

Insurance Markets: Lecture 8

1 Regulation of Insurance Markets

It is useful to begin this topic with a discussion of the history of regulation of the German insurance market on the one hand, and the British insurance market on the other. This is because over the period from the mid-1930's until 1994 the German market was very tightly regulated, perhaps the most tightly regulated in the world, while since 1994 the regulatory framework has become much looser. In the British market on the other hand regulation was probably the lightest in the world, and this has become the model for regulation in European insurance markets.

In virtually every country in the world in which an insurance market exists, it is at least to some extent regulated, in the sense that it will be subject to specific rules and procedures over and above the standard framework of laws concerning contracts, bankruptcy, fraud and corporate governance. We now set out the possible dimensions along which regulatory frameworks may be constructed.

1.1 Solvency

An insurance contract has a strong fiduciary element. A policy holder parts with his money in exchange for a promise of future payment under specified circumstances. A central concern of insurance regulation is therefore the solvency of the insurer, that is, its ability to meet these claims liabilities in full as and when they arise. The Law of Large Numbers implies that as the number of insurance contracts entered into by an insurer increases, the variance of the sum of the losses around its expected value also increases, but in such a way that the variance *per contract* goes to zero for a large enough number of contracts. This means that if the insurer sets a premium equal to the expected value of loss on each contract, then on average in the long run (and ignoring all other costs), he will just break even. In any one period

however, the total loss claims may well exceed the expected value of losses by a substantial margin, and so premium income in that period would not cover claims. As a result it is necessary to hold what are called *technical* or *mathematical reserves* as a buffer against this eventuality¹. Actuaries normally calculate these by first selecting a given *ruin probability* - the probability that the insurer will be unable to meet all loss claims - and then finding the critical level of loss claims that is exceeded with this probability. The required technical reserve is then the difference between this critical level and the expected value of loss claims. Typically however regulators set solvency reserve requirements well above these technical reserves, to take account of riskiness in the distribution of returns to the asset portfolio as well as other business risks - for example inflation in administrative costs - that affect the solvency of the insurer. These reserves will have to be held in liquid form so as to be immediately available to meet claims.

1.2 Entry.

The early history of insurance markets in most countries was characterised by rapid growth, premium competition, insolvencies and a measure of fraud. Someone selling insurance makes a profit for sure if he collects the premium and absconds, while the buyer of insurance is scarcely better off if the seller turns out to be unable to meet claims because he made an erroneous or over-optimistic assessment of the loss probabilities. Just as in the case of medical services, it was felt necessary to protect consumers from the consequences of fraud and incompetence by requiring practitioners to be licensed, and by subjecting would-be sellers to a test of their qualifications to be awarded this licence. In the case of insurance this usually takes the form of a check that the prospective insurer is a "fit and proper person" - for example not a criminal or undischarged bankrupt - and has sufficient initial capital to meet solvency requirements. A business plan will also usually be required, as a check on the entrant's competence and future viability. Naturally, as also in the case of medical services, this kind of reasonable entry regulation can be used as an entry barrier to protect monopoly quasi-rents, or to pursue aims of economic policy such as protectionism.

¹It is also possible for an insurer to take out reinsurance - effectively itself buy insurance - on part of its portfolio. The extent of reinsurance is always taken into account in the detail of solvency regulation.

1.3 Premium

Normally, a non-competitive market may be subject to regulation that seeks to set *upper* limits on prices. Insurance markets however often are, or in the absence of regulation would be, highly competitive. Maximum prices in such cases therefore, if they are binding, are analogous to policies such as rent controls and can be discussed in similar terms. More specific to insurance markets is the prevalence of *minimum* prices. Here the argument is essentially concerned with solvency. Unbridled price competition and/or incompetent or over-optimistic insurers, it is claimed, drive prices down to levels at which the future ability to meet claims is threatened. Minimum premium levels based on the regulator's calculation of expected loss levels are therefore put forward as an instrument of solvency regulation.

1.4 Contract conditions.

An insurance product is specified by the terms of the contract, in particular the risks covered, the information to be supplied by the buyer and the way in which the characteristics of the buyer determine his risk category and therefore the nature of the cover and size of the premium. In the case of the large-scale insurance markets, contracts are standardised rather than negotiated individually between every buyer and seller. Regulation of contract conditions usually takes the form of *extreme standardisation* of insurance contracts, that is, restrictions are placed on the differentiation in contract terms that insurers are allowed to offer. A further aspect of this is that insurers may not be allowed to refuse insurance to particular individuals or not to cover certain risks. There may also be restrictions on the information they can require - for example they may not be allowed to ask if the buyer has had an AIDS test or a genetic test of some sort, or to obtain the results of such a test.

