participants are not forced, their subscription to the WC system should be based on getting non-negative benefits above the WC insurance cost. Otherwise, employers would become nonsubscribers. Therefore, a survey of WC subscription rates may indicate whether the market price (i.e. the insurance premium) is improving or deteriorating from a previous benchmark. In this regard, a study on insurance premium is closely related to subscription surveys.

[4] See the reports page of the TDI-REG at www.tdi.texas.gov/reports/report9.html.

Figure 2 presents a summary view of the Texas workers' compensation system from 2000 to 2008 policy years. Total payrolls covered, on the left side scale, indicate that covered payroll amounts increased by 34 percent from 2000 to 2008. Since these are in current dollars, wage inflation as well as higher wages or an increasing number of employees covered may be the cause of this increase.[5]

Figure 2 also indicates that the total premiums paid by employers (written premiums) decreased since 2003. This decreasing total may be due to a lower rate or a lower number of subscribers, but since payrolls covered is increasing, it is more likely to be a lower insurance rate. Total benefits paid to injured employees decreased substantially from 2000 to 2005, but have been same or slightly increasing from 2005.[6] In short, Texas employers as a whole are paying a lower amount of premiums but covering a higher percentage of employees, receiving about the same amount of benefits in total since 2003.

Figure 2: Payrolls, premiums, and benefits, 2000-2008



[5] Total private business payrolls in Texas increased by 47 percent during the same period, indicating a lower proportion of employers are covered by workers' compensation in 2008 than in 2000, to the extent that the private payroll data in the BLS employment survey can be compared with NCCI policy data.

[6] "Benefits paid" are policy year incurred losses reported in the unit statistical plan data. These are apt to understate current cost levels due to likely claims development.

However, this picture is not complete since large deductible plans may increase payrolls covered but lower premiums at the same time. Such plans may not lower employers' total cost of insurance. The reported benefit amounts may also include benefits paid by insurers but ultimately to be reimbursed by the employers under a deductible plan. This 'gross' reporting method, typical of states such as Texas, requires the insurance carriers and the statistical agent to report all benefit expenses prior to settling via reimbursements. In this case, a substantial portion of the benefits paid may actually be employers' added costs, and the lowered premium may simply be compensation for increased employer costs.

To understand how employers make decision on whether to participate in the WC system, it is necessary to fully account for costs and benefits faced by those employers. However, available reports on the workers' compensation insurance premiums and expenses are mostly concerned about financials of and from the point of view of the insurance carriers.

The purpose of this study is to calculate total costs and benefits from the point of view of the employers who must decide whether to subscribe to the Texas workers' compensation system or not. One difficulty involves large deductible plans. With a large deductible plan, employers receive a large discount—sometimes 70 percent or more—in premium, which reduces the amount of premium received by the insurer. However, employers are faced with out-of-pocket costs of medical and indemnity benefit payments to reimburse the insurance company for payments made to injured employees up to the agreed deductible amount. In such cases, an employer's total real cost is the premium plus out-of-pocket expenses. In addition, employers have expanded various injury prevention and training efforts as well as more effective return-to-work programs. Costs associated with these programs should also be added to the premium paid to the insurers.

2.1 Statistical Plan Data

This section of the report is based on the unit statistical data compiled by the National Council on Compensation Insurance (NCCI), as TDI's statistical agent. NCCI is a nationwide rating and data collection bureau specializing in workers compensation, and funded by its member insurers. Unit statistical data consists of the audited exposure,

premium, and loss information for a policy. It is used in determining rate changes at the classification code level, production of experience modification factors, and actuarial analysis. The following is a few characteristics of this database:

- **Policy Year** Data elements are by policy year, and observations are organized by policy. The last policy of the policy year (PY) 2008 expires in December 2009. A policy may cover several establishments that may have different Federal Employer Identification Numbers (FEINs) or multiple policies may be written for one FEIN.
- **Maturity** Unit statistical data is mature data. The first report is valued after 18 months of maturity. The first report of the last policy of the PY 2008 is valued in June, 2010, and reported by August 2010. The complete data for PY 2009 has not been received and processed by TDI. Therefore, this report analyzes only up to PY 2008.
- **Report Tables** The database consists of several relational tables and each table may be corrected and/or updated later by submitting new lines of data. An examination shows that over 85 percent of submitted data consists of single report with no corrections. This section's analysis is restricted to the first report for all policies.
- **Classification and Statistical Codes** Details of premium calculation discussed in this section are drawn from the exposures table where each component of the premium is noted with either a classification or a statistical code. Classification codes are assigned according to the grouping of certain employees who share a risk profile and thus the same premium rate can be applied. For each classification, the insurer applies a manual rate to the sum of the employees' payrolls in that classification. On the other hand, a statistical code is used when the entry is either a credit or a debit item and these are usually added to or subtracted from the premium. The state of Texas maintains a particular list of classification codes which differs from that of other states or the one used by NCCI. State also uses a different set of

statistical codes.[7] However, examinations of the data show that the list of statistical codes is not very reliable. For this analysis, some statistical codes could not be verified and thus had to be ignored while other codes were assigned to similar codes that proceeded or followed the codes in a particular range. Nevertheless, these codes represent a small percentage of the total premiums and discounts.

2.2 Components of the Premium and Total Costs

In this section, we investigate how the average workers' compensation premium is determined in Texas. In the process, we discuss various components of credits and debits that contribute to the final premium. We begin with the total payroll since premiums in the workers' compensation insurance are based on the amount of payroll (remuneration) to be covered by the insurance policy. Rules that define what is included in the payroll to calculate premiums are determined by each state. Furthermore, workers' compensation premiums are subject to auditing retrospectively so that premiums can be re-calculated according to the actual payroll data that may be different from the data considered at the inception of a policy.

Discussing such rules is beyond the scope of this study and interested readers should consult the Texas Basic Manual of Rules, Classifications and Experience Rating Plan for Workers' Compensation and Employers' Liability Insurance, which is accessible at the TDI's information page at www.tdi.texas.gov/wc/regulation/index.html.

Payrolls and Manual Rates

Total payrolls covered by WC insurance policies were $195 billion in 2000 and $266 billion in 2008, a 36 percent increase (see Table 1). These represent about 70% of the Texas total private industry payrolls estimated by the Quarterly Census of Employment and Wages (QCEW) published by the Bureau of Labor Statistics. The total Texas-wide

[7] As of 2010, 35 states including the District of Columbia adhere to rules and classification codes in the Basic Manual for Workers' Compensation published by the National Council on Compensation Insurance. 12 states including Texas have independent rules and manuals. 4 states allow only monopolistic state funds to write workers' compensation insurance.

private payroll also increased by a similar percentage in the same time period, and as a result we estimate WC subscription rates to be around 70 percent during the period.

A more detailed study requires more complete data from QCEW and an investigation into what portions of the QCEW data should be compared with the NCCI-provided covered payroll data. One of the advantages of using covered payroll to estimate subscription rates is that the unit statistical data is current and detailed by NAICS or SIC industry groups. However, the data's identification fields (employers' FEINs and NAICS codes) are often incomplete, posing serious difficulties in linking it to the government data. Nevertheless, an effort to link NCCI covered payroll data with the BLS government survey may potentially result in more detailed, up to date and cost effective estimates for the Texas WC subscription rate than the current biennial telephone surveys.

Table 1: Payrolls, manual rates and base premium

Policy year	Payroll covered	Average manual rate per $100 payroll	Manual premium
2000	194,641,734,299	2.77	5,401,274,489
2001	199,930,429,576	2.93	5,859,588,498
2002	194,358,418,377	3.03	5,894,950,630
2003	198,085,623,131	3.20	6,346,849,111
2004	204,233,950,515	3.17	6,469,525,508
2005	222,110,691,113	2.92	6,480,238,308
2006	241,285,770,452	2.80	6,755,522,265
2007	265,757,149,487	2.58	6,864,226,646
2008	265,918,225,355	2.23	5,917,441,097

Once the total payroll is known, insurers apply an initial rate (manual rate) to the payroll to calculate a base premium (or manual premium). Manual rates are different for each class or group of employees, and they represent risk premiums roughly based on the possibility of injuries and thus the potential payments expected by the insurer. For example, clerical workers (classification code 8810) have lower risks of injury and benefit payments and thus a lower manual rate is applied compared to a higher risk group such as retail store workers (classification code 8017). Using the unit statistical plan data,

the average manual rate for clerical workers was estimated to be 0.35 (35 cents per $100 payroll) in 2008 while that for retail store workers was 4.14.[8] Insurers may use relativities posted by TDI or adopt a different rate system such as loss cost multipliers filed by another rating agent.

Table 1 shows payrolls and base premiums along with manual rates per $100 payroll as an average of all rates for all classification codes reported in the unit statistical data. The manual rate of $2.23 in 2008 means that a Texas employer was quoted a base premium of two dollars and twenty-three cents per one hundred dollar payroll by an insurer and it represents the lowest rate since 2000, a 30 percent decrease from the 2003 high of $3.20.

Increased Liability Limits

The initial manual premium is further adjusted with premium credits and debits before the insurer applies an experience rating modifier (or modification factor). This modifier raises or lowers the whole premium by a percentage that corresponds to the insured's past injury experience. For example, if an employer had more severe or costly injuries in past years than average, its experience rating modifier might be greater than one, resulting in a higher premium. Low-loss employers receive a modifier less than one such as .8 that represents a 20 percent discount in premium based on past experience.

Some credits and debits are subject to this experience modifier and thus applied before applying the experience modifier. When the liability limit is increased, expected future benefits will also proportionally increase. Therefore, costs associated with an increased liability limit are applied prior to experience modification.

The most common liability limit chosen by Texas employers is $1 million. Table 2 shows total premium increases due to a higher liability limit. This results in an increase of 1.9 percent in the manual premium.

Along with liability debits, other credits and debits are applied before the experience rating modifier. These include small employer premium incentive discount, debits due to the waver of subrogation right, and an additional debit to bring the premium to the

[8] Rates by classification are discussed later in Section 2.3 in more detail. See Table 10 for these data.

minimum. In some cases, a negotiated experience modification credit is used in lieu of experience rating modifier. Net adjustments generally result in additional premium in most years (see Table 3) but these constitute a minor component of the total costs.

Table 2: Debits due to increased liability limit

Policy year	Increased liability debit	Manual premium	Debit as % of manual premium
2000	91,450,270	5,401,274,489	1.69%
2001	101,988,494	5,859,588,498	1.74%
2002	123,150,917	5,894,950,630	2.09%
2003	108,008,174	6,346,849,111	1.70%
2004	120,241,319	6,469,525,508	1.86%
2005	124,368,984	6,480,238,308	1.92%
2006	128,703,212	6,755,522,265	1.91%
2007	135,044,603	6,864,226,646	1.97%
2008	114,764,829	5,917,441,097	1.94%

Table 3: Other credits and debits before experience rating

Policy year	Other credits	Other debits	Net other credits or debits
2000	-32,815,693	22,026,930	-10,788,763
2001	-22,020,396	25,181,429	3,161,033
2002	-18,317,293	28,791,042	10,473,749
2003	-17,791,352	32,795,070	15,003,718
2004	-15,486,782	38,749,483	23,262,701
2005	-17,141,229	41,406,263	24,265,034
2006	-20,481,280	47,616,184	27,134,904
2007	-23,164,137	48,130,466	24,966,329
2008	-34,669,738	42,784,490	8,114,752

Experience Rating Modifier and Modified Premium

Manual premiums that are adjusted for the above credits and debits become the basis for experience modification. Experience rating is a financial incentive to employers to minimize the financial cost of workplace injuries, and they are offered to policies with a premium of $10,000 or more with one year of experience data or with a premium of

$5,000 with two years of experience data. Some employers with higher than average injury experience may see their manual premiums increase via an experience rating modifier that is greater than 1.[9] Small employers can also benefit from the Premium Incentive for Small Employers program that requires credits, discounts and surcharges for small employers based on their most recent one to two years of experience.[10]

Some employers may have incentives not to report certain injuries to maintain favorable experience. Experience rating is also formulaic and data dependent. It is based on three full years of experience, reported and compiled by NCCI, except the one year before the current policy year. If one's experience is negative, one option available in Texas may be to opt out of the workers' compensation system for four or more years to reset one's experience before re-subscribing to the workers' compensation system.

