Competition in the General Insurance Industry

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Abstract

Using a large sample of cross-sectional data for 1998 of companies operating in the general insurance industry we attempt to shed some light on the issue of competition in this industry. Companies offering products and services in the general insurance market are believed to trade under very competitive conditions. In order to test this widely-held claim we investigate whether firms' pricing policies reflect competitive or monopolistic market features. Under competitive conditions companies are forced to pass on any increase in costs in prices and thus their revenues will rise *pari passu* should wages, underwriting costs or other expenses increase. By contrast, a firm operating under monopolistic competition responds to an increase in marginal and average costs by increasing price and reducing output, resulting in a less then complete pass-through in revenue; profit falls. Our study is the first, to our knowledge, to apply this research methodology to the general (casuality/liability) insurance industry. Firms in this industry generate revenue through underwriting of insurance risks and from investing their assets. As underwriting and capital markets are in general segmented (catastrophe bonds apart), our empirical approach is based on the insurance and portfolio behaviour of firms and not on an integrated view of both. Previous investigations of this kind have focussed on the banking industry. Contrary to widely held views we find that competition is less than perfect.

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1. Introduction and Motivation

This paper assesses the state of competition in the Australian General Insurance industry. Companies offering products and services in the general insurance market are believed to trade under very competitive conditions. The number of competing firms is very large; entry into the industry and exit is relatively easy; no substantial sunk costs are involved. Firms exiting the industry either by choice or circumstance, go into run-off mode where they write no new business and satisfy existing claims liabilities. In order to throw more light on the widely entertained claim of a competitive market we investigate whether firms' pricing policies reflect competitive or monopolistic market features. Under competitive conditions companies are forced to pass on any increase in costs in prices and thus their revenues will rise *pari passu* should wages, underwriting costs or other expenses increase. By contrast, a firm operating under monopolistic competition responds to an increase in marginal and average costs by increasing price and reducing output, resulting in a less then complete pass-through in revenue; profit falls. This is the first study, to our knowledge, that applies the so-called Panzar-Rosse hypothesis to the insurance industry. Previous investigation of this kind have focussed on the banking industry. Contrary to widely held views we find that competition is less than perfect.

In section 2 we delineate the major features of the general insurance (GI) industry such as entry and exit barriers, the distribution of assets amongst its constituent firms, including information of the level of asset concentration, and their revenue and cost positions. Our discussion of the institutional background and of the basic economics of the industry enables us to develop a focused test equation and it assists in the interpretation of the results. Part 3 presents the theoretical basis for our econometric test approach. We use the framework of perfect competition as the reference point where monopolistic competition constitutes a plausible outcome on the basis of *a priori* reasoning. In the next section 4 we conduct an empirical investigation into the competitive state of the industry. Our search for a reliable measuring rod for competitive behaviour evolves around the question of whether and to what extent companies in this industry shift higher factor input costs on to revenues. A firm operating in a perfectly competitive market without a profit cushion would be forced into a complete pass-on or exit the market. Section 5 explores attempts to determine the equilibrium features of the industry. Lack of an equilibrium status for the industry could invalidate our results as they might be tainted by short-term transitional behaviour of firms. Finally in part 6 we attempt to reconcile theory and the observed structural features with the outcome of our tests.

2. Features of the General Insurance Industry

At the end of 1998 the general insurance (GI) industry in Australia consisted of 172 private sector and 15 public sector insurers.[1] In this paper we are only concerned with the former companies. The private sector group is subject to the Insurance Act 1973 and supervised by the Australian Prudential Regulation Authority (APRA). The activities of

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[1] The insurance sector in Australia comprises three distinct segments, the life, general and health insurance. Their respective shares of premium income during 1998 were 61%, 31% and 8%.

the GI industry comprise a broad range of products and services. In order of importance, the three largest categories of GI industry activity are: all motor vehicle (45%), house (16%) and fire (7%). In the following we discuss entry and exit barriers, analyze firms' assets, their distribution in the industry, the market structure in which general insurers operate and we examine the revenue, cost and return features of companies.

2. 1. Entry and Exit Barriers

Entry into the GI industry is surprisingly easy considering the complexities of insurance contracts and the significant risk exposure of relatively uninformed customers. During the period of observation the minimum capital requirement for authorization for general insurers stood at $2 million. APRA is now in the process of tightening authorization, entailing, *inter alia*, an increase in the required start-up capital to a minimum of $5 million, the application of a 'fit and proper' test to Board and senior management and the appointment of a valuation actuary and approved auditor (for details see APRA 2001).

Exit from the industry can be orderly or disorderly. In an orderly retreat from the market the general insurer switches to run-off mode, where it ceases to write new business and runs off its claims liabilities or transfers these to another authorized insurer. A disorderly exit occurs when current losses wipe out the insurer's capital; run-off is then out of the question and not all contracts may be transferred to other companies.

Investment proposals by *foreign interests* in the GI industry (acquisition of existing businesses, establishment of new business and offshore takeovers) are subject to the notification provisions of the Foreign Acquisitions and Takeovers Act 1975 and the Foreign Investment Review Board. Foreigners may operate through subsidiaries or branches. No special restrictions apply to foreign investment in this industry.

2. 2. Company Assets and their Distribution

In September 1999 GI industry private sector assets inside Australia stood at $49.7 billion and total assets, including those outside Australia, at $56.6 billion (APRA September Quarter 1999). Assets are held in the form of cash, deposits, debt securities, equities and real estate. Compared to superannuation funds and life offices, the GI industry holds relatively more of its assets in liquid form (cash and deposits) and less in equities. This investment pattern is dictated by the predominantly short-term liability risks that companies face.[2] For example, the hail storm in 1997 created an immediate

[2] In terms of the nature of insurance products and services, the industry distinguishes generically between short-tail and long-tail business. Products involving claims related to loss or physical damage to property which can be settled relatively quickly are known as short-tail business; it generates about 75% of total premium revenue. Long-tail business covers mainly liability products (public and product liability), professional indemnity, workers' compensation and compulsory third party insurance. It accounts for the remaining 25% premium income. However, these figures do not include the government insurance sector which deals mainly with long-tail business such as workers' compensation.

very large number of claims. This contrasts with the longer term liabilities horizons of superannuation funds and life offices and the more certain nature of the claims they face (ISC Bulletin, March 1998).

The histogram in Figure 1 plots the number of firms in each of the various asset classes out of a total of 160. The histogram appears to reveal two underlying, perhaps overlapping, populations which suggests separate treatment of both. The first distribution encompasses firms with $1 million to $500 million of assets. This segment of the market consists of 138 companies which make up 86 per cent of total firms. The second population comprises the larger company segment from $ 750 million to $ 7 billion. In line with our view, one could argue that the three firms in the $750 million bin could form the right-hand tail of the first and the left-hand tail of the second distribution.

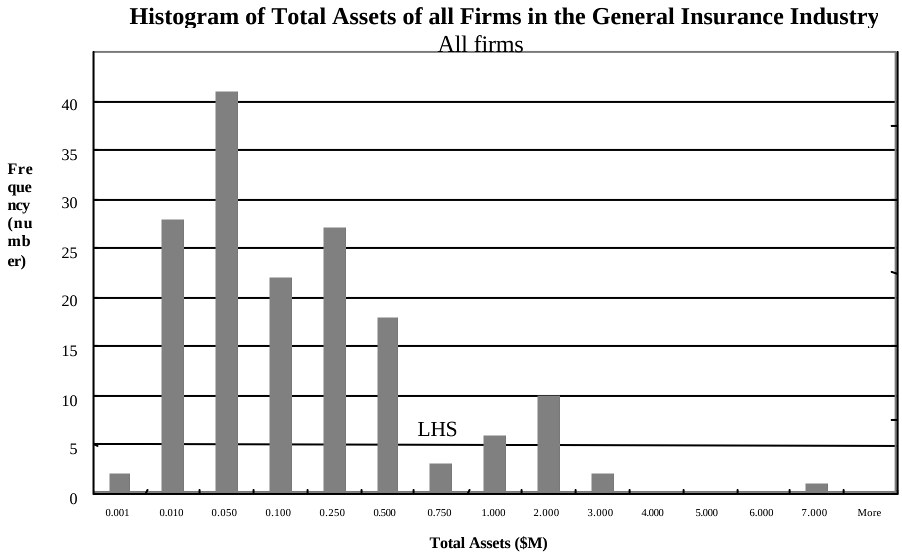

Figure 1: The industry's distribution of assets of all firms 1998[3]

In this study dealing with the competitive behaviour of firms active in the GI industry we were unable to include all 160 companies due to data limitations. A complete set of input prices, revenue, income and asset data was only available for 58 firms. The vast majority of exclusions was due to missing wages data. Some firms did not report underwriting expenses or premium revenue.[4]

[3] The balance dates for the companies vary from March May June, September to December with the mid- and end-of-year dates the most frequent balance sheet events.