1.5 Profit

Since insurance markets tend in the absence of regulation to be competitive, there is no reason in general for regulating their profits. Where, however, premium regulation is used to ensure solvency of insurers *ex ante*, this often results in high profits *ex post*, and so regulators specify rules concerning the distribution of a proportion of profits back to policy holders, either as a direct

cash rebate or, in life insurance, as an addition to the asset value of the policy. In the former case this means that the effective premium paid *ex post* is less than that *ex ante*, but by an uncertain amount, so that price is a random variable. The rebates at any one time will also differ across insurers, because of random differences in claims experience and asset returns, and this makes price comparisons across insurers difficult. Where rebates are added to the asset value of the policy, this means that an apparently fixed-interest savings instrument is in fact one with a variable return, albeit with a given minimum.

1.6 Service quality

Regulators' efforts in this respect tend to be minimal. There will usually be some sort of office or ombudsman, possibly financed by the insurers themselves rather than the regulator, which collects and processes complaints from policy-holders about companies' performance, especially in respect of claims settlements. Aggregate statistics on these complaints may be published, but data on complaints about individual insurers are rarely made public. The complaints unit may perform an arbitrating function, but essentially the policy-holder's main redress must be through the legal system.

1.7 Portfolio composition

As a further aspect of solvency regulation, constraints may be placed on the composition of an insurer's asset portfolio. Upper limits may be placed on the proportion of the portfolio that may be held in assets, such as ordinary shares, that are considered risky, and certain kinds of assets, such as financial derivatives, may be ruled out entirely. There will be further conditions to ensure a matching of assets with insurance claims liabilities, in terms of the currency in which they fall due (a crude way of dealing with exchange rate risk), and of the timing of the claims - the liquidity issue.

1.8 Distribution

There is not usually any attempt to regulate the basic composition of the distribution system as between independent brokers, direct selling, and use of subsidiaries and tied agents. There is evidence to suggest however that the more tightly regulated the insurance markets, the greater the proportion of subsidiaries and tied agents. A possible explanation is that the less the

variety of contract terms and more uniform the premiums *ex ante*, the less need is there for brokers who offer a range of products. There may well be specification of maximum commission rates and selling expenses, and again this tends to be more marked where there is premium regulation, since the high profits induce more intensive selling activity.

2 The German and British Insurance Markets

2.1 Germany

The German insurance markets have the largest premium volume in Europe, amounting to 208.4 bn.DM in 1994, of which life insurance accounted for 83.4 bn.DM and non-life for 125 bn.DM. In life insurance, around 80% of premium income flowed from contracts consisting of life insurance plus a savings plan, offering a fixed minimum interest rate plus participation in future surpluses. Auto-insurance accounted for about 45% of non-life premiums.

Concentration in the market is apparently quite low, with the leading 10 insurers having less than 50% of premium income. However the largest insurer, Allianz, had close to 20% of the market, with the three next largest coming in at about 4% each.

The foreign presence in this market is extremely low. Branches of foreign companies have less than 5% of the market. German subsidiaries of foreign companies are not recorded separately but all indications are that they also play a very minor role.

The distribution structure is characterised by a very high degree of vertical integration, with about 80% of outlets being subsidiaries or tied agents, selling the products of just one company, 5% are banks, again selling one company's products, 2% were direct sellers and only 10% were brokers dealing in products of more than one company.

Profits in the German insurance markets have been consistently high and stable, which can be attributed to the regulatory regime. In the entire post-war period there have been no bankruptcies of German insurance companies.

2.2 The U.K.

The insurance markets in the UK have in total the second largest total premium volume in Europe, with £27.5 bn in non-life premium income and £35.7 bn. in life insurance in 1994. In the non-life market concentration is high but falling, with the largest 5 firms accounting for almost 80% of premium income in 1982 (when the British insurance markets were substantially deregulated) to just above 60% in 1994. This appears to have been due to significant market penetration by specialist companies and "niche" products. The life insurance business on the other hand was much more fragmented and apparently competition on this market has been fierce, with non insurance companies such as banks and building societies taking more than 10% of the market. There is also a wider range of life insurance products than are observed on the other European markets, especially Germany, with a much greater emphasis on equity-related investments.

The foreign presence in the market is also much more marked than in other European markets, with about one-third of the market supplied by branches and subsidiaries of foreign companies. There was a sharp increase in the foreign share in 1982, following the market deregulation in that year, and another surge in 1993, in anticipation of the deregulation of European insurance markets in 1994.

Vertical integration into distribution is relatively low in the UK, with brokers and other independent agents representing around two-thirds of the market, and tied agents and direct writing accounting for about 30%². The greater availability of apparently "independent" sources of information has not however prevented the occurrence of the kind of event that lends weight to the arguments of the supporters of tight regulation, the so-called "mis-selling scandal". This refers to the following events. In the late 1980's it became possible for members of employee pension schemes to "opt out" or transfer their pensions to schemes offered by the insurance companies. The structure of commission payments meant that brokers had an incentive to persuade people to switch in this way, and it appears that a substantial number of investors did so at significant loss to themselves.