Since experience rating is applied differently to different policies, a Texas-wide average of the experience rating modifier is not an appropriate indicator for actual practice. Nevertheless, we can estimate the average effect of experience modification by dividing the total premium after the modification by the adjusted manual premium subject to experience modification. This average factor has been around .80 and .87 (see Table 4). It implies that, in all years from 2000 to 2008, Texas employers on average received between 13 and 20 percent discount in their manual premium based on their past injury experience before other credits and debits are applied. However, it is not clear whether these continuous discounts have resulted from an improving injury experience or not. When above-average and below-average experiences are balanced, we would expect the average discount rate to be 1. If a discount based on past experience is a constant 20 percent, this may indicate a different type of discount factor.

[9] Experience rating is a way to reflect one's risk profile in the premium one pays. In contrast, 'community rating' would apply the same factor to all insured, which results in sharing the risks equally. This often leads to an 'adverse selection' problem because some participants who have lower than average risk may not be willing to pay premiums based on community rating and leave the insurance market. Experience rating attempts to assign a higher premium to higher risk participants, which encourages low-risk participants to stay in the market. On the other hand, high-risk participants may leave the market preferring not to have costly insurance coverage.

[10] This program was created by the Texas Legislature effective January 1, 1991 to be an 'experience modifier' for employers with premium less than $5,000 (Texas Insurance Code Section 2053.251-256).

Table 4: Experience rating modifier and modified premium, 2000-2008

Policy year	Experience rating modifier	Modified premium
2000	0.835	4,577,150,299
2001	0.846	5,086,389,830
2002	0.859	5,209,025,345
2003	0.870	5,662,916,638
2004	0.866	5,754,528,146
2005	0.845	5,629,291,812
2006	0.825	5,735,820,046
2007	0.797	5,637,595,464
2008	0.814	4,975,044,556

After the experience modifier is applied to the manual premium, the result is the modified premium, which was about $5 billion in 2008. The modified premium is the base amount to which deductible plan discounts, schedule rating discounts, and network credits are applied to get the standard premium that are usually reported as written premiums in various insurance reports.[11]

Experience rating has an important implication in the performance of an insurance market. An insurance market that shares risk equally tends to fail when low-risk participants refuse to pay for high-risk participants and leave the market. As this happens, the price of insurance gets higher and higher, ultimately failing to act as a risk sharing mechanism. This is called an *adverse selection* problem in economics. Texas workers' compensation system is a unique market where participants can leave the market voluntarily. According to the standard economic theory, nonsubscribers would have lower risks than subscribers. If so, the market would not be able to sustain. On the other hand, if premiums are determined according to one's own risk and past experience, the market will not suffer from the adverse selection problem, and market participants may have lower risks than nonsubscribers if some of the high risk employers opt to forgo workers' compensation insurance. To the extent that there is some measure of risk

[11] Definition and usage of such terms as modified, standard and net premiums vary widely as to which credits and debits are included or excluded. This report uses them as defined by the Texas Workers' Compensation Statistical Plan available at www.tdi.texas.gov/wc/regulation/index.html#stat. See 'Part III – Exposure and Premium' for definitions.

sharing (i.e. low-risk firms or classes subsidizing high-risk firms or classes), retaining low-risk participants—and thus low overall premium levels—will be critical for the continued survival of the voluntary workers' compensation system.

Large Deductible Plan Credits

The most significant factor that affects the level of insurance premium is the existence of large deductible plans and premium reductions associated with these plans. Deductible credit is the amount by which the modified premium is reduced as a result of the policyholder's election of a deductible option. The deductible credit is applied according to Texas Basic Manual of Rules, Classifications and Experience Rating Plan for Workers' Compensation and Employers' Liability Insurance, Rule XIX.

Deductible plan credits amounted to almost $1.5 billion in 2008, representing about 30% discount of the modified premium (see Table 5). Standard deductible plans are offered to policies with a minimum premium of $5,000. Large deductible plans are those policies with a deductible amount of $100,000 or more. As a result, large deductible plan discounts are mostly for medium to large employers who are willing to pay out-of-pocket expenses up to the deductible amount. We will discuss the impacts of these plans in more detail in Section 2.4.

Table 5: Premium credits due to large deductible plan

Policy year	Modified premium	Deductible plan credit	As % of modified premium
2000	4,577,150,299	-1,472,240,735	-32.17%
2001	5,086,389,830	-1,896,052,025	-37.28%
2002	5,209,025,345	-1,782,542,318	-34.22%
2003	5,662,916,638	-1,893,529,307	-33.44%
2004	5,754,528,146	-2,030,467,618	-35.28%
2005	5,629,291,812	-1,911,632,624	-33.96%
2006	5,735,820,046	-1,732,131,405	-30.20%
2007	5,637,595,464	-1,710,770,509	-30.35%
2008	4,975,044,556	-1,478,447,239	-29.72%

Schedule Rating and Network Credits

Schedule rating credits (or debits) and network credits further reduce modified premiums. A schedule rating debit or credit may be applied to the premium depending on individual characteristics of the employer´s business that may not be reflected in the rate. Schedule rating credits reflect employers' efforts in maintaining safer work environments, commitment to safety, and management practices regarding automated work environment, safety officer on staff, hazardous machinery and so on, and these incur additional costs to employers. In this sense, schedule rating credits may be considered to equal employers' out-of-pocket expenses.

Schedule rating credits fluctuated widely from 13.1 percent of the modified premium in 2000, to 5.5 percent in 2003 and to 11.6 percent in 2008 (see Table 6). Schedule rating credits and debits should reflect changes in actual risk characteristics of the employers and should not be used as a pricing or marketing tool. However, when schedule rating credits decreased from $601 million in 2000 to $312 million in 2003, such decreases are hard to explain only on the basis of drastic changes in the employers' operations. If schedule rating credits are used as a pricing tool, then these credits may not be appropriate to be equated with employers' out-of-pocket costs.

Table 6: Schedule rating and network credits

Policy year	Modified premium	Schedule rating credit	Network credit	Total credits as % of modified premium
2000	4,577,150,299	-601,204,903	-324,375	-13.14%
2001	5,086,389,830	-472,683,077	-126,770	-9.30%
2002	5,209,025,345	-403,361,473	-48,379	-7.74%
2003	5,662,916,638	-311,865,452	-14,708	-5.51%
2004	5,754,528,146	-389,637,621	-20,557	-6.77%
2005	5,629,291,812	-490,337,053	-2,370,845	-8.75%
2006	5,735,820,046	-596,882,708	-50,962,589	-11.29%
2007	5,637,595,464	-640,729,469	-109,927,825	-13.32%
2008	4,975,044,556	-578,566,656	-117,543,443	-13.99%

Network credits are given when the insured elects to participate in a workers' compensation health care network. The workers' compensation certified health care network was a result of the HB 7 reforms enacted in 2005. Total network credits

increased as the number of certified networks and policy holders with network endorsements increased. . Prior to 2005, there were small scale informal or voluntary networks that could contract with the insurance carriers. All these networks are required to be certified by 2011.

Standard and Net Premium Levels

Premiums are reported in various terms depending on particular analytic needs or data reporting requirements. For example, premiums are reported as earned premium or written premium, designated statistical reporting (DSR) level premium, company standard premium, or net premium, and by policy year, calendar year or injury year. Often gross and net premiums are differentiated on the basis of returned premium and reinsurance. Reported premiums may also be restricted to certain type of policies. Such disparity often works as a deterrent to comprehensive and meaningful comparison and analyses of the premiums and other costs reported by the insurance carriers. After settling on a particular definition of the premium, there still exist problems in estimating non-reported, out-of-pocket costs of the employers.

Using the definitions for standard and net premiums in the statistical plan, the standard premium is calculated from the modified premium after applying deductible plan credits, schedule rating credits and network credits. To the standard premium, further debits and credits—expense constant, premium discounts and terrorism premium debit—are applied to get 'net premium'.

Table 7 summarizes standard premium and the three adjustments needed to calculate net premium. Premium discounts, which are more common in large policies, account for most of these adjustments. Overall, these net adjustments amount to about 5 percent of the standard premium.

An expense constant is a premium charge which applies to a policy in addition to the premium. It is a flat charge and covers issuing, recording and auditing expenses related to the policy. A premium discount is a reduction of the premium based on the economies of scale related to the size of the policy, and as a result, it is associated more with large premium policies. Terrorism premium debit was implemented following the Terrorism

Risk Insurance Act (TRIA) of 2002 passed in response to 9/11 terrorist attacks. Originally scheduled to expire in three years, TRIA has been extended twice till December 2014.

Table 7: Standard and net premiums

Policy year	Standard premium	Expense constant	Premium discount	Terrorism premium debit	Net adjustment to standard premium	Net premium
2000	2,509,172,517	17,747,508	-160,885,061	0	-143,137,553	2,366,034,964
2001	2,686,116,705	18,373,147	-170,219,709	0	-151,846,562	2,534,270,143
2002	2,993,030,376	18,731,942	-198,764,544	113,514	-179,919,088	2,813,111,288
2003	3,427,163,872	18,624,696	-216,111,995	33,796,875	-163,690,424	3,263,473,448
2004	3,309,093,331	17,927,183	-224,042,288	37,108,237	-169,006,868	3,140,086,463
2005	3,198,132,986	18,739,487	-230,077,420	40,973,540	-170,364,393	3,027,768,593
2006	3,322,088,981	19,029,630	-219,856,040	40,386,850	-160,439,560	3,161,649,421
2007	3,129,806,933	19,767,915	-202,856,091	41,882,671	-141,205,505	2,988,601,428
2008	2,737,150,717	20,660,086	-183,117,406	45,554,675	-116,902,645	2,620,248,072

Average Premium per $100 Payroll

Figure 3 presents three estimates of the average standard premium paid by Texas employers.[12] The middle line in the figure denotes the estimated average standard premium of all policies. The average standard premium increased from $1.27 in 2000 to $1.66 in 2003 but decreased to $1.03 in 2008. These estimates are quite lower than other estimates discussed in Section 1. The reason is because these estimates are the average of all policies written in Texas, including policies with large deductible plan credits that account for 50 percent of covered payroll and receive about 80 percent of the deductible plan credits (about 30 percent of the modified premium).

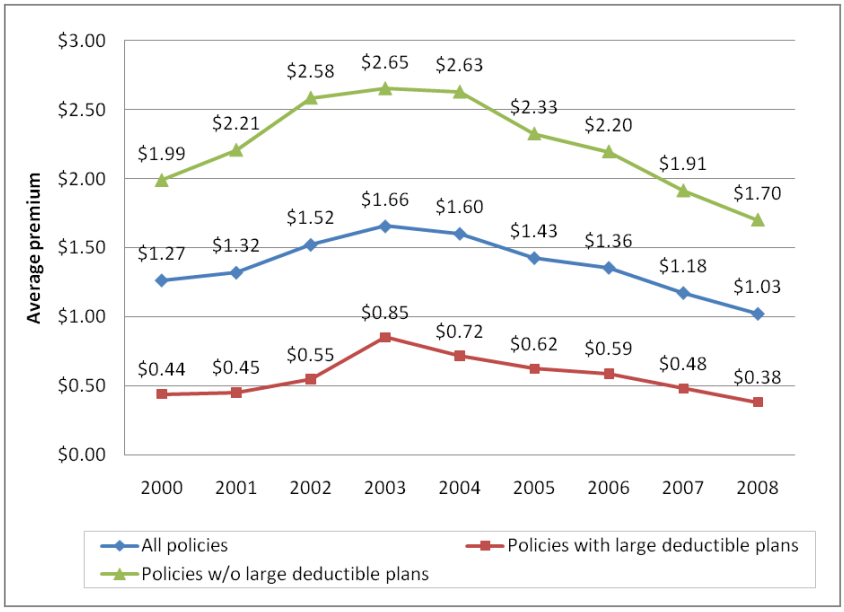
If we separate policies with and without a large deductible plan, differences in the average premium estimates appear extreme. In 2003, larger policies with deductible plan (the lower line in Figure 3) paid about 85 cents for $100 payroll while smaller policies without a deductible plan (the upper line) paid $2.65. In 2008, larger policies paid 38 cents per $100 payroll compared to $1.70 for smaller policies. However, employers with

[12] NCCI's unit statistical data only reports standard premium that excludes expense constant and premium discount. Others define standard premium to include expense constant but not premium discount. Net premium is often defined as standard premium after premium discount is considered. We exclude both of these amounts and use the standard premium as the unit of analysis.

large deductible plan must incur out-of-pocket costs up to the large deductible limit. If we add deductible plan credits back to the standard premium, the difference between larger and smaller policies becomes negligible.