[4] Companies without premium income are most likely in run-off mode, that is, they do not write any more business and are running off their claims liabilities. Although this is quite a common feature in the GI industry we decided against including these companies in our sample. As the aim of our study is the assessment of the competitive behaviour in this industry, firms in run off do not appear to potentially contribute to any rivalry in the sector.

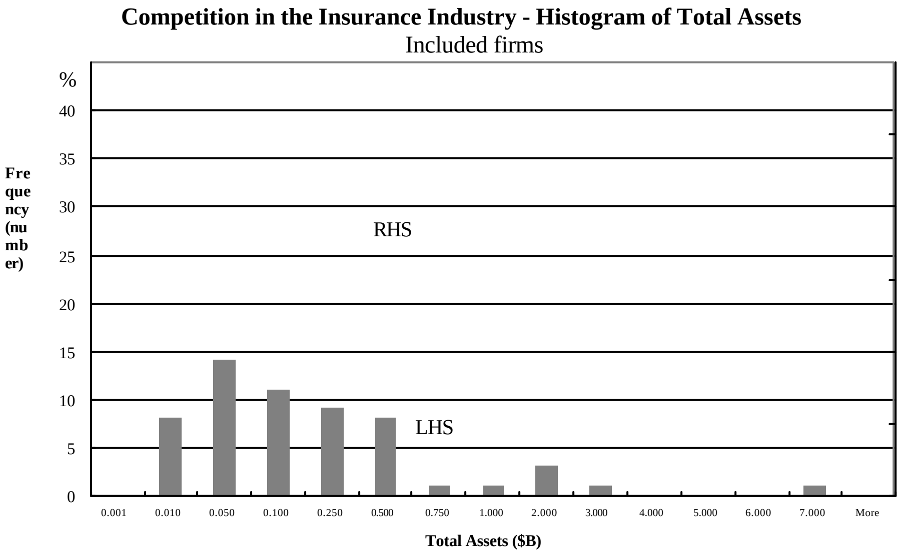

Figure 2: The industry's distribution of assets of included firms

The asset data and number of firms in each asset class, corresponding to Figure 1 as well as their respective cumulative distributions are given in Table 1. The histogram of the assets of those firms included in our investigation is plotted in Figure 2.

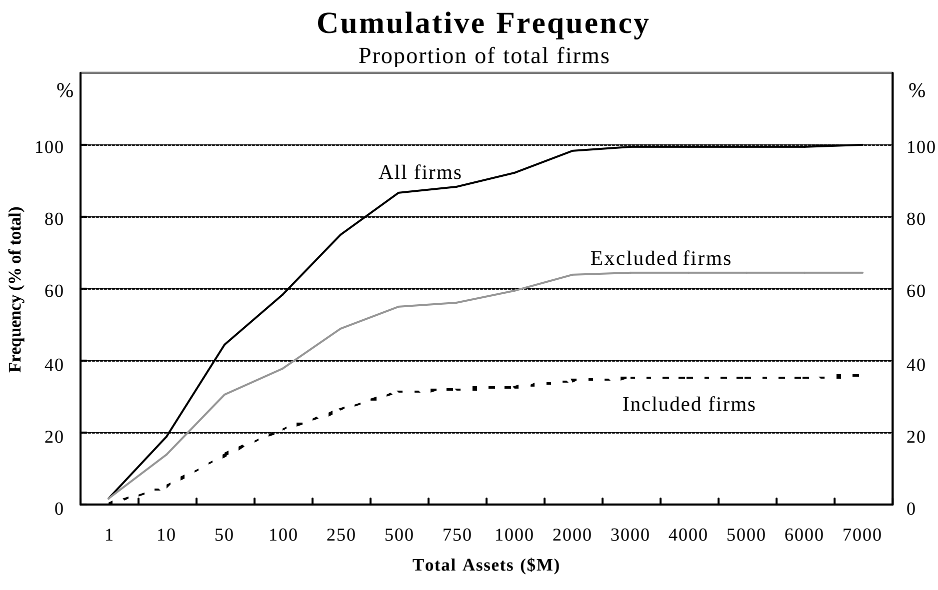

Figure 3: Cumulative frequency

Finally, Figure 3 presents the cumulative distributions of assets of all firms as well as the included and the excluded companies. An ocular inspection suggests an absence of bias in our choice of the sample as far asset size is concerned. The corresponding distribution of assets for the sample of firms mirrors closely that of the population. In particular it also exhibits the twin frequency distribution pattern.

Table 1: Distribution of Firms

Firm size based on total assets

By total assets		
Total Assets ($B)	**Frequency**	**Cumulative**
0.001	2	1.25%
0.01	28	18.75%
0.05	41	44.38%
0.1	22	58.13%
0.25	27	75.00%
0.5	18	86.25%
0.75	3	88.13%
1.00	6	91.88%
2.00	10	98.13%
3.00	2	99.38%
4.00	0	99.38%
5.00	0	99.38%
6.00	0	99.38%
7.00	1	100.00%

2. 3. Market Structure

The extent of concentration in the general insurance industry is commonly measured by the Herfindahl-Hirschman Index (HHI). The Herfindahl-Hirschman Index (HHI) covers the whole industry and is defined as

$$\text{HHI} = \sum_{\mathbf{i}=1}^{\mathbf{n}} \mathbf{MS}_{\mathbf{i}}^{2} \qquad (1)$$

where MS is the market share of company *i* and *n* equals the number of insurance companies in the GI industry. The market share is measured, alternatively, as total assets, premium revenue and premium income plus investment income. By construction, the HHI tends to zero for a very large number of tiny firms and has an upper value of 10,000 for a monopoly.

For the five largest companies, on the basis of asset and premium revenue and total income (premium revenue plus investment income)[5] the HHI stands at 2700, 2400 and 2400 respectively (see Table 2). This accords with a Group of Ten (2001, Data Annex B) study, where five of our largest companies own 27 percent of the industry's assets. This measure places us at the lower end of the concentration scale (asset measure), above that for Germany (23 %), but below the benchmarks for the UK (68), France (58), Japan (54), the Netherlands and US (both 30).

[5] Premium revenue and investment income are for the whole of 1998.

Table 2: Herfindahl-Hirschman Index

Base	Market				
	Five largest	Ten largest	Fifteen largest	Twenty largest	All companies
Total assets	2,700	1,400	1,000	800	400
Premium revenue*	2,400	1,200	9,00	700	400
Premium revenue and investment income	2,400	1,200	9,00	700	400

* Premium revenue (less reinsurance expense)

The low HHI-value of 400 for the whole market appears to support the widely-held view of the competitive nature of the GI industry.[6] It does not take into account affiliations amongst firms due to data limitations.

2. 4. Data Analysis of Companies

In this section we delineate some pertinent characteristics of the data that will be used in subsequent estimations. The vast majority of Australian general insurers operate only at home. They hold their asset onshore, generate premium revenue and investment income and incur costs at home. A few companies operate at home and overseas. However, the sample of firms with a complete set of data of overseas assets, revenue, income and costs is too small for the type of analysis we carry out in this paper. For this reason we focus on inside-Australia data. For the time being we ignore data relating to insurance activities of companies overseas.