The financial outcomes on the British insurance markets stand in marked contrast to those on the German. Underwriting results have been volatile, with overall profitability relatively low, and bankruptcies have been more or

²Recently however there has been a marked growth in direct selling, especially in motor insurance.

less continuous in the 1980's and 90's, with a sharp peak in 1992, a consequence of the sharp deterioration in financial results in the three years previously.

In Table 1 we summarise the very different regulatory regimes in the German and British insurance markets.

Table 1. Summary Comparison of German and British Regulation

	Germany	U.K.
Solvency	Detailed and stringent	Monitoring
Entry	Costly, entry deterrent	Monitoring, no entry deterrent
Contracts	Fully standardised, uniform	No regulation
Premiums	Regulated, cost-plus	No regulation
Profit	Compulsory redistribution	No regulation
Service	Complaint collection	No regulation
Portfolio	Restrictions on asset type	No regulation
Distribution	Ceiling on commissions	Disclosure regime

We now amplify briefly the relevant aspects of this table.

Germany

Solvency. There were detailed and stringent requirements for solvency reserves over and above technical reserves to be held by insurers. Insurers had to submit annual reports on their solvency position and the regulatory agency had the right to require the insurer to adopt whatever policies it deemed necessary to correct what it regarded as an unsatisfactory position.

Entry. Prospective entrants had to submit a detailed business plan specifying contract conditions, premiums, expected costs and revenues, financial reserves and so on. There was a lengthy procedure of scrutiny and investigation, with frequent requests for further information. The process was regarded as costly and time consuming and seems to have worked as a deterrent to new entry.

Contract conditions. In the main areas of life and property/liability insurance contract terms were fully standardised, along lines laid down by the regulator, so that in effect only one product was sold by all insurance companies. Risk categories were rather coarse and involved extensive pooling. In life insurance, there was a standard interest rate of 3% as the fixed interest component of savings contracts. Insurers were not allowed to refuse insurance.

Premiums. In life and auto insurance, as well as some other markets, there was a form of cost-plus price regulation. Premium calculation for a

specific line of business was based on a standardised calculation of the expected loss, common for all insurers and specified by the regulatory agency. The firm could then add a loading reflecting its own costs. It was allowed a profit *ex ante* of 3% on the final premium.

Profit. The excess of the insurer's *ex post* profit over 3% of premium income was to be divided between policyholders and shareholders, with at least 90% being paid out to policyholders. This "surplus participation" (Überschußbeteiligung) was normally substantial and amounted in effect to a delayed, random rebate on premiums paid, which, moreover, varied across insurers.

Service quality. The regulatory agency collected complaints concerning insurers' service and published aggregated statistics annually. It did not however publish information on individual insurers, and it is not known what action, if any, was taken in respect of insurers with high rates of complaint.

Portfolio composition. There were specific restrictions on the types of assets that could be held, particularly limitations on equity holdings. This led to a high concentration of insurance company asset holding in government debt and other fixed interest assets, amounting to around 60% of total assets.

Distribution. There was no regulation of the form of distribution outlet. However the commissions that were paid to agents were restricted to be no more than 11% of premiums, and marketing expenditures in total were not allowed to exceed 30% of premiums. Such restrictions of course provide evidence of high levels of selling activity.

U.K.

Solvency. Companies were required to submit annual reports to the Department of Trade and Industry (DTI) to allow it to assess their solvency and determine whether specified solvency margins were satisfied. If so, no further action was taken. If not, the Secretary of State for Trade (head of the DTI) had quite far-reaching powers to acquire further information, require a business plan to rectify the situation, and, if need be, suspend the insurer's ability to write new business and receive new premiums and place restrictions on the composition of the asset portfolio. In serious cases he was able to arrange for the insurance business to be taken over by a sound insurer.

Entry. Insurers must be authorised by the relevant government department (DTI) before they can set up in business, and for this they have to submit a business plan, satisfy a capital requirement that depends on the

type of business, and show that the people running the company are "fit and proper persons". There is no evidence to suggest that this process as such was particularly costly or acted as a barrier to entry.

Distribution. This is the only respect in which the otherwise lightly regulated UK insurance markets were subject to tighter regulations than their counterparts in the rest of Europe. Under the Financial Services Act, 1986, sellers of life insurance have to inform potential buyers as to whether they are recommending a particular policy out of a whole range of available products or whether they are exclusively selling the product of one company. Moreover, following the "mis-selling scandal", discussed above, in January 1995 a new "disclosure regime" was introduced, under which the seller of an insurance contract must provide the potential buyer with information about the insurer's selling expenses, including the agent's commission. The aim clearly is to force provision of information to the buyer that will allow him to assess the incentive an apparently "independent" agent may have in selling him a particular policy. This is not necessary when the seller is an exclusive agent of a particular insurer, and so this kind of provision would not be so important in insurance markets, such as the German, where selling is mainly conducted by exclusive subsidiaries or agencies.