To be able to estimate actual costs, we need more complete data from insurers as well as employers. But there are several issues regarding these data. In a 'gross loss' state like Texas, all worksite injuries have to be reported to the insurers who pay for the benefits first, and are later reimbursed by employers up to the deductible amount. Therefore in theory, employers' out-of-pocket expenses should be equal to their reimbursements to the insurers. But these reimbursement amounts are not reported in unit statistical data. There is a placeholder for such data but it is mostly empty. If the reported losses (benefits paid) are at a gross level, this would exaggerate insurer's losses while the reported premium excludes deductible credits. This will result in smaller revenues and larger losses, resulting in lower profits. If, on the other hand, losses are net of reimbursed amount, we need to estimate the cost of benefits handled by the employers, which may be significant. However, it appears that losses are reported as gross and that implies that the reported losses should be adjusted for future reimbursements by the employers.

Figure 3: Average standard premium paid per $100 payroll by policy type



Regardless of whether reported losses are gross or net, employers also have incentives to not report certain injuries that might increase unfavorable experience rating. This possibility lowers the amount of benefit costs. At the same time, employers pay additional expenses to maintain various premium credits and incentives. These costs must also be included in the total insurance cost, but there are many difficulties in quantifying these expenses. When all these costs are added and adjusted, the average premium may differ substantially from those in Figure 3.

2.3 Variations by Employer Size, Class, and Carrier Type

The average insurance premium for workers' compensation varies greatly by employer size since premium rates differ greatly with or without a large deductible plan. The majority of Texas employers are small employers whose premium is less than $5,000, and they face the higher average premium rate in Figure 3. In addition, premium and cost profiles are different by the classification of workforce on which risks and premiums are calculated. Finally, the type of insurance carriers such as mutual, Lloyds, and stock companies may result in some systematic differences in premiums and costs since they are organized on different principles and attract different classes of employers and workers. This section presents a more detailed look at the insurance payments and costs to employers by drilling down to these selected categories.

By Employer Size

An overview of all employers in the Texas WC is presented in Table 8 based on the most complete 2008 policy year unit statistical data. Unit statistical data is organized by policy and policies sometimes may not match one-to-one with employers or establishments used in government census and other databases. Some policies may encompass a number of worksites and establishments under the same management or ownership while other multiple policies may belong to only one employer. Each census and database differs in the definition and treatment of an 'establishment'. In our data, a unique policy in general corresponds to an employer with a unique Federal Employer Identification Number (FEIN). In this report, various terms of policy, establishment,

company and employer mean the same thing and we use them interchangeably to mean an employer.

Table 8: Policy details by employer size, 2008

	Number of policies	Total payroll	Average payroll per policy	Average number of employees	Average standard premium
1-9 employees	127,401	16,471,052,352	129,285	2.8	2,996
10-99 employees	40,134	56,406,641,326	1,405,458	30.6	26,957
100-499 employees	4,963	46,024,045,673	9,273,433	201.9	124,557
500+ employees	1,743	146,974,008,247	84,322,437	1,835.5	375,572
Total	174,241	265,875,747,598	1,525,908	33.2	15,705

Once policies are equated with employers, we calculated the number of employees by dividing the total payroll covered by the average Texas private wage in 2008 ($45,939).[13] We then divide employers into four groups: 1 to 9 employees, 10 to 99 employees, 100 to 499 employees, and 500 or more employees.

Seventy three percent of employers are small employers with less than 10 employees, having an average of 2.8 employees. However, they account for only 6.2 percent of total payroll. Since workers' compensation insurance premium is based on payroll, small employers account for 14 percent of the total premium. This represents a relatively higher share of premiums compared to their payroll share. This is due to several factors including expense constants, the type of workforce (the difference in classifications and manual rates), and/or differences in premium discounts and credits offered. Each employer pays a premium of about $3,000 on average for workers' compensation insurance.

On the other hand, large employers with 500 or more employees—1,743 employers representing one percent of the total—account for 55 percent of the total payroll and 24 percent of the total premium. Large employers' share of the premium is relatively small in view of their share of the payroll. This is mainly because large employers tend to utilize a large deductible plan with a substantial discount on premium. In addition, larger

[13] U.S. Bureau of Labor Statistics, *Quarterly Census of Employment and Wages, Annual Averages 2008*, January 2010. See the BLS page at www.bls.gov/cew/cewbultn08.htm.

employers receive lower base rates, lower experience modification factors and other credits, resulting in a much lower premium rate than all other employers (see Table 9).

Table 9: Payroll and premiums in 2008 by employer size

	Payroll	Standard premium	Premium rate per $100 payroll
1-9 employees	16,826,982,207	387,500,855	2.30
10-99 employees	57,502,776,160	1,088,304,128	1.89
100-499 employees	47,311,272,437	621,021,085	1.31
500+ employees	150,838,454,557	660,562,532	0.44
Total	272,479,485,361	2,757,388,600	1.01

By Classification of Employees

Classification codes group employees into classes so that each class reflects the exposure common to those employees. Each employer may have one or more classes of employees covered Classification codes are listed in the Texas Basic Manual of Rules, Classifications and Experience Rating Plan for Workers' Compensation and Employers' Liability Insurance. The most common class of workers is the 'clerical office employees, not otherwise classified' (class code 8810), which accounts for 41 percent of all employees in Texas (in terms of payroll share) (see Table 10).

In a sense, employees may be grouped as either clerical or non-clerical for the purpose of calculating workers' compensation premium. In 2008, the average premium rate for clerical workers was 26 cents per $100 payroll. Table 10 presents the top 10 classification codes in Texas in terms of the total payroll covered, showing their shares in total payroll and total standard premium. Attorneys and accountants have lower premium rates than clerical workers. Other classes such as retail store employees and construction workers face much higher premium rates.

Premium shares, manual rates, and average premium are supposed to be determined as a function of the expected injury rate and benefit payment for each group of employees. These are normally calculated by actuaries using past loss patterns. Because rates are based on expected losses and expected losses are in turn based on past (cumulative) losses, the precision of these estimates is bound by the dependability of the

available data and the mathematical methods used in the estimation (called loss development). In addition, proper classification of workers into several hundred classes is not an easy task. As a result, actual market rates often deviate from the estimated loss trend or loss development. These factors seem to play a significant role in premium pricing being often unresponsive to changes in losses/benefits and other WC market environments.

Table 10: Top 10 classification by size of payroll covered, 2008

	Class code	Payroll covered	Pay share	Premium share	Manual rate	Standard premium per $100 payroll
Clerical office employees, NOC	8810	108,380,716,116	40.77%	5.91%	0.35	0.26
Salespersons, collectors or messengers - outside	8742	21,776,466,618	8.19%	2.18%	0.57	0.48
Physicians and clerical	8832	7,713,904,748	2.90%	0.86%	0.56	0.53
College: professional employees and clerical	8868	6,263,837,951	2.36%	1.09%	0.98	0.84
Architect or engineer - consulting	8601	5,873,658,036	2.21%	0.64%	0.72	0.52
Executive officers, NOC - performing clerical or outside salespersons duties only	8809	5,036,209,607	1.89%	0.46%	0.50	0.44
Hospital professional employees	8833	4,919,370,680	1.85%	1.28%	1.53	1.26
Store: retail NOC and drivers	8017	4,454,517,761	1.68%	3.23%	4.14	3.49
Attorney - all employees and clerical, messengers, drivers	8820	4,139,567,035	1.56%	0.18%	0.23	0.21
Auditor, accountant or factory cost or office systemizer - traveling	8803	3,898,578,847	1.47%	0.10%	0.17	0.13

The data on the class of clerical workers is further analyzed by the employer size in Table 11, which, when compared with Table 8, shows that the largest employers have more workers classified as clerical than do small employers. Employers with 500+ employees account for 55 percent of total payroll but 65 percent of clerical payroll. However, larger employers pay a higher share of their premium for this classification relative to their overall premium share. In total premiums, the largest employers paid

only 24 percent of the total (mainly due to large deductible plan credits) but paid 55 percent of the clerical class premium. We can infer that the average premium for clerical workers is higher for larger employers. In the meantime, shares of benefits or losses appear to be roughly in line with premiums paid by each employer size group.

Table 11: Classification 8810 (clerical workers) by employer size, 2008

	Payroll	Standard premium	Benefits paid	Payroll share	Premium share	Benefits share
1-9 employees	4,234,630,555	15,765,254	3,468,633	3.89%	5.51%	4.49%
10-99 employees	17,811,529,807	61,354,380	18,022,729	16.34%	21.45%	23.33%
100-499 employees	16,477,678,813	52,947,263	15,680,081	15.12%	18.51%	20.29%
500+ employees	70,451,152,528	155,936,056	40,095,089	64.65%	54.52%	51.89%
Total	108,974,991,703	286,002,952	77,266,532			

By Carrier Type: Mutual vs. Stock Companies

A mutual insurance company is one that has no shareholders but instead is owned entirely by its policyholders. A stock company is a corporation owned by their shareholders. In Texas, about 85 percent of the payroll in the workers' compensation system is covered by stock insurance companies while 14 percent is by mutual companies including Texas Mutual Insurance Company (see Table 12). A small percentage of Texas employees are covered by Lloyds organizations (voluntary associations of individuals) and reciprocal exchanges that are private unincorporated groups of individuals and corporations that insure each other.

The premium share of stock companies is comparatively smaller than their payroll share. The main reason appears to be the fact that stock companies cover larger employers and more clerical workers, and as a result offer greater premium discounts for large deductible plans.

Table 12: Payroll and premium by carrier type, 2008

	Payroll	Standard premium	Payroll share	Premium share
Lloyds	3,525,078,453	56,950,423	1.29%	2.07%
Mutual	37,296,147,945	805,772,738	13.69%	29.25%
Reciprocal	1,565,789,144	20,254,885	0.57%	0.74%
Stock	229,984,282,978	1,871,761,906	84.44%	67.95%
Total	272,371,298,520	2,754,739,951		

2.4 Effects of Large Deductible Plan Credits

One significant factor in determining the average premium cost of workers' compensation insurance is the use of large deductible plans. In 2008, the modified premium was reduced by 30 percent due to large deductible plan credits. Large deductible plans are popular among large employers as they afford employers more control on losses and fees, and give insurance companies a greater flexibility in pricing. These plans are offered for large employers defined as having a minimum level of standard premium. In Texas, employers with a minimum premium of $5,000 are eligible for deductible standard plans. The standard deductible plans include the following:

- **Per accident deductible option.** This option offers deductibles of $1,000, $2,000, $5,000, $10,000, and $25,000 per accident, not to exceed 50 percent of the employer's estimated annual premium.
- **Aggregate deductible option.** Applies to all accident claims covered during the policy period. Deductibles range from $2,000 to 100 percent of the employer's estimated annual premium, up to a maximum of $100,000.
- **Per accident/aggregate deductible option.** This option is a combination of the two options listed above.

Employers with a premium of $100,000 or more may negotiate with the insurance company beyond this standard plan.