2. 4. 1. *Inside Australia Data*

We examined the relationship between premium revenue plus investment income as a proportion of assets and the total costs to assets ratios where a definition of the variables and the data choice are given in the Appendix. We also carried out the analysis using instead net premium revenue plus investment income in the numerator. No clear picture between the revenue plus income to assets ratios emerges. A priori we entertained the expectation of investment income playing the role of a strategic variable in setting insurance premia and/or adjusting their costs. For example, a relatively high rate of return on invested funds could be used for aggressive pricing of insurance products. Alternatively, superior investment performance is expended on increasing salaries and wages or used to lift other expenses. The negative linkage between ln *ii* and ln *tlc* in the Partial Correlation Matrix (Table 5) below does not confirms this conjecture though. This

[6] Regulators in the US use the HHI as a screening device for mergers. If the post-merger value of the HHI is below 1,800 points *and* the increase in the merger-induced change in the index is less the 200 point, the merger is not deemed to have anti-competitive effects. Should either of the values be exceeded, regulators look for mitigating factors (Cetorelli, 1999). In their absence the merger is not allowed.

outcome excludes the possibility of a reverse causation relationship between independent and dependent variables.

For firms with long-tail products, short-term fluctuations in investment income are unlikely to impact significantly on year-to-year pricing. They are more concerned with the build-up of reserves than short-term pricing adjustment. Moreover, long-tail insurers but not those with short-term short-tail business on their books, may hedge by investing in growth assets which typically have higher returns without affording the insurer any pricing advantage. The data base does not allow us to separate companies according to line of business to probe this issue in greater detail.

Our analysis also showed the existence of significant differences in the relationship of revenues-incomes to costs. We appear to have a large number of profitable companies but at the same time, a group of firms is tightly bunched together with low or even negative numbers. The co-existence of marginal and intra-marginal firms appears to put a dent into the notion that the GI industry "is very competitive".

2. 4. 2 Return on Assets and Company Size

The return on assets (roa) provides a broad performance measure that is often used in the finance industry. This return-measure indicates how efficiently the insurer has deployed its assets in the turning of profits. In particular it focuses on how well premium revenue and investment income have been generated and on the cost-effective use of the firm's resources. For the computation of the roa at the company basis we subtract for each firm total costs from premium revenue plus investment income (= premium income) and divide the resulting sum by its assets, ie.

$$\text{roa} = \frac{\text{premium income - total costs}}{\text{assets}}$$

The average rate of return on assets for the industry stands at about one percent in 1998. This is similar to the average return on assets earned in the banking sector. The return on assets ranges from about 60 percent to negative 29 percent. Moreover, the frequent occurrence of negative rates of return appears to militate against the notion of a perfectly competitive industry. If this were the case they would have to leave the industry due to a lack of a capital cushion.

We now examine the relationship between rates of return on assets and company size. Company size is based on the amount of assets they hold. Fig. 4 provide distributions of the companies’ returns on assets linked to firm size.

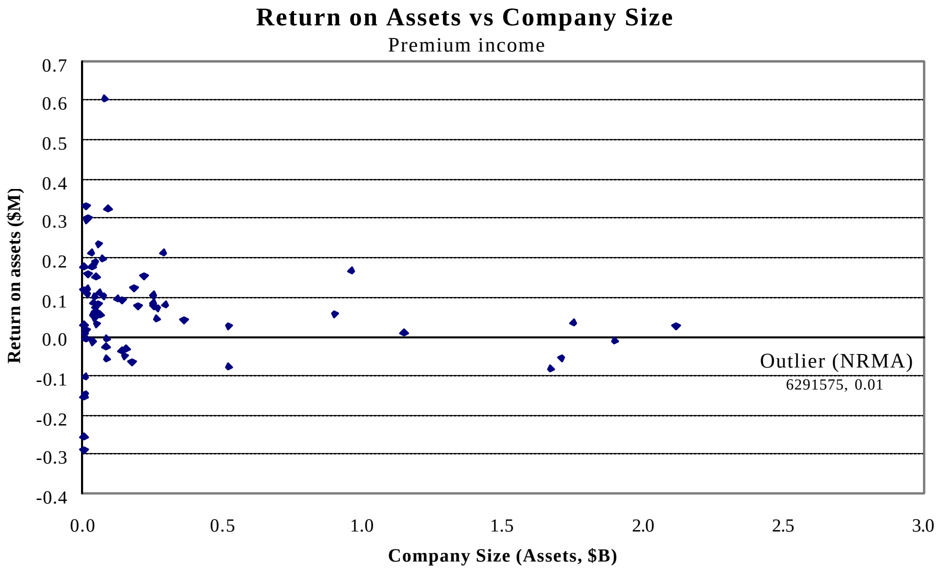

Figure 4: Return on Assets

The graph appears to suggest a negative relationship between return on assets and firm size. The larger the company, the lower the return on assets. This result is hardly surprising. According to the law of large numbers, the underwriting risk is larger for small companies. Small insurers therefore have to offset this risk by charging higher premiums, undertaking riskier investments and/or operating at lower cost than larger firms. The incidence of large negative returns on assets for minnows amongst insurers appears to point to their greater riskiness. However, the performance of some of the smaller insurers is also influenced by their select group of customers. They encompass often a guild-related clientele with a common bond. Such companies know a lot more about the risk profiles of members than do firms that are open to all-comers.

3. The Theory

Over time economists have approached the measurement of competition in industries in a variety of ways. The earliest studies attempted to infer the competitive conduct and performance of firms from the market structure of the industry. This approach is mainly associated with Bain (1956). The number of firms and any concentration of market share are believed to determine the competitive conduct. Fewer firms with more concentrated market shares are more likely to engage in anti-competitive behaviour than when the industry is populated by numerous small firms. Alternatively, a small number of large companies may form a cartel and dictate prices and conditions. Furthermore, one or two dominant firms may act as price setters while the many smaller peripheral firms accept the formers' price leadership. This structure-conduct-performance approach provides regulators with a convenient yardstick, as we explained above, when they rule on the competitive impact of mergers.

An alternative approach to competitive behaviour examines the revenue and cost structures of companies, using the framework of perfect competition as the reference position. Firms in an industry operating under conditions of perfect competition, are unable to absorb any of the cost increase. They are forced to pass on the entire rise of input costs in output prices and revenue, leaving output unaffected. Of course, not all firms survive.[7] By contrast, under monopolistic conditions in equilibrium, a rise in input prices, such as wages or administrative costs, results in a reduction in output and a rise in prices by a smaller amount than the increase in costs, leading to a shrinking of total revenue. Marginally profitable firms may have to leave the industry.

Our analysis of the industry's features rules out the two polar cases of market organization. It appears to suggest firms in the GI market to operate under *monopolistic competition* à la Chamberlin (1933). A group of firms offers a range of insurance products. By differentiating their products they are able to create downward sloping demand curve segments for their insurance products through advertising and other selling costs. The many competitors allow each firm to believe that its actions will not prompt retaliatory actions. Entry into the industry is relatively easy and collusion such as price fixing or market sharing virtually impossible.[8]

APRA regards the general insurance industry as "extremely competitive" (APRA, December 1998) which at face value is compatible with a range of market structures. The number of competitors is certainly large. The Australian Prudential Regulatory Authority supports this claim by pointing to an underwriting loss (premiums fall short of claims and expenses) of $ 2.0 billion for 1998. Even after allocation of investment revenue, it only generated a total return on assets of 1 per cent during 1998 as reported above.

Under monopolistic competition in long-run equilibrium output is determined where the average cost curve is tangential to the average revenue curve. Companies do not make economic profits since long-run average cost equals price. Since firms produce at less than minimum cost, the theory of monopolistic competition suggests that the industry is operating under excess capacity. As a result more firms exist than if production occurred at the average cost minimum. The market becomes overcrowded. If assets delineate capacity, the low rate of return on assets appears to support our conclusion. If production occurred at the long-run cost minimum, the return on assets would, of course, be higher.

Rosse and Panzar (1977) were the first to actually test these implications of the textbook descriptions of monopoly as well as monopolistic and perfect competition for the American daily news paper industry and they developed their approach further in Panzar and Rosse (1987). Their reduced-form revenue equation at the firm level is based on the hypothesis that the sum of the elasticities of the factor prices with respect to revenue would be negative for a monopoly, less than one for monopolistic competition and equal

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[7] In a general equilibrium framework any industry-specific rise in input costs would result in reduced demand for the output of the industry, forcing some firms out of the market.