2.3 The European Commission's Policy toward Insurance Market Regulation.

Faced with the impossibility of obtaining agreement on a common framework for regulation of all insurance markets in the European Union (EU), the European Commission (EC) adopted a policy consisting principally of three elements.

- An insurer licensed to do business in any one EU country is able to do business in any other EU country without having to undergo a further licensing procedure.
- A common set of rules for financial reporting and for the solvency regulation of insurance companies throughout the EU, to be administered by the regulatory authorities in each country, was introduced.
- The regulatory framework applying to the activities of an insurer is that of the country in which it is licensed - the *home* country - rather than that of a country in which it may do business - the *host* country.

In principle, any country is free to retain aspects of its regulatory system that are not directly affected by these principles, for example premium regulation, regulation of contract conditions, and so on. In practice however, and this is so predictable a consequence that it must be surmised to have been the intention of the EC, the *competition among regulatory systems* opened up by this policy must eventually lead to a *de facto* harmonisation of regulatory frameworks on something very close to the British and French models.

The argument underlying this assertion is simply that we would expect that any regulatory provision that places insurers in one country at a competitive disadvantage in their own market to insurers based in another country must sooner or later disappear. Most probably sooner, as the disadvantaged insurers pressure their domestic politicians and regulators for change, rather than later, as disadvantaged sellers lose market share, entry of new sellers occurs only in those countries that have the most favourable regulatory regimes, and firms relocate to escape from less favourable to more favourable regulation. As we have seen, the main features that distinguished the regulatory frameworks of the UK on the one hand, and Germany on the other, were the regulation of premiums, contract conditions and portfolio composition in the latter country. Each of these can be expected to place a German insurer under a competitive disadvantage vis-à-vis a French or British competitor in the German market.

In terms of the premium, a French or British insurer could offer a fixed premium below the *ex ante* premium offered by its German competitor. Even where, once the *ex post* participation in surplus of the German insurer is taken into account, the expected value of the premiums were the same, we would expect a risk-averse insurance buyer to choose the fixed premium. This assumes of course that the non-German insurers are not perceived as having a higher solvency risk than the German insurer, i.e. that the premium regulation in fact contributes nothing in this regard. This is further discussed in the next section.

As regards contract conditions, the extreme coarseness of the risk categorisation in the German standard contracts provides ample scope for insurance products that offer better terms to lower risk buyers, thus leaving the German insurers with higher risk buyers, further worsening their premium position. In life insurance, the range of equity index-linked products developed by British insurers could be an attractive alternative to the German, where the surplus participation element is a less transparent variable return component than a clearly specified share index.

Finally, where constraints on portfolio composition are binding, this must imply lower returns or higher costs to the insurance business relative to the situation where no such constraints exist. Thus again insurers subjected to such regulatory constraints are at a competitive disadvantage.

3 Conceptual Issues in Insurance Market Regulation.

As we suggested in the previous section, the EC, in its policy toward insurance market regulation, seems in effect to have come down in favour of one side in the debate, the side favouring minimal regulation. Common to all national regulatory frameworks was the licensing of new entrants and the regulation of solvency. This continues, with the latter being standardised across countries and the former being conducted in such a way that no country can, through its licensing procedure, restrict entry from other EC countries. We would expect that more extensive forms of regulation, such as that of premiums, contract conditions and even portfolio composition will be "competed away", and there are indeed signs that that is happening. However, *should* it happen? Or, conversely, should even solvency be subject to regulation? What are the arguments for and against regulation of insurance markets?

The most often cited aspect of concern in relation to solvency regulation is of course the well-being of the policy-holder, or, in the case of third-party liability insurance, the injured party. Insolvency of the insurer, in the absence of any other measures, means the loss of the expected compensation. There is also a further concern, which is a version of the *lemons problem*. It is very difficult for an individual buyer of insurance to be able to assess the risk of insolvency of his insurer. He would have to know the joint distribution of loss claims and the returns on its asset portfolio, now and in the future, in order to calculate the probability that claims will exceed assets. It is usually argued that a policy-holder does not have this information and would not be able to make the requisite calculations even if he had. There is therefore intrinsic uncertainty concerning the product quality, that is, the insurer's insolvency risk. It is then held to be in the interests of all insurers that this uncertainty be kept to a minimum, otherwise the demand for insurance as a whole could be adversely affected. Since there is also a free rider problem - it could pay any one insurer to have a high insolvency risk as long as buyers believe that

it is sure to be solvent - regulation is seen as the means of ensuring that buyers' expectations of low insolvency risk are confirmed.

Some sort of solvency regulation is almost universally encountered in insurance markets. The main issues that present themselves for economic analysis concern its extent and nature, and whether regulation should extend to premiums, contract conditions and portfolio composition.