Certified self-insurance is an alternative Texas workers' compensation insurance arrangement available for large employers with an unmodified premium of at least $500,000. In some ways, workers' compensation insurance with a large deductible plan behaves much like a self-insurance plan with insurance claim services outsourced. A large deductible plan, compared to self-insurance, tends to have less regulatory requirements and administrative burden but retains market incentives for the employers to improve worksite safety and reduce losses. However, administrative process and costs of the outsourced plans are beyond the control of the employers. This principal-agent problem would increase costs and lower efficiency beyond those of a self-insurance option. In addition, self-administration of claims by the employers may introduce

problems in estimating and forecasting future losses and rates due to a lack of data. Finally, unlike self-insurance plans that must comply with various requirements for safety investment and solvency, large deductible plans may be used to avoid such investments and regulations, which raise concerns about the employer insolvency.[14]

A premium credit due to a large deductible plan is equal to the difference between a full-coverage premium and the expected losses and other costs that will be reimbursed by the employer. To the extent that the full-coverage premium is adequately calculated and reimbursable losses are reported completely, large deductible plan credits may not distort premiums and rates in the market. In this case, we can consider these credits as expected out-of-pocket costs of the employers. Employers' total cost could be estimated as the sum of standard premium paid to the insurer and the deductible plan credit.[15]

On the other hand, an insurance policy using a large deductible plan represents an alternative risk-sharing arrangement between the insurer and the insured. This may change the behaviors of the market participants and introduce some complexity in measuring employers' total cost. For example, as the employer takes more of the risk, the role of the insurer is more risk-sharing than risk-taking, and as such the optimal level of premium may need to be different from the full-coverage premium. Also, employers faced with deductible payments have different incentives in managing and reporting losses, which introduces some deviation from the normal expected loss calculation. When measuring efficiency in regard to taxes and fees that are proportional to the final premium and the administrative costs incurred by the insurance industry, we should also consider the increasing cost of risk management functions that are now performed by the insured and the level of costs that insurers charge for their administrative services.

Finally, a workers' compensation insurance policy is often written in connection with other insurance policies for the employer, and its premium and discounts are often determined within the combined total premiums. In this case, the workers' compensation premium is determined not only by costs, benefits and efficiency concerns within the

[14] For a more detailed discussion on this issue, see "Workers' compensation large deductible study" by NAIC/IAIABC Joint Working Group, 2006.
[15] For instance, for the purpose of maintenance taxes, the 'gross premium' is defined as the sum of standard premium and deductible plan credits (Texas Administrative Code §3.828).

market but also by strategic and marketing needs of the insurance carriers. To the extent possible, the employers' cost should be adjusted by some estimates of cross subsidies that may exist. Even though there are problems obtaining transactional data to enable such estimates, a differential comparison of the pricing between the companies writing workers' compensation only and other companies writing multiple lines of insurance may potentially reveal the effect of the interaction across different lines of insurance on premium.

3. Expenses, Incomes, and Outputs of the Workers' Compensation Insurance Industry

The average cost by itself does not indicate whether costs paid by the employers are above or below an optimal level. This level can be estimated only by comparing employers' costs with benefits they receive in return. Utilizing available data, this section looks at the benefits and associated expenses and profits which in sum would be equal to the employers' cost. Another purpose of this section is to identify types and amounts of data that can represent outputs and inputs of the workers' compensation insurance industry so that we can measure the industry's production efficiency in the next section.

Some benefits from the workers' compensation insurance cannot be directly quantified. For example, medical and indemnity benefits paid to injured employees are reported and available as insurance companies regularly report their expenses and incomes to the National Association of Insurance Commissioners (NAIC) as part of states' regulatory reporting requirements. But we find scant data regarding indirect benefits and costs such as better worksite safety, lower injured-employee physical and mental functioning, injured employees' out-of-pocket expenses, protection against some lawsuits, and reduced future financial risks. Given these limitations on data, this section primarily looks at the Insurance Expense Exhibits and financial data reports available from the NAIC.

3.1 Functions of the Insurance Companies

Defining the output of a service industry is not as straightforward as in the case of a manufacturing industry since the former involves several products and services in its production process.[16] The insurance industry's output can be defined in a few different ways. For example, in previous studies of the workers' compensation insurance, the industry's output has been defined variously by total premium, premium minus losses (or

[16] See "Difficulties in the measurement of service outputs" by Mark K. Sherwood, *Monthly Labor Review*, pp. 11-19, March, 1994, and "Price, output and productivity of insurance: conceptual issues" by Jack E. Triplett, in *Productivity in the U.S. services sector: new sources of economic growth*, eds. by Jack E. Triplett and Barry P. Bosworth, pp. 123-176, Brookings Institution Press, 2004.

profits), incurred losses, total payroll covered, number of covered employees, or investment incomes.

Total premium may be defined as output since it is the total revenue that represents the total value of production as in the case of Gross Domestic Product. Profits, or premium minus losses, may also be used if one believes that the losses are equivalent to the materials used in the service delivery process and only the value added portion of the revenue represents the output of the insurer. Also, investment incomes are often used as the industry's output since a major source of profit for insurance companies is the investment gains from reserves and policyholder surplus. Especially in workers' compensation where medical and indemnity benefits are often paid for many years in the future following the accident year, insurance companies rely heavily on reserves, and sometimes the insurance operation is carried out to secure a supply of reserve and investment cash flow.[17]

The first step in determining the industry's output is to define the role of the insurance companies. It is generally understood that insurance companies perform two different functions: the risk management function and the intermediary financial service. The risk management function, which is the definitional role of the insurance, refers to the sharing risks with, or assuming risks from, the employers regarding workplace injuries and associated costs. Productive operations under this function are the underwriting activities. On the other hand, the intermediary financial service refers to the investment activities undertaken by the insurance companies. These are intermediary functions since the funds used by insurance companies are provided by or consigned by the employers and the profits from these investment funds are shared by both.[18]

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[17] In the 2011 annual letter to shareholders of Berkshire Hathaway, Warren Buffet calls this 'insurance float.' "Insurance float – money we temporarily hold in our insurance operations that does not belong to us – funds $66 billion of our investments. This float is 'free' as long as insurance underwriting breaks even, meaning that the premiums we receive equal the losses and expenses we incur. Of course, underwriting results are volatile, swinging erratically between profits and losses. Over our entire history, though, we've been significantly profitable, and I also expect us to average breakeven results or better in the future. If we do that, all of our investments – those funded both by float and by retained earnings – can be viewed as an element of value for Berkshire shareholders." Source: Wall Street Journal, Feb. 26, 2011.

[18] Employers share some of the investment profits via distributed dividends and/or lowered premium rates when rates may be lowered to the level of negative underwriting profits. Insurance companies can afford to lose money from their underwriting operations because investment incomes will usually more than offset these losses.

For each function, the industry's inputs and outputs need to be defined. For the first risk management function, the insurer's output is a service that compensates the insured in the case of a financial loss, and thus the losses paid by the insurer may approximate the level of output. Inputs are costs incurred to produce this output, or to carry out the compensatory service. Costs can be divided into loss-related and other expenses. Loss-related expenses are those costs that vary directly with the level of losses paid, and are generally reported as 'allocated loss adjustment expense' (ALAE) or 'defense and cost containment expense' (DCCE). Losses and DCCE are often combined as the loss cost. Other costs—unallocated loss adjustment expense, acquisition costs, general and other expenses—do not vary with the level of losses/benefits paid and these expenses are input costs that are associated with the general business of the insurer. In the following section, we investigate the expense and income components of the industry's risk management function. In Section 3.3, we examine outputs and inputs in the industry's production activities as intermediary financial service.

3.2 Risk Management Service Expenses and Outputs

The insurance industry's risk management or underwriting activities entail a series of services such as setting premium rates, acquiring policies, reviewing claims, paying and reserving for losses, and administering billing and claiming processes. While some of these expenses are reported annually in the statutory Annual Statement and other supplements, a detailed view of expenses is limited by the low availability of data.

Expense and Income Allocation in the Insurance Expense Exhibit

The Annual Statement report to the National Association of Insurance Commissioners (NAIC) shows revenues and expenditures by line of business but only if they are directly associated with particular policies in a line of business. Unallocated and general expenses are not broken down by line of business. To remedy this problem, the Annual Statement is supplemented by Insurance Expense Exhibit (IEE) data reports. The purpose of these reports is to provide information by line of business, on a countrywide basis, detailing profit and losses, loss adjustments, underwriting and investment expenses. Losses from the insurance company point of view are benefits paid to employers and their employees.

The data in the Insurance Expense Exhibit is on a calendar year, countrywide basis. All expenses and incomes are allocated by line of business with the use of predetermined formulas.[19] The countrywide data are further allocated to states by the countrywide expense ratio and each state's share of the countrywide earned premium. In this regard, some expense and income figures reported in the IEE and this section are 'allocated' or estimated numbers since some expenses and incomes of a multinational corporation cannot be identified by line of business and by state.

Annual Insurance Expense Exhibit reports are available on the TDI's website at www.tdi.texas.gov/reports/report4.html. They consist of three sections. Section I shows direct business countrywide results of all businesses written in Texas (equivalent to the IEE Part III – Direct Business) and Section II shows the same in net business basis (equivalent to the IEE Part II – Net Business). 'Net business' refers to the net of reinsurance and any returned premiums from the 'direct business.' Investment incomes and pre-tax profits after-investment gains are shown in Section II only based on the argument that some of the direct premiums reported in Section I may not belong to the insurer. Section III shows the direct business results (same as Section I) but adjusted for Texas volume of business. This means that the countrywide results of the Section I are allocated to Texas by the ratio of Texas-generated premiums to the countrywide premiums unless an expense item is already reported for Texas in other parts of the Annual Statement reports. In the latter case, these Texas-specific figures are used. Six out of fourteen reported items are 'allocated' by this method. Investment gains are not calculated in Section III since direct business may include reinsurance premiums. In this report, we allocated investment gains the same way other expenses are allocated. Although there may be some difference between direct and net business figures, any such difference is trivial for our purposes.

Incurred Losses and Dividends

The largest component of the underwriting activities is the incurred losses that consist of indemnity benefits paid to injured employees and medical benefits paid to healthcare

[19] See "The Insurance Expense Exhibit and the allocation of investment income" by Sholom Feldblum, 1997, available from Casualty Actuarial Society at www.casact.org/library/studynotes/feldblum7can3.pdf.

providers. A dividend is a portion of the premium returned to policyholders, which has the effect of lowering premiums. Although dividends may be paid by either mutual or stock companies, almost all dividends in Texas are paid by one mutual company. The amount of dividends in each year also fluctuates widely as it depends on the level of surplus and profit in a particular year. Both incurred losses and dividends are payments to the insured and their beneficiaries.

These payments steadily decreased from the high of 69 percent of the earned premium in 2003 to 48 percent in 2009 (see Table 13). This decline is greater if we consider incurred losses alone: from 68 percent to 44 percent of the earned premium. While benefits decreased substantially, earned premiums—Texas employers' total payments to the insurance companies—increased from 2003 to 2006 by 7 percent and decreased from 2006 to 2009 by about 17 percent.

Table 13: Premiums and losses, 2003-2008

Calendar year	Direct premiums earned	Dividends paid to policyholders	Direct losses incurred	Dividends and incurred losses as % of earned premium
2003	2,569,283,389	34,857,078	1,747,454,375	69.37%
2004	2,613,289,639	56,227,869	1,341,225,948	53.47%
2005	2,664,919,380	60,672,059	1,519,691,166	59.30%
2006	2,743,776,171	114,185,514	1,388,217,347	54.76%
2007	2,662,376,355	139,696,882	1,382,786,758	57.19%
2008	2,592,361,944	167,788,244	1,221,207,168	53.58%
2009	2,290,864,694	96,652,984	1,004,197,637	48.05%

Loss Adjustment Expenses

Loss adjustment expenses are expenses incurred to investigate and settle losses. Prior to 1998, loss-related expenses are divided into allocated and unallocated loss adjustment expenses (ALAE and ULAE). These were reclassified by NAIC as defense and cost containment expenses (DCCE) and adjusting and other expenses (A&O) beginning in 1998. DCCEs are expenses that are associated with the loss amounts and include cost containment, defense and litigation expenses. A&O's are expenses other than DCCEs

that are associated with delivering benefits. The major component of A&O expenses is the cost associated with claim adjusting—the cost of adjusters, and the cost of inspectors, appraisers, and fraud inspectors while working in the capacity of an adjuster.