[8] Current authorization requirements stipulate, *inter alia*, that the general insurance company has paid-up share capital of not less than $2 million (APRA 1999c). In view of the importance of capital for the solvency of general insurers and considering the possibility of a clustering of claims (eg. due to a hailstorm) the regulatory capital cushion appear to be wafer thin.

to one for firms operating in a perfectly competitive market where firms are price takers. These results are commonly summarized in the Rosse-Panzar H-statistic (Table 3).

Table 3
Interpretations of the Rosse-Panzar H-statistic

Competitive market structure tests	
H < 0	Monopoly
0 < H <1	Monopolistic competition
H = 1	Perfect Competition
Equilibrium Test	
H < 0	Disequilibrium
H = 0	Equilibrium

Subsequently, this approach has been applied by Shaffer (1982), Nathan and Naeve (1989) and Molyneux, Lloyd-Williams and Thornton (1994) to the banking industry. To our knowledge this is the first study of its kind for the General Insurance industry.

4. Empirical Estimates

From a universe of 160 companies active in the general insurance industry we used in our empirical estimates a sample of 58 companies. The excluded companies had missing data. In the vast majority of cases, wages data were unavailable for firms, followed by lacking underwriting expenses. Several companies (8) did not have any premium income which appears to suggest that they were in run-off mode. That is, they do not write any more business and are running off their claims liabilities. However, they are still exposed to future claims. Where possible, they cancel existing contracts, reduce staff levels and close branches. Even though the incidence of managed run-offs is not unusual in insurance, we decided against their inclusion in the sample as the reduced business state of such companies presumably have no impact on the competitive behaviour of the general insurance industry. Furthermore we excluded in part of our estimates one company with a large negative amount of investment income (relative to its assets) which is most likely caused by an unrealized loss from investments held. Again this is not uncommon in the general insurance industry. As it turns out, the impact of this outlier company on our results is minimal.[9]

4. 1. Estimation Equations

Though our estimation equations are empirically based we attempt to buttress our approach with arguments derived form economic theory. We are at pains to reconcile our model with the features of the GI industry and generally accepted behavior of firms in a fragmented market.

[9] To boot the excluded company is very small; in terms of asset size it holds position 146 out of 160 companies.

The revenue equations (1) regresses cross-sectionally the ratio of *premium income* to *assets* (pi) on the ratio of *input prices* to assets and on *total assets* (where lower case letters indicate ratios):

- net claims expenses/asset (nce)
- underwriting expenses/assets (ue)
- general and administrative expenses/assets (gae)
- total labour costs/assets (tlc) and
- total assets (TA)

$$\ln pi_i = \alpha + \beta_1 \ln nce_i + \beta_2 \ln ue_i + \beta_3 \ln gae_i + \beta_4 \ln tlc_i + \beta_5 \ln TA_i + e_i \qquad (1)$$

where
premium income = premium revenue *plus* investment income and
ln = natural logarithm

In equation (2) the dependent variable is net premium income to assets (npi)

$$\ln npi_i = \alpha + \beta_1 \ln nce_i + \beta_2 \ln ue_i + \beta_3 \ln gae_i + \beta_4 \ln tlc_i + \beta_5 \ln TA_i + e_i \qquad (2)$$

where
net premium income (premium revenue plus investment income minus reinsurance expenses). We would have preferred to regress the dependent variables on *expected* factor input cost; however, data unavailability does not allow this.

The choice of premium income as the proxy for the GI industry's output requires some comment. As is well known premia consist of price times quantity. In life insurance studies therefore authors now use addition to reserves (Yuengert 1993) or current benefits plus additions to reserves (Cummins et al., 1999) as output measures. However, incurred benefits and reserving are much more predictable and thus smoother for life insurers than for general insurance companies. A hailstorm, hurricane or other calamitous event might only affect a segment of the industry and thus incurred benefits could be grossly distorted for these companies. Moreover, insurance companies have scope in their reserving policy and the choice of the risk adjusted interest rate. Given these facts, market determined premia may be a better proxy for output than benefits/reserves-additions which are more appropriate for life insurance studies.

Due to data unavailability the factor input prices as defined above are proxies for the true factor costs. For example, instead of using net claims expenses (nce) per claim we relate nce to assets and proceed in a similar way with the remaining cost factors. Total assets have been included as an independent variable, in order to assess whether larger firms enjoy economies of scale in their operations and in portfolio investments.

The close relationship between the variables on both sides of equations (1) and (2) is a test design feature. This approach serves the purpose of providing the basis for assessing the revenue response of firms to a change in input prices.[10]

The intercept is measured by α and β_1 to β_5 are the estimation coefficient of the independent variables. As the equations are in log-form, the beta coefficients measure elasticities of revenue with respect to the independent variables. Of particular interest are the coefficients of the variables nce, ue, gae, and tlc all of which are defined as ratios to total assets. Their sum indicates whether firms in the industry are on average able to pass on fully, only partially or not at all, changes in input costs in premium revenue and/or investment income. Such behavior of firms in markets of varying degrees of competitiveness is readily accepted with respect to premium revenue. For example, firms in a perfectly competitive market with no profit cushion are forced to pass on any increase in factor costs in output prices (and thus raise revenue proportionally for given output) in order to survive. In monopolistically structured markets price and output may be varied.

This allows us to state the H-statistic in the following form:

$$H = \sum_{i=1}^{4} b_i \qquad (3)$$

Depending on the sum of the beta coefficients we may obtain an outcome from Table 3 indicating monopolistic competition ($0 < H < 1$) or perfect competition ($H = 1$).

Before embarking on estimating the elasticity of premium income (and net premium income) to changes in input prices, an analysis of the data used is provided.

4. 1. 1. The Dual Nature of Insurance Revenue

Firms in this industry generate revenue through underwriting of insurance risks and from investing their assets. As underwriting and capital markets are in general segmented (catastrophe bonds apart), our empirical approach is based on the insurance and portfolio behaviour of firms and not on an integrated view of both. Thus, our estimation equations (1) and (2) contain underwriting revenue and investment income in the dependent variable. We therefore have to explain how increases in input prices can be passed through to investment income. The investment income component of the independent variable does not appear to fit into the monopolistic competition mode in markets for goods and services. However, market pressure appears to force companies to employ similar investment strategies enabling them to match competitors' investment yields. As they record consistently underwriting losses, that is, premium income falls short of claims payments and expenses, there is considerable pressure on companies to generate

[10] We are not attempting to explain the revenue of companies. To do so would require the inclusion amongst the independent variables, of marketing resources, the product quality and mix, number or branches and brokers, etc.

satisfactory investment returns. Finance theory suggests that a higher return from a given amount of available funds may only be had by investing in riskier assets. This implies that firms in the GI industry have to take greater risk than would seem to be compatible with prudence, considering their underwriting losses. Applied to the problem at hand this means that firms can only recoup rising costs in investment markets by reshuffling their portfolios towards more risky assets and thus reap higher returns. The asset risk materializes in the form of market and credit risks.[11]

4. 1. 2. Risk Adjustment

Insurance provides cover for risk of loss for specified events. These risks frequently overwhelm insurers themselves. They face

- underwriting risk (increase in liabilities) which result from unexpected (random) increases in claims; risk of error of computation of premiums; sudden change of loss distribution (catastrophe)
- asset/investment risk due to unexpected asset price, interest rate or exchange rate gyrations and
- credit risk (defaults of bonds they hold or reinsurers)

In our econometric tests we neither adjusted liabilities nor assets of GI-sector firms for risk.[12] In our view this is acceptable procedure for the following three reasons, namely solvency regulation, absence of a reliable alternative risk measure and reinsurance. First, in the insurance industry liabilities and assets contain considerable amounts of risk. On the liabilities side general insurers are uncertain regarding the occurrence, the timing and the size of the claims. On the assets side insurers hold their investments, capital and other claims. The investment assets form by far the largest balance sheet item and they are subject to the usual credit and market risks. These risks on both sides of the balance sheet are managed through prudential regulation which uses a two-pronged risk management approach. The Insurance Act imposes a minimum solvency requirement on general insurers. This obliges firms to maintain assets (valued at market) in excess of reported liabilities by at least a prescribed amount. While the value of marketable assets[13] can be relatively easily inferred from market prices for similar or comparable securities, the reliable determination of the value of liabilities is more complex to say the least. Current

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[11] Both types of risk are particularly relevant for financial institutions whose viability they may threaten. For this reason they are subject to an intense debate which has given rise to new risk measurement and management techniques, known as value-at-risk. The Bank for International Settlements acts as the clearing house for the debate (BIS, July 1999 and BIS 1995). Curiously, the market-VaR and credit-VaR-concepts have so far failed to make their debut in the insurance literature.