I would argue that it is inefficient to use the regulatory mechanism effectively to make bankruptcy impossible, as was the case in Germany, simply because bankruptcy is a mechanism by which inefficient firms are forced to leave the market. I would argue further that, while continuing to monitor individual insurance company solvency, regulatory agencies should be concerned with processing the information collected as a result and making it available to policy holders, who would then make rational insurance decisions on the basis of this. The undeniable asymmetry of information with respect to an insurer's claims and asset returns distribution makes it desirable that this information be collected and published, and the regulatory agencies are probably the most effective means of doing this. The information dissemination process could in time make the direct regulation of solvency unnecessary, since, as we have argued, solvency is not a problem when consumers are fully informed.

The experience in the UK suggests that minimal regulation, which allows the possibility of bankruptcy, does not lead to collapse of the market under the weight of the lemons problem, for a number of reasons. Insurers have an incentive to signal their financial solidity, rating agencies exist to provide a market in evaluating solvency risks of insurers³, and a Guaranty Fund⁴, under which policy holders continue to have their claims met even if their insurer becomes insolvent, ensures that welfare losses due to the bankruptcy process are minimal.

If we accept, as all policy-makers and regulatory agencies appear to do, that some kind of solvency regulation is currently necessary, the question arises of whether it should be accompanied by regulation of premiums, con-

³It is noteworthy that in Germany the loosening of regulation has been accompanied by the growth of independent rating agencies.

⁴Guaranty funds are the equivalent in insurance markets to deposit insurance in banking. Typically, all insurers pay a small proportion of their premium income into a fund which then meets policy holders' claims in the event of an insolvency. As with deposit insurance, there is of course the possibility of moral hazard. Empirically speaking however, this does not appear to have been a problem.

tract conditions and portfolio composition. The argument used by the German regulatory authorities is that this is also necessary in the interest of consumers to prevent ruinous price competition which then threatens solvency. Both the theoretical arguments and the empirical evidence run counter to this. If solvency regulation is in force, this can be used to ensure that insurers have sufficient reserves to supplement premium income in meeting claims, and it is precisely the function of reserves, and not of artificially high prices, to fulfill this role. The cost-plus nature of price regulation gives no incentives for efficiency and indeed allows revenues to be absorbed as "organisational slack" and "hidden reserves", rather than being declared as profits and distributed to policy-holders and shareholders. Moreover, it can be shown in a formal model of Bertrand competition among insurance firms that, in equilibrium, firms earn zero profits and, given that consumers are fully informed about insolvency risk, carry enough reserves not only to cover their own liabilities, but also to allow them collectively to take over the market share of any one firm that deviates from the equilibrium by raising its price. Thus even the most extreme kind of price competition does not undermine solvency provided consumers are informed of solvency risks.

Critics of the policies and practices of the German regulatory agency have argued that the solvency argument is essentially a pretext, and in fact the agency was essentially involved in running the insurance industry as a cartel. The empirical evidence from France and the UK supports the position that premium regulation cannot be said to be in the interests of consumers. A study in the mid-eighties by J Finsinger showed that premium rates in non-life insurance were significantly lower, and rates of return on the savings components of life insurance significantly higher in these countries than in Germany. The bankruptcy rate in France has been no higher than that in Germany (although the fact that many insurers in France were publicly owned should be taken into account here), while analysis of the causes of the bankruptcies in the UK and the US suggests that they were not due to premium competition as such, but rather to the underestimation of and inadequate provision for claims liabilities, which is a form of inefficient decision taking in the provision of insurance that is appropriately dealt with by bankruptcy. Moreover, as we have already pointed out, policy-holders need not lose coverage when their insurance company goes bankrupt. In the UK, Guaranty Funds, financed by a compulsory levy on all insurers, are used to meet claims on insolvent insurers, while portfolios of life policies are simply taken over by viable companies. It is doubtful then if the welfare losses

generated by excessively high premiums are compensated by benefits arising from improved solvency protection.

If premium regulation is not justified, then part of the argument for regulation of contract conditions also falls away. There are three reasons usually given for this aspect of regulation. One is that it facilitates premium regulation, since uniform prices require uniform products. The second is that it improves transparency and reduces buyers' costs, both in terms of search costs and the costs of making mistakes, since they are not faced with a "bewildering variety" of products. Thirdly, it is often argued that on equity grounds risk categorisation should be less finely differentiated than might be the case if left to the market, so that higher and lower risks are pooled and socially desirable cross-subsidisation takes place.

In our view the second of these arguments is also very weak. Although greater variety of insurance products may involve consumers in more shopping around, there is nothing peculiar to them as compared to other quite complex consumer products, such as automobiles and consumer durables, where the market is allowed to determine the degree of standardisation (subject of course to constraints, such as safety regulations, which can be embodied in specific legislation).