Loss-related expenses show some interesting characteristics (see Table 14). They fluctuate widely over the years from 9 percent to 16 percent of the earned premium. Levels of DCCE and A&O do not move in concert. But the overall level seems to be steady around 11 percent of the earned premium. These loss-related expenses normally vary with the level of losses. As seen in Table 13, total incurred losses decreased significantly during the study period, but loss-related expenses did not. As a result, loss-related expenses as a percentage of the incurred losses increased greatly from 17 percent in 2003 to 32 percent in 2009. One possible explanation is that the loss adjustment costs associated with claim processing may be fixed costs of the insurance industry exhibiting little correlation with the level of losses. As losses shrink, the share of loss adjustment costs in the premium will continue to increase, which represents a decrease in productive efficiency.

Table 14: Loss adjustment costs

Calendar year	Defense and cost containment expenses (DCCE) incurred	A&O incurred	DCCE and A&O as % of earned premium
2003	167,384,379	129,441,655	11.55%
2004	158,640,895	253,699,151	15.78%
2005	195,278,556	174,896,941	13.89%
2006	191,116,299	141,587,183	12.13%
2007	121,485,362	127,679,191	9.36%
2008	173,367,868	123,761,851	11.46%
2009	166,214,251	150,586,429	13.83%

Note: DCCEs are from the Annual Statement report which shows Texas-only figures. A&O's are calculated from the IEE countrywide figures by using the countrywide expense ratio.

General and Other Expenses

Loss-related costs may be considered as variable costs for the insurance output (paid losses). All other costs are fixed costs in relation to the level of output. As fixed costs,

they represent costs that companies must incur regardless of business outputs, and are associated with the initial investment (entry) costs and the scale of operation. These costs include the acquisition cost, general expense, and other costs.

Commissions and brokerage expenses are acquisition costs, and they are associated more with the number of policies than with the output (losses). While commissions may vary with the level of premium, other acquisition costs may not. These include overhead expenses for agents' offices and advertising. General expense refers to costs of offices and personnel and other administration costs. Finally, other expenses include premium taxes, licensing fees, and investment expenses.

Commissions and other acquisition expenses are the insurance industry's closest equivalent to the employee labor cost in other industries. They account for 12 to 14 percent of the revenues or earned premiums, increasing steadily from 2003 to 2009 (see Table 15). General expenses are pure administrative and materials costs for the insurance industry, and, together with tax and licensing fees, increased from 8.7 percent of the earned premium in 2003 to 11 percent in 2009.

Paid Losses as Output and Expenses as Inputs

In Section 4 below, we attempt to estimate the industry's economic and production efficiency. For this purpose, a production model has to be specified with appropriate inputs and outputs. Most recent studies on the property insurance industry adopted some form of incurred losses as the measure of the industry's output since losses represent a proxy for the risk being transferred and managed by the insurer.[20] This is based on the view that the primary activity of the property insurance industry is a risk-sharing or risk-assuming function.[21] Even with this view, there are alternative metrics for the output such

[20] For example, see "Frontier efficiency methodologies to measure performance in the insurance industry: overview, systematization, and recent developments" by Martin Eling and Michael Luhnen, *The Geneva Papers*, 2010, 35: 217-265; "Market structure and the efficiency of European insurance companies: a stochastic frontier analysis" by P. Fenn, et al., *Journal of Banking & Finance*, 32: 86-100, 2008; "Firm performance in the Chinese insurance industry" by Tyler Leverty et al., Center for Risk Management and Insurance Research *Working Paper* #04-10, Georgia State University, 2004.

[21] 'Risk-sharing' means pooling a risk among participants of an insurance mechanism. This is close to the definition of a mutual insurance scheme. But today when most employers purchase a workers' compensation insurance, they almost always expect the insurer to assume or take the risk in exchange of the premium paid. Under a risk-sharing or pooling arrangement, the insurer does not assume the risk, and therefore the insurer's output is simply the net value added (premium minus losses). In a risk-assuming

as gross revenue or premium, the number of employees or employers covered, or the number of policies. But gross premiums include profits that may not correlate with outputs. Other measures, like employers and employees covered, have the advantage of being measurable quantities but current reports are mostly financial and accounting aggregates in nature and the data about these quantities are often incomplete. In the future, a more detailed research into the available data from NAIC and NCCI may reveal some ways to use these quantities as output metrics. At present, losses are the most commonly accepted proxy of insurance output.

Table 15: General and acquisition costs

Calendar year	Commissions and brokerage expenses	Other acquisition expenses	Taxes and licensing fees	General expenses	Acquisition cost as % of earned premium	General expense and tax as % of earned premium
2003	184,994,907	124,879,877	82,540,539	141,060,403	12.06%	8.70%
2004	203,923,342	127,517,931	86,256,888	131,306,529	12.68%	8.33%
2005	197,281,474	126,862,298	78,834,391	136,654,546	12.16%	8.09%
2006	212,200,983	123,659,351	84,782,606	112,120,235	12.24%	7.18%
2007	219,845,613	140,824,876	101,267,685	161,093,133	13.55%	9.85%
2008	216,363,713	142,314,988	79,028,341	162,956,707	13.84%	9.33%
2009	190,567,018	113,504,548	68,175,379	183,050,059	13.27%	10.97%

Note: Texas portions of other acquisition expenses and general expenses are calculated using the countrywide expense ratio.

Unlike other studies that use incurred losses, however, we use paid losses as the measurement for the industry's output. Incurred losses are the sum of paid losses and changes in the loss reserve. For example in 2008, incurred losses were $1.22 billion, the sum of paid losses ($945 million) and changes in unpaid loss reserves ($276 million or 11 percent of the earned premium). Since the total value of a claim must include all future payments, associated reserves should be included in any calculation of a claim's cost. However, loss reserves reported in aggregate may increase or decrease depending on the insurance carrier's loss experience and financial operations, and as a result, reported incurred losses may be substantially different from actual projected losses for the year.

arrangement, the insurer takes the transferred risk and an appropriate output measure may be the gross premium (total revenue) or the losses.

To eliminate this accounting effect, we use actual paid losses as a proxy for the industry's output.

For the industry's inputs, we aggregate various expense components into three categories: (1) loss-related costs, representing variable and material costs, (2) acquisition costs, representing labor costs, and (3) general expenses, representing administrative costs. Loss-related costs are the sum of DCCE and A&O expenses; acquisition costs combine commissions and other acquisition costs; and the general expenses combine general expense and taxes and licensing fees.

3.3 Outputs in the Intermediary Financial Service

In addition to the risk management service function, the property and casualty insurance industry acts as a financial intermediary, collecting and investing funds. Investment gains are an integral part in calculating premium rates, profits and solvency requirements. However, this view of insurance industry as a financial intermediary has been conflicting with the earlier risk management approach and many have debated which one is a more appropriate measure of the output.[22] It is difficult to settle on one primary function when the industry provides multiple services. But the debate about the industry's primary output stems from the fact that most studies utilized a parametric model that required one and only one output as the dependent variable. Today, many parametric methods and non-parametric method like the one we use in Section 4 allow multiple dependent variables.[23] We simply add investment gains as another output of the insurance industry.

Investment gains are the result of the industry's financial intermediation service, and are often more important source of profits than underwriting profits. They are reported in the Insurance Expense Exhibit, Part II – net business as the countrywide total allocated by line of business. However, they are not separately reported for each state since funds for investment are often aggregated and invested nationally. Source funds also include capital surpluses that are often not associated with a particular line of business. Nevertheless, there is no theoretical reason that prevents us from allocating investment

[22] For a brief discussion about the controversy, see Eling and Luhnen, 2010, p. 230.
[23] See Section 4.1 for an introduction to these methodologies.

gains on the basis of the state's share of earned premium or some other measure.[24] Therefore, we have allocated Texas shares of investment gains from the IEE's countrywide figures and present the result in Table 16.

Investment gains depend highly on the condition of the market and available investment instruments and the performance of the investment professionals managing the funds. During the financial crises after 2009, it is expected that investment gains will be much lower than previous years. Nevertheless, the industry's performance is consistently stable unlike underwriting profits that may gyrate widely. In Table 16, underwriting profits are shown in the fourth column (pre-tax profits or loss excluding investment gains), which recorded $101 million loss in 2003 and $206 million profit in 2009. In comparison, Texas share of the investment gains from insurance funds ranged from $250 million in 2003 to $316 million in 2007. 'Insurance funds' refer to the funds associated with insurance transactions. These are primarily reserves set aside from premiums for various reasons.

Table 16: Investment gains from financial service activities

Calendar year	Texas share of investment gains from insurance funds	Texas share of investment gains from capital and surplus	Pre-tax profit or loss excluding investment gains	Pre-tax profit or loss including investment gains
2003	249,644,637	129,801,880	-101,148,665	278,297,853
2004	249,517,508	134,833,888	287,065,081	671,416,477
2005	272,593,472	132,253,247	54,612,303	459,459,021
2006	286,668,221	185,420,416	298,157,101	770,245,738
2007	316,084,416	227,613,916	248,187,498	791,885,830
2008	258,305,075	175,257,523	290,218,556	723,781,154
2009	250,087,624	274,736,087	206,329,681	731,153,392

On the other hand, 'capital and surplus' (or policyholders' surplus) refer to the insurance company's own starting capital investment and retained earnings. Investment gains from reserves (or insurance funds) are much higher than those from capital and surplus. This is mainly due to the fact that reserves are a bigger part of the industry's

[24] For example, relative shares of accumulated reserves or profits may be a better basis for allocation if we believe these provide the seed money for investment.

capital investment funds than its own capital. Net pre-tax profits for the Texas workers' compensation insurance industry is the sum of these investment gains and the underwriting profits. This amounted to an estimated $731 million in 2009, before federal income tax.[25]

Table 17 shows the major types of reserves that insurance companies set aside and maintain. These are the insurance funds that are used to generate investment incomes. Unearned premium reserve is set aside against possible refunds. Loss reserves are reserves for future loss payments. Reserves are also set up for DCCE and A&O expenses. In total, accumulated reserves amount to three to four times of the annual earned premium. For example, the Texas portion of the investment funds available to the insurance companies via reserve accounts amounted to over $9 billion in 2008.

But these reserves are running totals of each account to which some of each year's premiums are added. In other years, reserves may be released to be used to pay for losses or expenses. To find out how much of the premium is set aside as reserves, we need to calculate the changes in reserve. Table 18 summarizes 2003-2008 changes in reserves. In 2003, $16 million were set aside for unearned premium reserve, $434 million for loss reserve, and about $20 million for expense reserves. In each year from 2003 till 2007, about $500 million or more of the premiums were set aside as reserves. The largest reserve is held as the loss reserve that is used to pay for future loss payments for the current year's claims.

Table 17: Reserves

Calendar year	Direct premiums earned	Unearned premium reserve	Loss reserve	DCCE reserve	A&O reserve	Total reserves
2003	2,569,283,389	782,090,942	5,171,657,890	410,866,987	248,665,100	6,613,280,919
2004	2,613,289,639	796,597,724	5,512,247,374	463,967,114	252,679,397	7,025,491,609
2005	2,664,919,380	841,198,544	6,050,366,515	526,586,048	270,595,045	7,688,746,152
2006	2,743,776,171	899,693,908	6,591,888,014	588,924,679	281,799,564	8,362,306,165
2007	2,662,376,355	969,196,939	7,120,633,642	597,036,712	275,234,551	8,962,101,844
2008	2,592,361,944	956,351,874	7,388,587,220	649,019,157	290,347,038	9,284,305,289
2009	2,290,864,694	848,328,351	7,437,167,675	694,813,579	306,665,394	9,286,974,999

[25] After-tax profits will be considerably lower than $731 million. NAIC's *Profitability Report* attempts to estimate the industry's profitability based on the return on net worth (the ratio of net income after taxes to net worth). This conservative estimate shows that Texas insurance companies had 11.2 percent return on equity (ROE) in 2009, compared to the national average of 3.8 percent ROE.