[12] Risk-adjustment is common in studies dealing with the banking industry and particularly necessary for the period before the implementation of the Basel 1988 Capital Adequacy Requirement. The implementation of the Basel Accord by internationally active banks limits the choice for risk taking. On a priori grounds we would therefore expect a diminishing influence of risk on the behaviour of banks. For example, Molyneux et al. (1994) include the total risk capital to assets ratio in their estimation equations spanning the pre- and post Basel 1988 Accord. Risk does not, as expected by the authors, feature as a statistically significant influence amongst the explanatory variables.

[13] As the majority of insurers' assets are marketable securities such as cash, deposits, bonds, notes and equities the need for linking assets to credit risk ratings appears to be superfluous. The issue of risk rating arises for banks with their sizeable portfolios of loans which are not traded and for which values are therefore difficult to establish.

regulation entails discounting of outstanding inflation-adjusted claims liabilities. When actuarial input in the risk assessment is involved, the expected value of the liabilities (Central Estimate) are computed and a Prudential Margin is added.[14]

Second, the weak link in the computation of the mean of the liabilities is a lack of precision in the valuation of liabilities. APRA is now in the process of firming up the statutory liability valuation standard for general insurers (APRA September 1999b). We were unable to distil from publicly available data a risk proxy for liabilities risk.

Third, the incidence of reinsurance is common in this industry because, according to the Insurance Act 1973, it is one of the authorization conditions. *Reinsurance provisions* have the potential to reduce the risk of direct general insurers. Reinsurance involves the selling for a fee of part or all of the business risk associated with writing insurance contract by one general insurance company. The vast majority of firms in the population and the sample during the year of observation decided to transfer (cede) their insurance liabilities risks to reinsurance companies. The purchase of reinsurance reduces the minimum statutory solvency requirement for the ceding general insurer (APRA, September 1999c). However, direct insurers face credit risk in the case of reinsurance failure. Moreover, a small number of the GI firms are themselves reinsurers. To this extent the risk remains in the industry. In the absence of a reliable alternative measure of insurance risk, given the imposition of supervisory risk measures and the widespread use of reinsurance, we abstained form including a risk variable in our estimation equations.[15]

4. 2. General Data Analysis

Table 4 contains a general description of the dependent and independent variables used in subsequent tests. The independent variables pi (premium income) and npi (net premium income) as a proportion of assets are of roughly similar size. We also included in this table premium revenue (pr), net premium revenue (npr) and investment income (ii). Their ranges in size, variances and coefficients of variation are very similar. Of the explanatory variables, nce (net claims expenses) is by far the largest. The total labour costs (tlc) are broken down into its constituent components. Of note is the relatively large coefficient of variation of gae (general and administrative expenses).

The inclusion of net claims expenses (nce) amongst the independent variables requires some explanation. We regard it as a factor cost as the insurance company has some discretion about the timing and the size of the claims it settles. For example, in the car insurance the general insurer can appoint authorized repair shops, resort to litigation and grade cars on the basis of likely insurance bills and thus set the corresponding premium.

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[14] The factors that determine the size of the Prudential Margin are enumerated in APRA (September 1999a).

[15] In an earlier version of this paper we experimented unsuccessfully with the solvency ratio as a risk proxy.

Table 4: Data Analysis*

Proportion of total assets

Name	Description	Mean	Standard deviation	Variance	Minimum	Maximum	Coefficient of variation
pi	Premium income	0.48	0.27	0.08	0.01	1.09	0.57
npi	Net premium income	0.39	0.25	0.06	0.01	1.09	0.65
nce	Net claims expense	0.25	0.18	0.03	0.00	0.74	0.72
ue	Underwriting expense	0.09	0.07	0.00	0.00	0.32	0.75
gae	General and administrative expense	0.04	0.07	0.01	0.00	0.48	1.76
wse	Wages and salaries expense	0.03	0.02	0.00	0.00	0.08	0.70
oec	Other employee costs	0.01	0.01	0.00	0.00	0.04	1.00
tlc	Total labour costs	0.04	0.03	0.00	0.00	0.12	0.71
TA	Total assets ($million)	352700.00	930940.00	866.65bn	1737.00	6291600.00	2.64
pr	Premium revenue	0.44	0.27	0.08	0.00	1.06	0.62
npr	Net premium revenue	0.35	0.25	0.06	0.00	1.06	0.71
ii	Investment income	0.04	0.03	0.00	0.00	0.16	0.60

* Based on the "final" 57 companies (excluding MTQ).

The partial correlation matrix is given in Table 5 which contains the logs of the model variables. Amongst the independent variables only the relationship between the underwriting expenses (ln ue) and net claims expenses (ln nce) shows a tight fit.

Table 5: Partial Correlation Matrix*

Model variables

	ln nce	ln ue	ln gae	ln tlc	ln TA	ln pr	ln npr	in ii
ln nce	1.00							
ln ue	0.88	1.00						
ln gae	-0.23	-0.28	1.00					
ln tlc	0.19	0.16	0.10	1.00				
ln TA	0.27	0.24	-0.38	0.00	1.00			
ln pr	0.93	0.90	-0.20	0.21	0.17	1.00		
ln npr	0.94	0.92	-0.15	0.25	0.17	0.97	1.00	
ln ii	0.35	0.30	-0.17	-0.07	0.09	0.27	0.36	1.00

Based on the "final" 57 companies (excluding MTQ), except for investment income (based on 55 companies).

4. 3 Hypothesis Tests

The null hypothesis of the test for competitive behaviour of companies in the general insurance industry is given by (4). If the sum of the four coefficients of each of the equations (1) and (2) equals one, we are dealing with perfect competition. Otherwise the market is monopolistically structured.

$$H_0 : \sum_{i=1}^{4} b_i = 1 \qquad (4)$$

The test results for (1) and (2) have been carried out for the full sample of firms as well as for a sample that excludes the outlier. The results for the sample of 57 companies are given in Table 6. All input prices have the expected positive signs. With the exception of general and administrative expenses (gae) in one set of estimates, they are also all statistically significant at the

Table 6: Tests for Competitive Behaviour

(Inside Australia data)

	Equation (1) **Dependent variable: ln pi**		Equation (2) **Dependent variable: ln npi (2)**	
	Standard covariance matrix	Heteroscedasticity consistent covariance matrix	Standard covariance matrix	Heteroscedasticity consistent covariance matrix
Independent variables				
ln nce	0.46***	0.46***	0.42***	0.42***
	(0.0554)	(0.0545)	(0.0606)	(0.0638)
ln ue	0.16***	0.16***	0.21***	0.21***
	(0.0516)	(0.0512)	(0.0563)	(0.0573)
ln gae	0.01	0.01	0.06**	0.06***
	(0.0255)	(0.0172)	(0.0279)	(0.0192)
ln tlc	0.12***	0.12***	0.14***	0.14***
	(0.0384)	(0.0419)	(0.0420)	(0.0441)
ln TA	-0.06***	-0.06***	-0.05**	-0.05**
	(0.0221)	(0.0182)	(0.0242)	(0.0214)
Constant	1.54***	1.54***	1.53***	1.53***
	(0.2875)	(0.2651)	(0.3140)	(0.2953)
$\sum_{i=1}^{4} b_i$	0.75	0.75	0.83	0.83
$H_1 : \sum_{i=1}^{4} b_i < 1$	-5.07***	-4.78***	-3.14***	-3.42***
Diagnostic statistics				
R^2	0.92	0.92	0.91	0.91
F statistic	112.902	53.282	99.466	57.537
Durbin-Watson	2.05	2.05	2.07	2.07
Breusch Pagan/Godfrey	22.23***		18.51***	
Reset(3)	0.61		1.03	
JB Normality	2.55		0.65	
LM autocorrelation	9.247		10.672	
Auxiliary R2:				
ln nce	0.78	--	0.78	--
ln ue	0.78	--	0.78	--
ln gae	0.20	--	0.20	--
ln tlc	0.06	--	0.06	--
ln TA	0.18	--	0.18	--

*,** and *** imply significance at the 10, 5 and 1 per cent levels, respectively on the basis of t -statistics. Standard errors in brackets; 57 companies

generally accepted levels. From the data analysis in Table 4 we know that gae has the highest coefficient of variation which might be the result of inconsistent data collection. For example, one firm allocates the internal loss assessors' expenses to claims while another, using external assessors, might book the same outlay as gae. The results for net premium income are marginally better than those for premium income.