There is more to discuss in relation to the third point. It is certainly legitimate for public policy to require that pooling of, and cross-subsidisation between, certain risk classes should take place, provided this is clear, explicit and can be publicly debated. A competitive insurance market may well generate more premium differentiation between risk classes than social policy would regard as equitable. Again, however, this is an argument for specific constraints created by explicit legislation rather than for absolute standardisation of contracts.

Finally there is an interesting paradox in relation to portfolio regulation. Above we referred to a proposition to the effect that if consumers are fully informed of solvency risk an insurer will choose to be solvent. This holds on the assumption, as in the example earlier, that it is in effect costless to hold capital in an insurance company as opposed to investing it privately. This is true however only as long as there are no constraints on the way in which the capital may be invested. If there are such constraints, and they are binding, then this creates a specific opportunity cost of holding capital in the insurance company, and it may then be the case that even under full information in equilibrium the insurer chooses to run a positive insolvency risk, the consumer paying a lower premium as a result. There is simply a

"low quality" equilibrium. This is a second best as compared to the case where there are no such opportunity costs on insurance capital. Thus we have that regulation of portfolio composition creates a situation in which additional solvency reserves are perceived as having to be imposed on the insurer, when in fact removal of the portfolio constraint would allow the first best to be reached.

4 Theoretical Issues.

In the discussion of the model of the price-taking insurance firm (Lecture 6), it was shown that, because essentially of the technical characteristics of the loss distributions insurers typically face, insurers, if unregulated, would choose either to put up none of their own capital, or would put up enough to ensure that they were never insolvent. The trade-off is between the gain from truncation of the loss distribution, on the one hand, and the loss of future profits in the event of insolvency, on the other. However, an unsatisfactory assumption underlying this analysis is that insurance buyers act as if they believe the insurer will never go bankrupt, regardless of the capital level it chooses. A paper by Rees, Gravelle and Wambach makes the opposite assumption. Suppose insurance buyers are perfectly informed about the capital of the insurer. Then it is shown that it will always pay the insurer to put up enough capital that it will never be insolvent. We now present the analysis.

We begin by introducing an insurance market into the model in almost the simplest possible way, short of just assuming a given demand function. We assume there is just one insurance buyer with loss distribution $F(C)$ and utility function $u(\cdot)$, with $u' > 0$, $u'' < 0$. In the absence of insurance she obtains an expected utility

$$\bar{u}_0 \equiv \int_0^{C_u} u(y_0 - C) dF \quad (1)$$

with y_0 given. The insurer makes a take-it-or-leave-it offer of an insurance contract giving "full cover" of loss at a premium P . However the buyer is able to observe the choice of K by the insurer and so the premium must satisfy her reservation constraint

$$\int_0^A u(y_0 - P) dF + \int_A^{C_u} u(y_0 - C - P + A) dF \geq \bar{u}_0 \quad (2)$$

In words, as long as the insurer's assets cover claims the insured has a certain income, but if her claim exceeds the insurer's assets, that is he is insolvent, she receives only the amount of these assets, and so she is left with a residual risk. She determines her willingness to pay accordingly. Then we can prove

When the insurance buyer is fully informed about the firm's choice of capital, the insurer's expected profit is larger at $K = K_u$ than at $K = 0$.

Proof: Let P_0 denote the premium that satisfies the equation as an equality when $A = P_0$, ie $K = 0$. Likewise P_u is this premium when $A = K_u + P_u$, when there is no default risk. We have to show

$$P_u - \int_0^{C_u} C dF > \int_0^{P_0} (P_0 - C) dF = F(P_0)P_0 - \int_0^{P_0} C dF \quad (3)$$

or

$$P_u > F(P_0)P_0 + \int_{P_0}^{C_u} C dF \quad (4)$$

Define \tilde{P} to satisfy

$$u(y_0 - \tilde{P}) = \frac{1}{1 - F(P_0)} \int_{P_0}^{C_u} u(y_0 - C) dF \quad (5)$$

By Jensen's Inequality

$$\tilde{P} > \frac{1}{1 - F(P_0)} \int_{P_0}^{C_u} C dF \quad (6)$$

or

$$[1 - F(P_0)]\tilde{P} > \int_{P_0}^{C_u} C dF \quad (7)$$

From (1) we have

$$u(y_0 - P_u) = F(P_0)u(y_0 - P_0) + [1 - F(P_0)]u(y_0 - \tilde{P}) \quad (8)$$

and again Jensen's Inequality gives

$$P_u \geq F(P_0)P_0 + [1 - F(P_0)]\tilde{P} \quad (9)$$

implying

$$P_u > F(P_0)P_0 + \int_{P_0}^{C_u} C dF \quad (10)$$

as required.

A similar result can be proved for any $K < K_u$. The intuition is that the consumer would always be prepared to pay more than the fair premium to insure against the insurer's insolvency, and so it pays the insurer to sell this to her, which in turn implies he must put up enough capital to remain solvent.