Table 18: Changes in reserves

Calendar year	Change in unearned premium reserve	Change in loss reserve	Change in DCCE reserve	Change in A&O reserve	Net changes in reserves
2003	15,693,567	433,803,503	25,709,970	-4,023,207	471,183,833
2004	14,506,782	340,589,484	53,100,127	4,014,298	412,210,691
2005	44,600,820	538,119,141	62,618,934	17,915,648	663,254,543
2006	58,495,364	541,521,499	62,338,631	11,204,519	673,560,013
2007	69,503,031	528,745,628	8,112,033	-6,565,013	599,795,679
2008	-12,845,065	267,953,578	51,982,445	15,112,487	322,203,445
2009	-108,023,523	48,580,455	45,794,422	16,318,356	2,669,710

The amount to be reserved is determined by various formulas that 'develop' losses. Basically, loss development means loss forecasting, and loss development or reserving models have primarily utilized somewhat elementary loss triangle or chain ladder methods.[26] By design, these forecasts, as in moving averages, smooth out year to year variations, and result in delayed reactions to actual changes. Thus, calculated reserves may be high and increasing resulting in higher premium rates, even when actual losses are decreasing. Also, reserve forecast may be decreasing when actual losses trend upward. This built-in delay may be one of the reasons why insurance premiums fluctuate in cycles. Nevertheless, this delay also acts as a buffer that mitigates the effects of unexpectedly increasing or decreasing losses, partly because reserves are maintained at an excessive level most of the times. Therefore, insurance companies during a competitive market cycle can afford to lower premiums by releasing reserves while accumulating reserves when the market is soft.

When selecting an output metric, we decided to combine investment gains from insurance funds (reserves) and from capital and surplus. Inputs for this output are certainly the funds themselves. The primary input is the amount of capital and surplus for each insurance carrier obtained from the NAIC's Insurance Regulatory Information

[26] See "Loss reserving: past, present and future" by Greg Taylor, G. McGuire and A. Greenfield, Center for Actuarial Studies, The University of Melbourne, *Research Paper* #109, 2003. For recent discussions on possible improvements, see "Class ratemaking for workers' compensation: NCCI's new methodology" by Tom Daley, *Casualty Actuarial Society E-Forum*, Winter 2009 (available from NCCI at www.ncci.com/documents/ClassRatemaking.pdf), and "A loss reserving method based on generalized linear models" by Jun Zhou and Jose Garrido, *Technical Report* No. 2/09, Corcordia University, 2009.

System. In addition, we included the unearned premium reserve as part of the investment inputs since it seems to vary closely with premium collecting activities. Another possible input for investment activities would be labor and material costs allocated specifically for investment activities. But this data is not available.

3.4 Summary

To recap our discussions on the employers' costs and the insurance industry's expenses, Figures 4 and 5 summarize how premiums are determined and how the collected premiums are used. Standard premiums paid by the employers—about $2.7 billion in 2008—are about 46 percent of the initial manual premiums quoted by the insurance carriers—about $5.9 billion at a rate of $2.23 per $100 payroll (see Figure 4). Total payroll covered by workers' compensation insurance policies was $266 billion. About $1.5 billion in credits were given due to the use of large deductible plans, mostly for large employers. Under a large deductible plan, the employer must pay for losses or benefits up to $100,000 or a higher deductible amount. Experience modification credits and schedule rating credits are also an important basis of discounts, but these in theory may be debits (additions to the premium) as much as credits. To get such discounts, employers must incur additional costs to improve workplace safety. Total workers' compensation costs to the employers are the sum of premiums paid and out-of-pocket costs due to deductible plans and safety programs.

Premiums paid by the employers become the revenues for the insurers. In 2008, about 54 percent of this payment was used to pay for medical and indemnity benefits and dividends (see Figure 5). Claim processing and adjustment expenses accounted for 11.5 percent of the premium, and acquisition costs amounted to about 14 percent. General expenses, insurance taxes and licensing fees explained 9.3 percent of the premium. The remaining 12 percent of the premium was the underwriting profits for the insurers. The policy year 2005 was somewhat different from other years. Losses accounted for a higher percentage of the earned premium while at the same time investment gains were comparatively lower. Beginning in 2005, reserves increased significantly even though losses were at the lowest level. The increasing reserves may have been influenced by the past increasing losses via the industry's loss development procedure.

Figure 4: Calculating standard premium from payroll, 2008

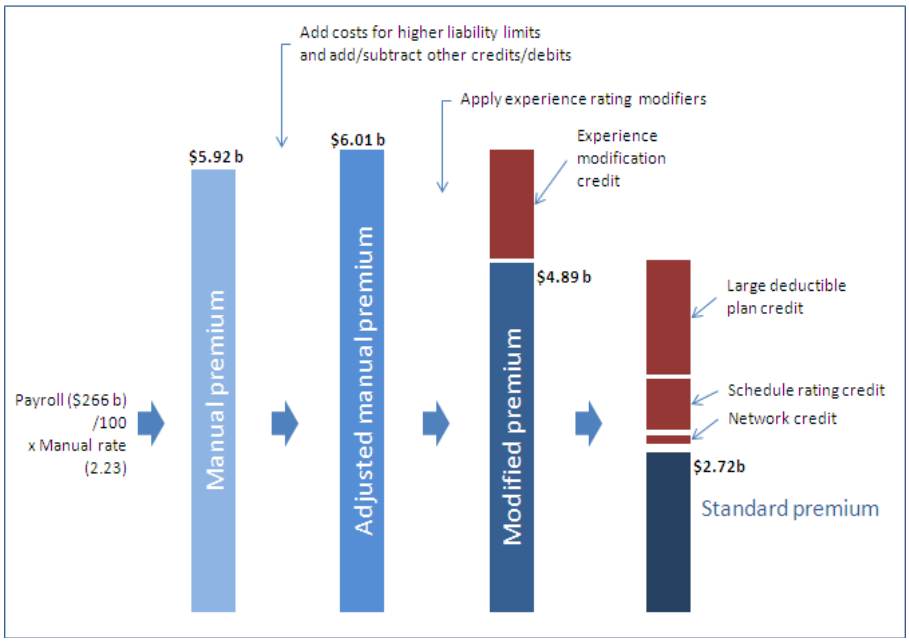
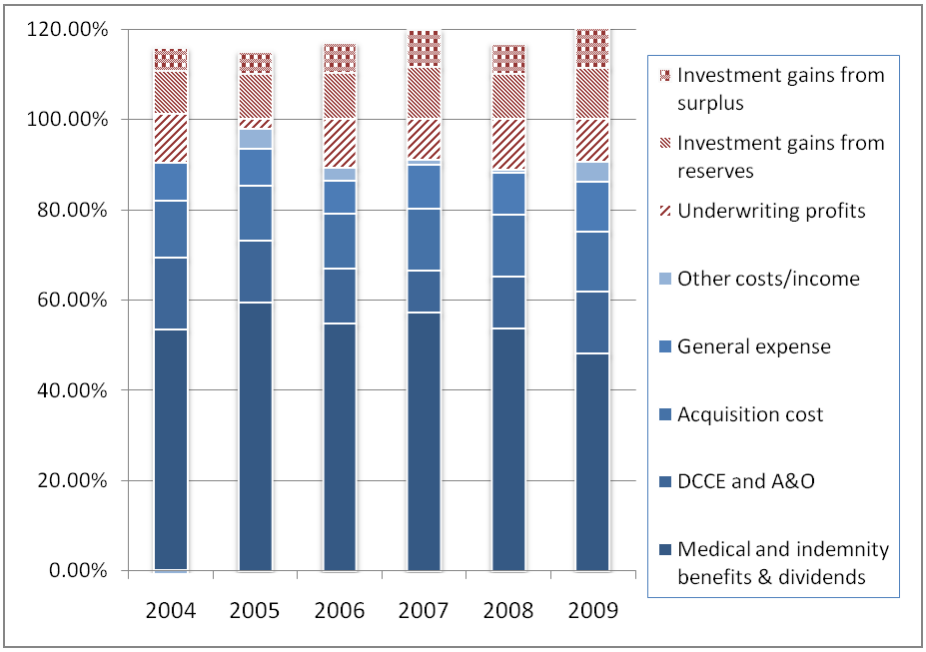


Figure 5: Expenses and investment gains as a percentage of earned premium, 2004-2009 calendar years



The underwriting profit is seldom the major income source for insurance companies, especially in a long-tail line like workers' compensation. A substantial portion of the premiums are held in various reserves and used as funds to generate investment gains. Estimated from the industry's nationwide figures using the Texas share of the workers' compensation premium, the Texas portion of the pre-tax investment gains from reserves and surpluses were $525 million in 2009, equivalent to about 24 percent of the earned premium.

Finally, the detailed discussion in this section of the cost components of the workers' compensation insurance is to gain some insight on the conditions of the market. An efficient market generates an optimal price, maximizes production given allocated resources, and satisfies employers, employees, and the insurers. A simple measure of a market's desirability or efficiency is a ratio of benefits to expenses, or outputs to inputs.

For example, this section showed that the level of premiums paid for workers' compensation insurance stayed about the same from 2003 till 2008, at around $2.6 billion, while the total amount of payroll covered increased by over 25 percent.[27] This implies that the premium rate per $100 payroll decreased substantially, which benefits Texas employers. However, a small number of large employers account for over 50 percent of employees in Texas, and these employers tend to use large deductible plans, paying benefits and other costs themselves. These costs are not captured adequately in most published statistics for workers' compensation insurance. Within the reported data, direct benefits paid to injured employees decreased considerably while administrative and operational expenses stayed at the same level or increased to some extent. In the next section, we investigate this issue of economic efficiency in more detail.

[27] See Table 13. The direct earned premium in 2009 was $2.29 billion, a decrease of 12 percent from $2.59 billion in 2008. This may indicate that the effect of the decreasing losses in the past few years is finally catching up with the premium.

4. Efficiencies in the Workers' Compensation Insurance

Employers' costs, as discussed in Section 2, are revenues to insurance companies that engage in production activities to deliver insurance services to the insured. Section 3 focused on the expenses and profits incurred by insurance carriers. This section is an effort to evaluate how these costs and expenses can be utilized to measure the efficiency of the insurance market. The efficiency of the industry may be measured by the ratio of benefits to costs or by the rate of profits. But these measures involve certain assumptions about a desired level of premiums, benefits, or profits. On the other hand, a productivity analysis or a productive efficiency measure is only concerned with the degree of efficiency in converting inputs into outputs. We focus on the productivity analysis to limit our analysis to pure technical efficiency of the market as this report is the first attempt at such studies with available data.

4.1 Efficiency Estimation Methods

An economically efficient industry is one that produces a maximum amount of output given a set of inputs, or that uses a minimum amount of input given a set of outputs. This definition of efficiency is about the productivity of the producers. Therefore, researchers first specify the maximum level of production possible for a set of inputs and a model of production technology that converts inputs to outputs. This is often achieved by specifying a production function $y = f(x_1, x_2, \dots, x_n)$ where y is the output produced by N inputs of X's. This function maps out the most efficient points of production—often called the production possibility frontier. Firms that produce an output efficiently will lie on this frontier. Inefficient or less efficient firms will produce a lower output using the same inputs as the efficient ones.

Most econometric methods are based on a functional form with a view to estimate parameters of this function to measure efficiency.[28] However, they assume that we know

[28] For a general introduction in the context of insurance, see "Frontier efficiency methodologies to measure performance in the insurance industry: overview, systematization, and recent developments" by Martin Eling and Michael Luhnen, *The Geneva Papers*, 35: 217-265, 2010. Other useful references include "Analyzing firm performance in the insurance industry using frontier efficiency methods" by J. David Cummins and Mary A. Weiss, *The Working Paper Series 98-22*, The Wharton Financial Institutions

functional forms of productive activities. Some simple forms of production function have been used when studying manufacturing industries where inputs are physically transformed into a final output. For service industries such as insurance, however, this physical relationship between inputs and outputs is not apparent. Production functions required by parametric models are not known.