Since the incidence of firms having negative net premium revenue is not rare, it appears that they rely on investment income to sustain their cash flow. In order to confirm this plausible assumption we re-estimated equations (1) and (2) using as dependent variables premium revenue and net premium revenue, respectively. While all coefficients of the independent variables retained their correct signs and the estimates showed high coefficients of determination, a few were statistically insignificant. These results confirm our choice to carry out the core of the investigation with the more encompassing revenue and income flows as the dependent variables.

4. 4. Discussion of Estimates

Estimates of equation (1) using premium income (pi) as the dependent variable, are given in Table 6. The R^2 *value* suggests that 91.71% of the variation in ln pi is explained by the variation in the five independent variables. We omit the value for $\overline{R}^2$ (91%) as it does not fulfil a useful purpose when one is only concerned with the estimated results of a single regression equation.

The constant term and four of the five-factor input ratios are strongly statistically different from zero at the 1% significance levels and all variables have the expected signs. The exception is the coefficient of ln gae which is not significantly different from zero. Thus this variable is not a significant determinant of premium income. Omitting ln gae results in a very small reduction in the explanatory power of the model. We decided to retain ln gae as an explanatory variable in order to preserve comparability with similar estimates in other parts of the paper.

The *DW statistic* mainly addresses the problem of serial correlation in time series models which commonly does not arise when cross-sectional data are used. However, apart from also indicating possible auto-correlations in cross-section data, the DW test is sensitive to some forms of specification error which is not uncommon with such data. However, in this regression the estimated first order auto-correlation coefficient is negative but since it is not significantly different from zero at the 1% level, there is no evidence of a significant problem of specification error.

The *F-statistic* serves as a test of the overall significance of the model in explaining how the values of ln pi are determined. In particular, in this regression model, the Null Hypothesis

$$H_0 : ß_1, ß_2, ß_3, ß_4, ß_5 \text{ all equal to } 0$$

is tested against the Alternative Hypothesis

$$H_1 : \text{at least one of } ß_1, ß_2, ß_3, ß_4, \text{ or } ß_5 \text{ is non-zero.}$$

At the 0.5% significance level the Null Hypothesis is rejected. In other words, the five coefficients are jointly significantly different from zero.

The *JB statistic* in not significant, not even at the 10 per cent significance level. In other words, the null hypothesis that the OLS residuals are normally distributed cannot be rejected. This evidence is consistent with the error terms in the regression model being normally distributed, and hence that the statistical inference based on the estimated results is valid. However, the test does not *confirm* either claim.

In equation (1) the test for the *Reset(2)* test is not significant, even at the 10 per cent level. This test outcome indicates that the square of the predicted value of the dependent variable is not a significant explanatory variable. In turn this implies that at the 10 per cent significance level the null hypothesis (correct specification of the original regression model) cannot be rejected. Test for Reset(3) and Reset(4) yielded the same outcomes. However, a word of caution is in order. The power of the tests in detecting specific forms of specification errors is not known.

The *LM (autocorrelation) statistic*, while commonly applied to time series models, fulfills a similar purpose to that discussed in connection with the DW statistic. In this regression the sample evidence is consistent, even at the 10% level, with there being no problem of auto-correlation in the error term.

We implemented two versions of the *Breusch-Pagan/Godfrey* statistic to test for heteroscedasticity, though the result of only one is reported. However, both clearly indicate that heteroscedasticity associated with, or caused by, the explanatory variables is statistically significant the 0.5% level.

As discussed in the context of equation (3) the sum of the elasticities of the four input price ratios with respect to the revenue ratio are expected to be negative for a monopoly, less than one for monopolistic competition and equal to one for firms operating in perfectly competitive market environment. A statistical test of the Null Hypothesis of perfect competition *versus* the (one-sided, lower tail) Alternative Hypothesis of non-competitive conditions, that is,

$$H_0 = 1 \text{ and}$$
$$H_1 < 1$$

is given as

$$t = [\frac{H-1}{se(H)}]$$

where se(H) is the standard error of H. Given the standard errors of the estimated regression coefficients, calculation of standard error of the *H-statistic* is straight-forward. In equation (1) the above t-statistic is significantly less than one at the 0.5% level. Thus the H-test strongly indicates that the industry is non-competitive at the stated significance level. The F-and chi-square statistics for this test (in SHAZAM) yield exactly the same conclusion.

The *Auxiliary R^2 statistics* are the coefficients of determination obtained by regressing each of the explanatory variables in the model on all of the other explanatory variables. Its purpose is to detect the extent to which multicollinearity is present in the data, and which variables are involved. The pairwise sample correlation coefficients from Table 5 and the implied correlation coefficients involving linear combinations of the explanatory variables provided by the Auxiliary regressions indicate clearly that there could be a potentially serious degree of collinearity in relation to the first two explanatory variables, ln nce and ln ue. Unfortunately, there are no guidelines in the literature that would indicate what might constitute a potentially serious degree of multicolleariy in the data. Furthermore, the apparent lack of significance of the variable ln gae does not appear to be attributable to multicollinearity in the data.

4. 4. 1. Correction for Heteroscedasticity

In order to correct for heteroscedasticity in (1) we re-estimate the model using White's heteroscedasticity-consistent covariance matrix. While this procedure does not change the signs or t-values of the explanatory variables that were significant in the uncorrected version of (1), it does help ln gae over the line into statistical significance. However the White procedure has implications for the F-test and the H-statistic.

When the regression model is estimated using White's approach, the F-statistic for the test of the overall significance of the model is no longer valid.[16] Instead the test statistic is calculated by first constructing a chi-squared statistic for the Wald test of the set of linear restrictions imposed on the regression coefficients (Greene, 2000, pp. 506/7). The test is then reformulated equivalently as an F-test. Using either the chi-squared test or the F-test, the Null Hypothesis is rejected strongly at the 5% significance level, implying that the independent variables are strongly significant in determining the variable ln pi.

When the model is estimated using White's heteroscedasticity-consistent covariance matrix, the H-test is valid only asymptotically. This test can be reformulated as chi-square test, an F-test or a t-test. All three test procedures reject strongly the Null Hypothesis; that is, the estimated results of (1) for the heteroscedasticity consistent covariance matrix also suggest a lack of competitiveness in the GI industry.

In equation (2) [Table 6] the independent variable is ln npi (log of net premium income). The results are similar to those of equation (1), except that the variable ln gae is now significantly different from zero at the 5% level while the significance level of the variable ln TA has dropped. The value of R^2 remains very high at 91%. The diagnostic statistics resemble those discussed in connection with (1). Again the Breusch-Pagan/Godfrey statistic suggests heteroscedasticity of the error term. The test outcome confirms the non-competitive nature of the industry.

[16] We thank our colleague Daehoon Nahm for clarifying our discussion on this point.

Reestimation of (2) using White's heteroscedasticity-consistent covariance matrix improves the relevance of ln gae as a determinant of ln npi even further. It is now significantly different from zero at the 0.5% level. The overall results of Table 6 appear to confirm our conjecture that we are not dealing with a situation of perfect competition in the GI industry.