The case of a single consumer is of course rather special, but serves to bring out the main point. We can generalise quite easily. Thus suppose there are N consumers each with endowed wealth y , faced with an identical and independent risk of loss $L < y$ with probability p . Any risk of default is fully and correctly perceived by the buyers. In the case of default it is necessary to make some assumption about how insurance claimants would be rationed in the event that the value of claims exceeds the insurer's end-of-period assets. Thus we assume:

1. Insurance contracts are for full coverage.
2. There is random rationing in the following sense: if a consumer has a claim and total claims exceed assets then with a probability equal to the ratio of assets to claims each claimant will receive the indemnity in full, otherwise she receives nothing.

The first of these assumptions is made for simplicity, the second seems quite reasonable. We can imagine that losses hit consumers randomly throughout the period, are reported as they occur, and then payouts are made at the end of the period in the order in which losses were reported, until assets are exhausted or all claims are met. Given an insurance policy $\{P, I\}$, where P is the premium and I the indemnity, the representative individual buys insurance if and only if the participation constraint

$$(1-p)u(y-P) + p\{(1-\pi)u(y-P) + \pi[(1-\theta)u(y-P) + \theta u(y-P-L)]\} \geq \bar{u}_0 \quad (11)$$

or

$$(1-q)u(y-P) + qu(y-P-L) \geq \bar{u}_0 \quad (12)$$

holds. Here, \bar{u}_0 has the same meaning as before, π is the probability that the insurer is insolvent given the insured suffers the loss, and θ is the probability that she receives nothing given she has a claim and the insurer is insolvent. In effect then there are still only 2 "income events" for the consumer, one in which she either has no loss or receives full indemnity, and the other in which she bears the full loss. In both events of course she has paid the premium.

The probability of the latter event is $q = p\pi\theta$, and that of the former is $1 - q$. This probability can be written as follows. Suppose the insurer chooses to meet a given number $n < N$ of claims. Then

$$q = p \sum_{m=n-1}^{N-1} \{()N - 1mp^m(1-p)^{N-1-m}[1 - \frac{n}{m+1}]\} \quad (13)$$

It is then straightforward to prove the equivalent result to Proposition 1 for this model. It simply has to be noted that if the insurer has less capital than $K_m = N(L - P_m)$, where P_m is the largest premium that can satisfy (21) with $q = 0$, then $q > 0$, and the expected cost of claims is $N(p - q)L$, since NqL is the expected number of policy holders that will receive nothing. Then we have

If buyers are fully informed about the probability q that they will not be compensated, the insurer maximises expected profit by setting q to zero, ie by choosing a capital of K_m .

Proof: We have to show that

$$N(P_m - pL) \geq N(P_q - (p - q)L) \quad (14)$$

or

$$P_m \geq P_q + qL \quad (15)$$

where P_q is the largest value of P that can satisfy (21) for the given value of q . Since the buyer's reservation constraint is satisfied as an equality we have

$$u(y - P_m) = (1 - q)u(y - P_q) + qu(y - P_q - L) \quad (16)$$

and so by Jensen's Inequality we have

$$P_m > (1 - q)P_q + q(P_q + L) \quad (17)$$

as required.

Just as before, the intuition is simply that the insured would always be prepared to pay more than the fair premium to insure against the insurer's insolvency, the insurer finds it profitable to sell her this, but this requires him to put up enough capital so that he remains solvent.

These simple but far-reaching results suggest that the only purpose of "regulation" in insurance markets should be to inform consumers of insolvency risks. That is, an insurer would announce his capital and the regulator would also know the parameters of the claims distribution. The "regulator" would then announce the default probability for consumers, who would then make their insurance decisions. The above argument then suggests that in fact the capital will be sufficient to ensure no risk of insolvency. It could also be argued that the present European system of solvency regulation in fact is a simpler way of achieving the same result: the level of capital K is specified for insurers and consumers can then take their insurance decision consistent with the fact that there is a zero probability of default. The danger is, as we see in the German case, that regulation rather than information dissemination lends itself more readily to capture and extension of regulatory powers to effective enforcement of a cartel.

To conclude this section we extend this point somewhat. A feature of tightly regulated insurance markets is the imposition of constraints on the composition of the insurer's asset portfolio. We now show that this in itself can create the need for solvency regulation, in the sense that whereas without these constraints the above results would hold, in the presence of these constraints an insurer would choose a smaller capital than K_m and thus run the risk of insolvency, even though this is perceived by buyers and results in a lower premium. This is a Pareto inefficiency, since the insurer is worse off and insurance buyers no better off - they continue to receive their reservation expected utility. This inefficiency is not removed by then requiring the insurer to put K_m into the insurance business.