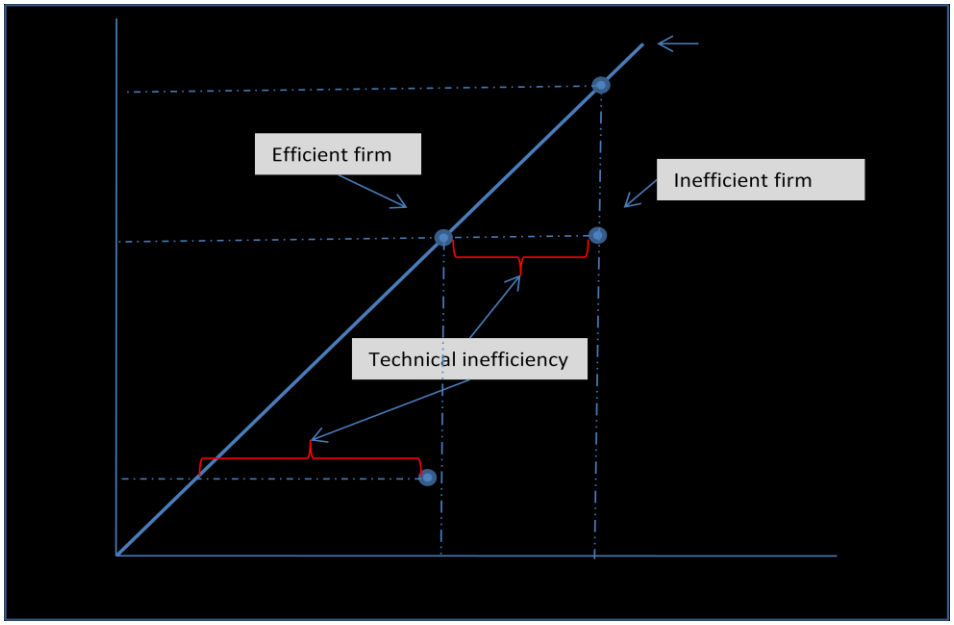
As a solution to this problem, some researchers use a non-parametric method to estimate efficiency in the insurance industry. The most popular non-parametric method is Data Envelopment Analysis (DEA). In DEA, firms in a sample are compared one by one against each other in all inputs and outputs to determine which ones represent the most efficient production combination. Once these on the production frontier are known, the distance between the most efficient one and all other firms is calculated. This is the basis of the DEA's efficiency measurement.

A graphical introduction is presented in Figure 6 involving only one output and one input. At a given output level, technical inefficiency is the ratio between the optimal inputs to the actual input. In the Figure 6, Firms A and B are producing the same output Y_2. But Firm B uses more input than Firm A. Therefore, Firm A is efficient (comparatively) while the technical or economic inefficiency of Firm B is the amount of the additional input used. Mathematically, Firm B's efficiency rate is calculated as the efficient amount of input (X_A) divided by the actual input (X_B), or X_A / X_B. If a firm is on the efficient production frontier, this rate will be 1. As the firm is further away from the frontier, this rate decreases: a lower number means lower efficiency. An efficiency rate of 0.8 implies that a firm is operating at the 80 percent of efficiency and it can reduce 20 percent of its input while maintaining the same level of output.[29]

Center, 1998; and "Economic efficiency and frontier techniques" by Luis R. Murillo-Zamorano, *Journal of Economic Surveys*, 2004, 18(1): 33-77.

[29] This is an input-oriented measure. We can also fix the level of inputs and examine whether outputs can be increased to the maximum. This is called an output-oriented measure and the technical efficiency is calculated on the Y axis, as Y_2 / Y_3. However, efficiency scores are the same for both approaches.

Figure 6: Technical efficiency measures

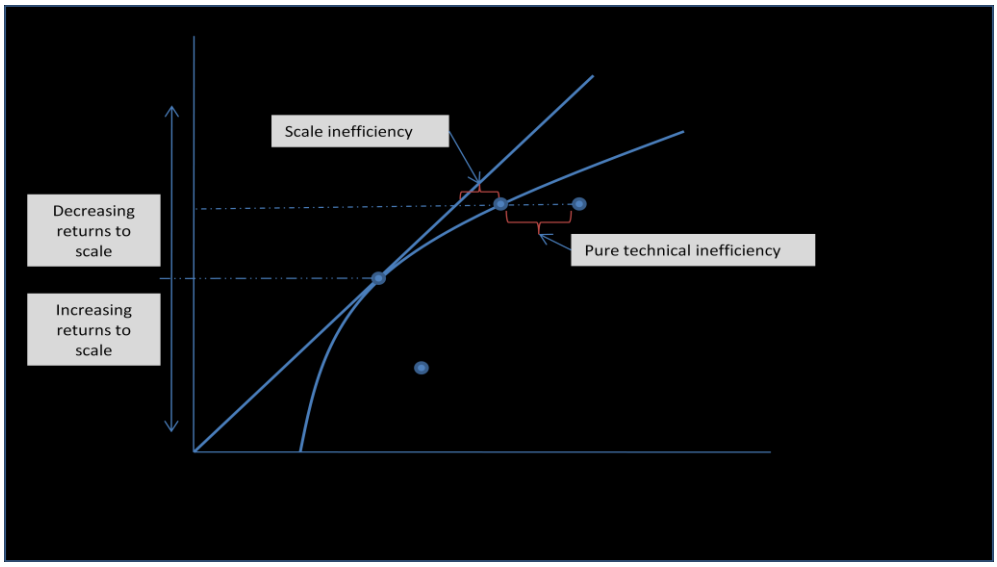


Although the DEA approach is conceptually simple, comparing thirty or forty firms one by one is computationally intensive when there are multiple outputs and inputs. In addition, Figure 6 assumes a constant returns-to-scale (CRS) technology where inputs and outputs change proportionally. But production technologies are often non-CRS. With decreasing returns-to-scale, output increases less than increased inputs; and with increasing returns-to-scale, firms experience higher output growth than a proportional increase in inputs. Therefore, a proper or efficient scale of operation must be determined for each firm.

When the scale of operation is allowed to vary, the most efficient production frontier is no longer a line from the origin, but a curve that shows increasing and decreasing returns-to-scale (see Figure 7). This new curve is the variable returns-to-scale frontier. Firms may operate at an inefficient scale of production, due to imperfect competition, constraints on finance and so on. In Figure 7, Firms B and C are in the decreasing returns-to-scale region. Decreasing returns-to-scale refers to the fact that one unit of added input results in less than one unit of output growth (a decreasing marginal return for input). In this case, the firm is operating at a scale that is bigger than the optimal. Nevertheless, Firm B is technologically efficient since it is on the variable returns-to-

scale efficient frontier even though it still has some inefficiency due to its excessive scale of operation. Firm C's inefficiency is larger and consists of pure technical inefficiency (operating with higher input than is necessary) and scale inefficiency. The overall technical or economic efficiency is calculated as the scale efficiency multiplied by the pure technical efficiency.

Figure 7: Efficiency measurement and scale economies



Due to intensive calculations needed, most DEA studies make use of computer software with linear programming. Although commercial statistical packages are available, we use an open-source computer program called DEAP[30]. Developed by Tim Coelli at the University of New England, Australia, DEAP is simple but provides most procedures needed for this study. A more sophisticated analysis with commercial software may be needed in the future when more and better data become accessible.

As a final note, it is necessary to discuss some limitations of the DEA models. The most important restriction of the DEA method is its assumption that the data be free of measurement errors. This is due to the fact that, unlike parametric or econometric models

[30] See "A guide to DEAP version 2.1: a data envelopment analysis (computer) program", *CEPA Working Paper 96/08*, University of New England, 1996, available at various online depositories including Rice University at www.owlnet.rice.edu/~econ380/DEAP.PDF. LIMDEP is the most versatile commercial package for DEA analysis. Although SAS and Stata are capable of running DEA-related analysis, currently available utilities are in limited configurations.

that specify error terms, DEA models have no error term since they do not assume any functional form. An error term is used to represent the difference between sample observations and the true values. Parametric models utilize distributional assumptions to estimate the degree observational errors affect their estimated parameters. Without an error term, however, any discrepancy in parameter estimates would include measurement errors. Since DEA models do not have parameters, any estimate of efficiency may either be data errors or true inefficiencies, or both.

Thus, some measurement errors are included in the calculated efficiency score under a DEA model. This error may increase or decrease estimated efficiency metrics. For example, an 80 percent efficiency estimated by DEA may actually be a 10 percent inefficiency plus a 10 percent positive measurement error, or a 30 percent inefficiency with a 10 percent negative measurement error. In the latter case, DEA estimates actually raise the efficiency score. The only way to minimize this problem is to increase the accuracy of the data. TDI's data come from a database of statutorily required reports. To the extent that the regulatory system operates efficiently, measurement errors are expected to be at a minimum even though errors stemming from model specification may still be present.

4.2 Insurance Outputs and Inputs

DEA models require quantities of outputs and inputs to calculate relative inefficiencies. For workers' compensation insurance industry, we use outputs and inputs examined in Section 3. To recap, we specified two outputs for the industry: *paid losses* as output of the industry's risk management function and *investment gains* as output of the industry's intermediary financial service function. Inputs for the risk management function are the three expense items: (1) loss-related costs, (2) acquisition costs, and (3) general expenses. The one input for the financial intermediary function is the sum of unearned premium reserve and the policyholders' surplus.

The most complete model would include all two outputs and four inputs. But this puts a harsh constraint on data, eliminating many observations due to missing, incomplete and wrong data. We therefore run three DEA models each with a different combination of outputs and inputs. First, the complete model with two outputs and four inputs is used to

estimate annual efficiencies of top 30 insurance companies from 2006 to 2009. Secondly, a one-output, three-input model is used to evaluate efficiencies in a longer time period from 2000 to 2008. In this specification, the industry's function is restricted to risk management and investment functions are ignored. Inputs are also simplified as DCCE, A&O expense, and general expense. Furthermore, data points are accumulated over 4 or 5 years to include as many companies as possible, resulting in two sets of samples. Still, this model analyzes each set of companies separately so that the two sets of efficiencies are not directly comparable. Finally, a simple database is constructed to run a Malmquist version of DEA that is specifically designed to estimate efficiency changes over a period. This requires that same observations have the same data points in all years, and for this reason, we use one output, three input model for Malmquist. Output is the same paid losses, but inputs are simplified with DCCE, A&O expense, and general expense.

4.3 Technical and Scale Efficiencies

Technical and scale efficiencies in DEA models are estimated in a given set of observation at a given time. Therefore, there is no concept of time series or temporal changes in these measurements. Even though we present results for multiple years, they are not to be understood as indicating temporal changes.

Model 1: 2-Output 4-Input Model

In this model specification, insurance companies perform two functions: risk management service and financial intermediary service (investments). Among all companies with usable data, the top 30 firms in terms of earned premium are selected in each year. Collectively, they represent 74 percent to 80 percent of the total earned premium. Summary statistics for the samples are presented in Table 19. When adding more firms into the sample, technical efficiency measurements decrease since there will be more variances among the sample firms. By selecting the top 30 firms, the analysis will be more homogeneous while having enough number of observations to be meaningful. The accepted sample size for a DEA study is at least 3 times the number of inputs and outputs ((2+4) x 3 = 18).

Table 19: Overview of the sample

	N	Earned premium	Top 30 earned premium	Top 30: % of earned premium
2006	361	2,743,776,171	2,191,023,748	79.85%
2007	358	2,662,376,355	1,990,743,358	74.77%
2008	375	2,592,361,944	1,914,054,714	73.83%
2009	383	2,290,864,694	1,755,695,011	76.64%

Efficiency estimates are summarized in Table 20. Total technical efficiency estimates are shown in the first column. In 2009, this was 0.820, meaning that companies on average operated at 82 percent of efficiency. In other words, 18 percent of inputs could have been reduced if all companies were efficient. Different sets of samples were used for each year, but the industry shows some improvement since 2006.