Furthermore, the coefficient of total assets is consistently negative, indicating declining ratios of revenue and revenue plus income to assets when total assets increase. This might suggest the presence of *diseconomies of scale* as far as revenues and investment income are concerned. A host of factors exert their, often offsetting, influences on the coefficient β_5. Larger insurers might have more and relatively larger claims than smaller companies. Due to their large client base they know less about the personal risk profile of customers, though they have more statistical client information. This makes claims more certain and should lower premiums relative to assets. In addition and as already mentioned, small insurers encompass a guild-related clientele with a common bond. Even though such companies know a lot more about the risk profiles of members than do firms that are open to all-comers, their small statistical data base makes claims uncertain which tends to raise premiums. On the other hand, the processing of a larger number of claims may entail cost economies. As both equations' independent variables encompass investment income, the negative coefficient on ln TA may also suggest that larger companies earn less per dollar of assets than smaller firms, perhaps because they are less flexible and have higher market impact costs.

We also tested the model on a sub-sample of small firms up to and including $0.750 billion in asset size. The results were very similar in every respect, (see Table 7) to those achieved in Table 6. A corresponding test for the remaining large companies could not be performed due to small sample size.

Table 7 Tests for Competitive Behaviour

Small Companies: up to 0.750 billion Assets, Excluding MTQ

	Equation (1) Dependent variable: ln pi		Equation (2) Dependent variable: ln npi	
	Standard covariance matrix	Heteroscedasticity consistent covariance matrix	Standard covariance matrix	Heteroscedasticity consistent covariance matrix
Independent variables				
ln nce	0.45***	0.45***	0.42***	0.42***
	(0.0565)	(0.0523)	(0.0620)	(0.0625)
ln ue	0.17***	0.17***	0.21***	0.21***
	(0.0529)	(0.0488)	(0.0580)	(0.0564)
ln gae	0.02	0.02	0.06**	0.06***
	(0.0273)	(0.0187)	(0.0230)	(0.0199)
ln tlc	0.13***	0.13***	0.14***	0.14***
	(0.0396)	(0.0431)	(0.0435)	(0.0430)
lnTA	-0.08**	-0.08**	-0.07**	-0.07**
	(0.0298)	(0.0261)	(0.0327)	(0.0307)
Constant	3.83***	3.83***	3.10***	3.10***
	(0.5546)	(0.6215)	(0.6088)	(0.6036)
$\sum_{i=1}^{4} b_i$	0.77	0.77	0.83	0.83
$H_1 : \sum_{i=1}^{4} b_i < 1$	-4.32***	-4.15***	-2.96***	-3.35***
Diagnostic statistics				0.91
R^2 statistic	0.92	0.92	0.91	
F	110.073	91.880	54.868	37.661
Durbin-Watson	1.79	1.79	1.84	1.84
Breusch Pagan/Godfrey	21.10***		15.66***	
Reset(3)	0.44	0.44	0.71	0.71
JB Normality	2.75	2.75	0.57	0.57
LM autocorrelation	19.17	19.17	22.52	22.52
Auxiliary R^2:				
ln nce	0.78		0.78	
ln ue	0.78		0.78	
ln gae	0.21		0.21	
lnTLC	0.04		0.04	

*,** and *** imply significance at the 10, 5 and 1 per cent levels, respectively. Standard errors in brackets. 51 companies.

Premium income also includes unrealized capital gains/losses. The test results are, however, not sensitive to this income component. Re-estimating equations (1) and (2) without these capital income elements yields very similar outcomes in terms of size of coefficients and test statistics.

4. 5. Inside and Outside Australia Data

The estimates in Table 6 pertain only to operations of insurance companies inside Australia. However, ten companies in the sample also hold assets overseas. When

Table 8: Results for Competitive Behaviour

All data (inside and outside Australia)

	Equation (1) Dependent variable: ln pi		Equation (2) Dependent variable: ln npi	
	Standard covariance matrix	Heteroscedasticity consistent covariance matrix	Standard covariance matrix	Heteroscedasticity consistent covariance matrix
Independent variables				
ln nce	0.40***	0.40***	0.32***	0.32***
	(0.0636)	(0.0528)	(0.0595)	(0.0531)
ln ue	0.17***	0.17***	0.21***	0.21***
	(0.0560)	(0.0502)	(0.0523)	(0.0532)
ln gae	0.02	0.02	0.04	0.04**
	(0.0273)	(0.0199)	(0.0255)	(0.0174)
ln tlc	0.08	0.08*	0.03	0.03
	(0.453)	(0.0409)	(0.0423)	(0.040)
ln TA	-0.07***	-0.07***	-0.05**	-0.05***
	(0.0223)	(0.0204)	(0.0209)	(0.0173)
Constant	1.66***	1.66***	1.09***	1.09***
	(0.2589)	(0.2403)	(0.2420)	(0.2079)
$\sum_{i=1}^{4} b$	0.67	0.67	0.60	0.60
$H_1 : \sum_{i=1}^{4} b_i < 1$	-4.21***	-4.56***	-5.66***	-6.12***
Diagnostic statistics				
R^2	0.78	0.78	0.77	0.77
F statistic	37.661	26.148	36.256	21.747
Durbin-Watson	2.02	2.02	2.06	2.06
Breusch Pagan/Godfrey	8.38		14.97**	
Reset(3)	0.23	0.23	0.71	0.71
JB Normality	1.85	1.85	3.32*	3.32*
LM autocorrelation	13.12	13.12	16.03	16.03
Auxiliary R^2:				
ln nce	0.65	--	0.65	--
ln ue	0.65	--	0.65	--
ln gae	0.31	--	0.31	--
ln tlc	0.10	--	0.10	--
lnTA	0.26	--	0.26	--

*,** and *** imply significance at the 10, 5 and 1 per cent levels, respectively. Standard errors in brackets. 57 companies.

the international business data for these companies are included, we obtain the results of Table 8.

The results of regression estimates for the expanded data base are broadly in agreement with those achieved for those with inside-Australia data. The coefficients of β_1, β_2, and β_5 have retained their significance level of 1% (with the exception of β_5 in one equation). The coefficients of β_3 is significantly different from zero at the 5% level in one equation and β_4 does not attain a significance level of above 10% in any of the four estimates.

Compared to the results in previous regressions, the coefficient of determination has dropped to 78.36%. The F-statistic suggests that at the 0.5% significance level the four explanatory variables are strongly jointly relevant in explaining how the values of the dependent variables (ln pi and ln npi) are determined. On the basis of the values of the DW-statistic and this test's sensitivity to specification error, there does not appear to be a reason to suspect that the model is mispecified. A similar conclusion can also be reached on the basis of the values of the LM-statistic. The Null Hypothesis that the error term is homoscedastic cannot be rejected at the 5% significance level for equation (1). However, the same pleasing result does not hold for estimates of equation (2). Using the t-statistics, the Null Hypothesis that H is equal to 1 is rejected storngly at the 0.5% significance level. The alternative Hypothesis that H is less than 1 is therefore accepted strongly at the said significance level. Thus, the statistical evidence is consistent with the absence of perfect competition in the GI industry and consequently supports the notion of monopolistic competition in the industry. The small number of companies (10) with assets outside Australia renders any attempt at running separate regressions impossible.

5. Testing for Equilibrium

As is well known from Chamberlin's theory of monopolistic competition, the pricing behaviour of firms in short-run equilibrium is radically different from that in long-run equilibrium. If the industry is in the process of moving from the former to the latter, or *vice versa*, distorted estimates are a likely outcome. The same applies in principle to the price and output patterns of monopolies and firms in perfect competition.