The intuition is quite straightforward. In the absence of constraints on portfolio composition it is effectively costless to put capital in the insurance business when there is no risk of insolvency - exactly the same portfolio can be chosen as would be the case if the capital were invested outside the insurance business. However constraints on the portfolio of the insurer create marginal opportunity costs of capital invested in insurance that would not otherwise exist, and this could lead to an optimum at an interior point of the interval $[0, K_m]$.

Thus suppose there are two types of assets, a riskless asset with gross return r and a risky asset with expected gross return $\bar{v} > r$ and *minimum* gross return $v_0 > 0$. This latter assumption is important because it ensures that there is always a finite amount of capital that can be invested in the insurance business to ensure solvency even when entirely invested in the

risky asset. It is also quite reasonable: even the riskiest share or property speculation loses less than 100% of its value. The risk neutral investor/insurer would put all his capital into the risky asset and so would require

$$K_m = \frac{C_m}{v_0} - NP_m \quad (18)$$

to ensure solvency, where C_m is the upper bound on total claims and P_m is the largest premium each of the N fully informed buyers would pay for full cover with no risk of insolvency. The earlier results imply K_m is optimal in the absence of portfolio restrictions. However suppose a regulator requires that a proportion $1 \geq \lambda > 0$ of any capital put into the insurance business must be invested in the riskless asset. Then we have

On the given assumptions the insurer may choose $K^* < K_m$ in the presence of portfolio constraints.

Proof: The opportunity cost of capital put into the insurance business is vK , while the expected return on this capital is $[\lambda r + (1 - \lambda)\bar{v}]K$. It follows that the net opportunity cost of a unit of capital invested in the insurance business is $\beta = \lambda(\bar{v} - r) > 0$. At $K = K_m$ the expected profit of the insurer is

$$V(K) = N(P_m - \bar{C}_m) - \beta K \quad (19)$$

where \bar{C}_m is expected claims costs. K_m will not be optimal if

$$V'(K) = N \frac{d}{dK}(P_m - \bar{C}_m) - \beta < 0 \quad (20)$$

We know from Proposition 3 that the first term on the right hand side is positive, but β can always be chosen sufficiently large that $V'(K) < 0$.

5 Solvency and Competition

The contention of the advocates of extensive regulation is that price competition undermines solvency. This could perhaps be lent support by the results of the model considered in Lecture 6, where it appeared that if there was a zero profit from the insurance business there would be no incentive

to avoid bankruptcy. We analyse the issue more explicitly in a model of Bertrand competition, which seems the most appropriate one for insurance markets since insurers are essentially price-setters. As we would expect, with identical firms and no transactions costs, each firm sets the fair premium at a market equilibrium.

More to the point, there is no bankruptcy risk in equilibrium. Each firm puts enough capital into the insurance business to cover the maximum total claims in the entire market. This is costless, as long as there are no restrictions on insurance company asset portfolios. The intuition is straightforward. The usual Bertrand logic says that if a firm's price is above marginal cost (here, the fair premium), the other can profitably undercut it by shading price slightly and capturing the entire market. In the present model that can only happen if indeed the firm cutting price has enough capital to ensure a zero rationing probability if it obtains the entire market. In other words having this amount of capital is required to make the price competition credible. Price competition could hardly be more cut-throat than in this market, but it does not undermine solvency because firms back it up with sufficient capital reserves.

We use the model of the previous section, with N insurance buyers each faced with the risk of a loss L with probability p , but now with two firms (this could easily be generalised).

The firms simultaneously announce a premium P and an amount of capital K . If premia and insolvency risk are identical each firm receives half the market, while with no insolvency risk the firm with a lower premium would take the entire market. We now define

$$K_m = N(1 - p)L \quad (21)$$

as the amount of capital an insurer would require to supply the entire market with no solvency risk, at the fair premium pL . Then we have

In the Nash equilibrium each insurer announces a premium pL
and a capital $K \geq K_m$

Proof: (i) Neither firm would choose a premium below pL , since this implies expected losses.

(ii) Suppose one firm sets a premium strictly above pL , with arbitrary capital. The other can gain the entire market at some premium just below this, and with at least the amount of capital. Moreover, as we saw in the

previous section, the highest expected profit can be made when the default probability is zero. Thus a firm's best response to a premium above pL is to choose capital $K \geq K_m$ and offer a slightly lower premium. The best response to this in turn is to choose capital $K \geq K_m$ and offer a slightly lower premium, and so on. Thus no premium above pL can be an equilibrium.

(iii) Suppose both firms offer the premium pL . It cannot be an equilibrium to have $K < K_m$. If $K < \frac{1}{2}K_m$, buyers face a default risk and we know that cannot be optimal for the insurer. If $\frac{1}{2}K_m \leq K < K_m$ one firm could raise the premium slightly, without losing all its customers, and so make an expected profit. The reason is that if all its consumers switched to the other insurer, there would be a default risk, while they would be compensated for sure if they stayed with the original firm. Since their willingness to pay is higher in the absence of default risk, the conclusion follows.