Table 20: Efficiency estimates of top 30 firms, 2-output model

	Technical efficiency	Pure technical efficiency	Scale efficiency	Number of IRS	Number of DRS	Number of Efficient
2006	0.776	0.850	0.905	19	3	8
2007	0.789	0.914	0.863	15	6	9
2008	0.752	0.854	0.881	11	7	12
2009	0.820	0.951	0.857	11	4	15

Technical efficiency can be divided into pure technical and scale efficiencies. Pure technical efficiency relates to managerial performance in organizing inputs in the production process. Scale efficiency relates to the ability of the management to choose the optimum size of resources. Managerial efficiency is higher than scale efficiency in 2009. In 2006, scale efficiency was higher.

The last three columns show the number of firms operating in a scale that is increasing (IRS), decreasing (DRS), or efficient (constant). An input's average productivity reaches its maximum at constant returns to scale, and thus it is the most efficient production level. In 2009, 15 of the top 30 firms operated at an efficient scale while 11 firms were at increasing returns to scale (IRS), which indicates that these firms have the capacity to increase their operational scale. One aspect of a less competitive

market is the firms' tendency to restrict output. That is, more firms operated in the IRS region as the above result shows. However, there is evidence of market improvements as more firms move up the efficiency scale.

Both the distribution of firms by scale economy and the overall technical efficiency are improvements (82% and 15 efficient firms) in 2009 over the results in 2006 (78% and 8 efficient firms). The gains in 2009 mainly comes from pure technical efficiency than from scale efficiency: in 2009, more firms (15) operated at an efficient scale than in 2006, but the scale efficiency is lower by about 5 percent while pure technical efficiency is higher by about 10 percent. This means that more firms are closer to their technical efficiency given the economic scale.

Model 2: 1-Output 3-Input Model

To compare an efficiency measurement of recent years with that of earlier years, we constructed a simpler model that enabled us to build samples covering 2000-2008 policy years. Using paid losses as output, this model considers insurance companies as providers of risk management function only. Inputs are also simplified from Model 1. To obtain a maximum number of observations, we used accumulated data to build two sets of samples, each with 30 top companies out of total 94 in terms of earned premium, about 80 percent of the total premiums in Texas. Results from Model 2 are presented in Table 21. The efficiency scores of '2000-2004' and '2005-2008' are not directly comparable but present a rough comparison between two time periods.

Table 21: Efficiency estimates of top 30 firms, 1-output model, accumulated

	Technical efficiency	Pure technical efficiency	Scale efficiency	Number of DRS	Number of IRS	Number of efficient scale
2000-2004 accumulated	0.559	0.706	0.794	16	11	3
2005-2008 accumulated	0.776	0.839	0.923	11	10	9

In the 2005-2008 accumulated sample, total technical or economic efficiency is at 78 percent of the maximum. This is further divided into the pure technical efficiency

(regarding production given current scale of operation) and the scale efficiency (regarding whether the scale of operation can be increased or decreased). Pure technical efficiency is 0.839 (84 percent) for the sample. This implies that 16 percent of inputs can be reduced if all firms operate at the maximum technical efficiency. Its scale efficiency is at 92 percent. Eleven firms operated at the decreasing returns to scale (DRS) region, indicating that their scale is larger than the optimal. Ten firms are in the increasing returns to scale (IRS) region, demonstrating that they have the capacity to increase their scale. Comparing the results with 2000-2005, both scale and pure technical efficiencies have improved in the Texas insurance market.

4.4 Changes in Efficiency: 2000-2008

The Malmquist Productivity Index is used to compare efficiencies of multiple companies or regions. It is a kind of distance measurement normalized by substituting inputs and outputs of each company in the comparison. The Malmquist Index can be calculated for the same companies at multiple time periods. In this case, it presents a view of changes in efficiency over time.

To measure temporal changes, the sample data must consist of the same observations throughout the analysis period. For this model, a simplified 1-output, 3-input model is used and investment gains and capital inputs are excluded. To construct the dataset, we begin with all large and small firms that have positive data in all years. This contains small firms unlike the above Models 1 and 2 which were restricted to the top 30 companies. There are 47 firms in the data summarized in Table 22. Total net premium ranges from a high of $692 million to a low of $96,000. This large variance in input usage and output scale may potentially affect the average efficiency scores.

Malmquist scores are presented in Table 23. There are only one set of scores that summarize the net change in efficiency during the period. The overall economic efficiency is called total factor productivity (TFP), which is at .893. This indicates that the overall productivity has decreased by 11 percent in the 9 year period.

Table 22: Overview of 47 firms for the Malmquist model

	Net premium	Paid losses	Paid DCCE	A&O expenses	General expenses
Total	1,092,179,122	254,735,757	21,562,226	52,903,445	102,941,203
Max	691,517,571	166,671,628	9,856,734	18,831,991	64,449,970
Min	95,877	935	380	15,251	8,732
Average	23,237,854	5,419,910	458,771	1,125,605	2,190,238

Note: Texas portion of A&O expenses and general expenses are calculated using countrywide expense ratio.

Table 23: Malmquist Index efficiency estimates, 2000-2008

(1) Change in total factor productivity	(2) Change in technology	(3) Change in technical efficiency	(4) Change in pure technical efficiency	(5) Change in scale economy
0.893	0.923	0.968	0.975	0.993

TFP can be divided into 'change in technology' (column 2) and 'change in technical efficiency' (column 3). Change in technology is concerned with the pure technological usage in the industry such as a change in the industry-wide production technology or frontier itself. Change in technical efficiency assesses how efficiently each firm applies this technology to production. Technical efficiency is further divided into pure technical efficiency (column 4) and scale efficiency (column 5). All measures are less than 1, indicating an increase in inefficiency.

Malmquist index for economy-wide change in technology is 0.923 while technical efficiency within firms' production process is 0.968, indicating that TFP decreased slightly more by industry-wide factors (8 percent) than by production practices within individual firms (3 percent). Within-firm factors can further be separated into pure technical change (0.975) and scale change (0.993). Pure technical change including management processes contributed more to the TFP decline than changes in operational scale.

One possible explanation for the efficiency decline is that 'change in technology' is influenced by the changes in the production frontier which is affected by the overall

decreasing output (i.e. 'paid losses') as losses decreased substantially during the period. This is somehow interpreted as a decrease in the productive capacity while fixed inputs may stay the same. This may imply that paid or incurred losses as output are not like the number of products in the manufacturing industry that usually grows when a firm is more productive.

Can an increase in paid losses with constant expenses be interpreted as efficiency gains in the WC insurance industry? If yes, an appropriate model of outputs and inputs may need to be constructed. For example, if we take the number of employees covered or total payroll covered, which were increasing, as output, then the efficiency result may be different. But the increase in the number of employees and payrolls covered may be largely due to the use of deductible plans which increases employers' costs and reduces insurers' losses. Thus, the industry's output may be exaggerated. Even with paid losses as output, the question remains regarding how much of the reported losses are actually reimbursed by the employers, which may affect the model's output. It suffices to say that our results are bound by limitations due to various data and model specification issues to be researched further.

4.5 Summary

Estimates show that the average insurance carrier in the Texas workers' compensation insurance is operating at about 80 percent efficiency of the most efficient firm. This average efficiency score improved over the years, but it is based on different samples in different years. More appropriately for temporal changes, we calculated the Malmquist Index and it showed deterioration in efficiency since 2000—an eleven percent decrease in the overall productivity.

For comparison, a recent study of the U.S. insurance industry between 1993 and 2006 reported an estimate of 0.61 for technical efficiency in the property-casualty industry.[31] A study of the Chinese property and casualty insurers found an average technical

[31] See "Economies of scope in financial services: a DEA efficiency analysis of the US insurance industry" by J. David Cummins et al., *Journal of Banking and Finance*, 34:1525-1539, 2010.

efficiency of 0.866 for the 1995-2002 period.[32] The same study also reports a TFP of 1.158, representing 15.8 percent increase in the overall productivity during the period. Another study of the Chinese property-casualty insurance industry reported estimates of 0.68 to 0.89 for technical efficiency, 0.91 to 0.95 for pure technical efficiency, and 0.72 to 0.94 for scale efficiency for various years between 2000 and 2004.[33] Malmquist indices indicated that the total factor productivity decreased during the period. A Malmquist productivity change study of the Greek insurance industry reported an annual 1.3 percent productivity gains between 1994 and 2003.[34]

The variety of these results indicates that the efficiency estimate in nonparametric methods depends critically on the sample selected. To obtain consistent and dependable results for Texas, our sample should contain all possible companies doing business in Texas for a significant period of time. This necessitates more in-depth examinations of available data and economic models. Although limited in scope, this section is intended to provide a basis for future studies.

[32] See "Firm performance in the Chinese insurance industry" by Tyler Leverty et al., *Center for Risk Management and Insurance Research Working Paper* #04-10, Georgia State University, 2004.
[33] See "Efficiency and productivity of Chinese property insurance industry" by Mingliang Yang, *International Journal of Business and Management*, 1(4): 81-90, 2006.
[34] See "A Malmquist index for the Greek insurance industry" by Milton Nektarios and Carlos P. Barros, *The Geneva Papers*, 35: 309-324, 2010.

5. Concluding Remarks

The total cost incurred by Texas employers for workers' compensation insurance is the sum of paid insurance premiums and out-of-pocket expenses. Standard premiums paid by the employers amounted to about $2.7 billion in 2008, which represented about 46 percent of the initial manual premiums quoted by the insurance carriers at about $5.9 billion at a rate of $2.23 per $100 payroll.

While the yearly amount of premiums collected by the insurers remained relatively constant, the average premium rate per payroll decreased substantially since its peak in 2003, mainly due to the fact that the total payroll covered by workers' compensation insurance policies increased steadily to $266 billion in 2008. However, the increase in covered payroll is mostly attributable to large employers who cover more employees under large deductible plans. These have the effect of covering more payrolls with lower paid premium because of premium discounts. About $1.5 billion in credits were given due to the use of large deductible plans. With a large deductible plan, employers must pay for losses or benefits up to $100,000 or higher deductible amount. This and other expenses associated with experience modification credits and schedule rating credits are added costs to the employers. Concrete estimates of these costs require more detailed data that is not currently accessible. Without such estimates, the average rates based on industry reported data will only be partial estimates.

Technical Efficiency Measurements

Estimates of the technical efficiency in the workers' compensation insurance industry indicate that there is sizeable room to decrease expenses given the current level of output in terms of paid losses. The technical efficiency score for the top 30 insurance carriers was .82 in 2009, indicating an average of 18 percent inefficiency. Efficiency measurements, however, show a steady improvement over the period, and the absolute inefficiency percentages are specific to the sample selected. A more complete evaluation would require a complete dataset, which necessitates a further investigation into data collection, access, and analysis of various data obtained from NCCI, NAIC, and other entities.

Estimating Subscription Rates Utilizing Covered Payroll Data

The workers' compensation system in Texas is unique in the U.S. in allowing most employers a choice to subscribe or not. In all other states, employers are mandated to have workers' compensation insurance via commercial insurance, self insurance, state-run risk pool or other methods. The subscription rate is of significant interest to all participants since the health of the Texas workers' compensation system depends on the number and type of employers within the system. Premium rates and injured employees' welfare are also a function of the subscription rate.

To evaluate the costs and benefits of participating in the Texas workers' compensation system, we need data not only on subscribers but also on nonsubscribers. For example, the price point at which some employers decide to opt out of the system represents an indifference point at which marginal benefits equal marginal costs of the system. This information is best obtained by analyzing the behaviors and costs of nonsubscribers at the margin. Unfortunately, available data is limited to those who subscribe. Nevertheless, Texas-wide employment data is available from federal and state employment agencies and surveys in greater details encompassing payroll, number of establishment, and size by standard industrial classification. By comparing subscriber data with this Texas-wide data, we can analyze nonsubscribing sectors in greater detail.

One of the impediments to more detailed analysis is the limitations in the datasets currently available and the way they are collected, managed, and used. This may be due to the nature of data collection and reporting in workers' compensation. Each state sets a different rule regarding what data to be collected and reported, and this process increases potential discrepancy in the data. Finally, most of these datasets are constructed and collected as part of the insurance industry's accounting practices. This poses significant difficulties when they need to be joined or compared with other economic data. A comprehensive evaluation and effort to organize existing data will be a prerequisite to maximizing the benefits of data reporting requirements that are ultimately funded by Texas employers.

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