In equilibrium, factor price changes should not impact on profitability as represented by the return on assets. If they do, the industry is adjusting towards an equilibrium position and our previous results would be unreliable. The value of the equilibrium H-statistic is given in Table 3. In order to establish the current state of the market, we regress the return on assets on input prices, where both dependent variables PIROA and NPIROA are defined in ratio form as

piroa = [(premium revenue plus investment income – total costs)/total assets]
npiroa = [(net premium revenue plus investment income – total costs)/total assets]
that is,

piroa = [(PI – TC)/TA]
npiroa = [(NPI –TC)/TA]
TC = (TLC + GAE + UE + NCE)
TA = (total assets)

The other variables have been previously defined. Since not all rate-of-return ratios are positive, we estimate (5) and (6) in non-log form (Table 9).

$$piroa = \alpha + \beta_1 nce_i + \beta_2\, ue_i + \beta_3\, gae_i + \beta_4\, tlc_i + e_i \qquad (5)$$

$$npiroa = \alpha + \beta_1 nce_i + \beta_2 ue_i + \beta_3\, gae_i + \beta_4\, tlc_i + e_i \qquad (6)$$

Table 9: Equilibrium Test

	Dependent variable: piroa Standard covariance matrix	Dependent variable: npiroa Standard covariance matrix
Independent variables		
nce	0.00 (0.4E-6)	0.00 (0.2E-6)
ue	0.00 (0.1E-5)	0.00 (0.1E-5)
gae	0.00 (0.1E-5)	0.00 (0.9E-6)
tlc	0.00 (0.2E-5)	0.00 (0.1E-5)
Constant	0.07*** (0.0189)	-0.02* (0.0137)
Diagnostic statistics		
R^2	0.04	0.04
$\overline{R}^2$	-0.04	-0.04

*,** and *** imply significance at the 10.0, 5 and 1 per cent levels, respectively. Standard errors in brackets. 57 companies.

The outcome of our tests appear as given in Table 9 suggests that equilibrium prevailed during the period for which the data were available. None of the independent variables in the equations employing total cost as well as the test containing a break-down into individual costs, is statistically significant at the commonly acceptable levels.[17] The coefficients of determination are zero or very low in both equations.

The equilibrium results can best be explained if we assume, that on the contrary, the industry is engaged in one of its periodical premium price wars where individual companies attempt to gain a larger market share at the expense of others. During such a period of intense competition firms can achieve a thinning of their ranks by temporarily absorbing cost increases and thus reducing mark-ups. The weaker companies are forced to leave the industry. For the remaining firms, an increase in the input cost ratios would systematically tend to reduce the ratio return on assets. Our results exclude this behavior of firms allowing us to conclude that during the period of observation equilibrium market conditions prevailed.

6. Discussion of the Results

The core outcome of our study suggests that firms in the general insurance industry operate in a less than perfect competitive environment. Not only is the sum of the factor input coefficients statistically different from one, it is also below one. This implies less than complete shifting of input costs into sales revenues. For example, companies are

[17] The Chamberlinian notion of equilibrium does not require that each and every firm has achieved this position. With a great number of firms one would expect unprofitable firms exiting and new ones joining the crowd.

only able to, say, pass on 0.8 percent of a one percent increase in all factor costs in revenue. Consequently, on average companies must make profits which enable them to absorb part of the increases in input prices. Companies without a profit cushion suffer losses. They would have to dip into their capital reserves and when they reach their regulatory limit, companies have to leave the industry. This interpretation receives strong support from our industry analysis in section 1. A significant contributory factor to the low average return on assets for the industry as a whole and our sample is the pull-down effect of those companies that have negative return outcomes. Furthermore, the not so infrequent occurrence of companies being in run-off mode is consistent with our interpretation of the results. The GI industry has been in a phase of adjustment and consolidation over the quarter of a century. In 1973 there were 483 general insurance companies operating in Australia and as at June 1999 the number has dwindled to only 162 general insurers. During the period from December 1998 to June 1999 their ranks thinned by 10. Since 1970 a total of 35 GI firms collapsed.[18]

In graphical terms, the test results are presented in Figure 5. It depicts the demand and cost structure of a typical firm in monopolistic competition. At price p_1 and quantity x_1 the firm's average cost curve touches the demand curve d_1. Applying this framework to the insurance industry we would interpret the premium rate per contract as the relevant price and assets (or premium revenue) as the company’s output. In this set-up, insurers operate on the downward sloping segment of the cost curve, indicating the presence of excess capacity at the company level. When factor input costs rise, in general, firms have their profitability reduced. Marginal companies are forced to leave the industry. Their business is distributed amongst the remaining players. Thus, the long-run equilibrium of the industry is perfectly compatible with changing demand conditions where some firms leave the industry, others expand and a few firms join it. However, to the extent that competitive pressures engender socially undesirable industry entry and exit activities, the regulator would be well advised to raise capital requirements, insist on more cautious reserving and generally insist on improvements in risk measurement and management systems.

However, the application of the monopolistic competition model as a behavioral framework of the general insurance industry has its limits. A company’s total revenue in this industry encompasses premium revenue and investment income. Our interpretation thus only applies to the former.

[18] In order to place the domestic failure rate in the international context, the experience of some other countries may be helpful. Of the non-life companies in the US, UK and France the frequency of insolvencies since 1980 reached maxima of about 2.5 % during the early 1980s and 1990s, for the remaining years the rates hovered between zero and 2 %. The heavily regulated insurance market in Germany over the same twenty-year period has not suffered a single insolvency (Swiss Reinsurance Company, No 1, 2000).

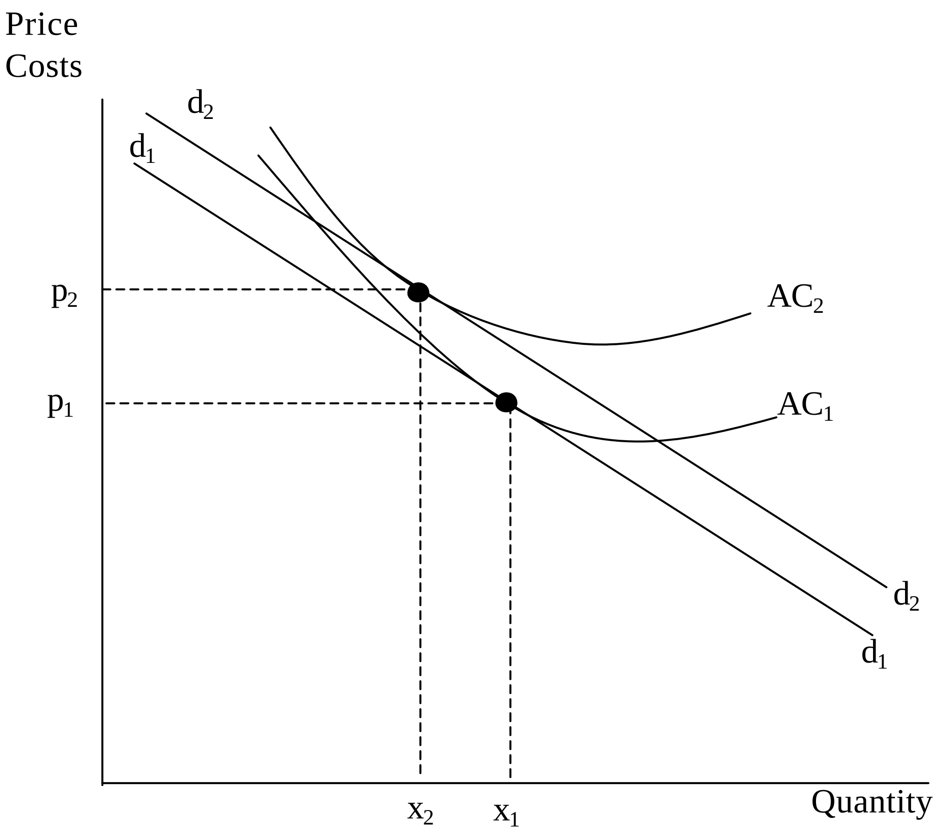

Fig. 5: Monopolistic competition in the GI industry

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Appendix

Definition of variables

Premium revenue (PR)	[*ADP01 Form 101*]
Net premium revenue (NPR)	= premium revenue less reinsurance expense) [*ADP03 Form 101*]
Investment income (II)	[*ADP09+10+11+13 Form 101*]
Premium revenue plus investment income (= premium income)	PR plus II
Net premium revenue plus investment income	

(= net premium income)	NPR plus II
Total Assets (TA)	[*ADP23 Form 102*]
Net claims expenses (NCE)	[*ADP06 Form 101*]
Underwriting expenses (UE)	[*ADP07 Form 101*]
General and administrative expenses (GAE)	[*ADP14 Form 101*]
Wages, salaries and other employee costs (TLC)	[*ADP02+03 Form 215*]