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Taxation of Insurance

Abstract

Should we exempt the services of insurance companies from VAT? Addressing this issue, the paper distinguishes between insurance against a general loss of resources and a loss of a specific commodity (property insurance). There is a case for exempting the former kind of insurance, but not the latter. Finally, comparing insurance through a producer warranty with insurance provided separately by an insurance company, it is conceivable that tax exemption of the latter will distort the choice of product quality.

JEL-Codes: H210.

Keywords: insurance, warranties, value added tax, VAT exemptions.

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1. Introduction

The taxation of financial services often deviates from standard principles due to a number of practical and administrative obstacles. The special features of financial services have prompted an extensive interest in how they can and should be taxed[1]. An issue highlighted in much of the literature is the VAT exemption of many financial services, often claimed to be a source of social inefficiency. This paper singles out insurance as a category of special interest. In European VAT, insurance is exempt. However, many countries levy some kind of separate taxes on insurance often taking the form of excise taxes on premiums or stamp duties.

There are at least three strands of literature addressing indirect taxation of insurance. One can treat insurance as part of a literature aiming at deriving general insights into taxation of financial services. A more targeted approach addresses explicitly which principles should govern taxation of insurance in particular. Examples are Barham et al. (1987) and Grubert and Mackie (2000), which we shall return to below. Finally, there is a literature addressing ways to implement taxes approximating as closely as possible ideal but not practically implementable taxes. (See e.g. Cnossen, 2103). As stated by Jack (2000): "Most authors take as given the desirability of taxing financial services, and confine themselves to implementation issues." The current analysis falls within the second category. Considering various insurance cases, we shall address the taxation of the use of resources needed to provide insurance services (collecting premiums and honouring claims), which we can interpret as the value added created by insurance companies. The approach is to ask if in principle it would actually be desirable to levy a value added tax when neglecting practical and administrative problems and impediments that may prevent us from doing so. Such problems of practicability would obviously be a concern only in case it would, in principle, be desirable to levy VAT.

The paper distinguishes insurance against a general loss of resources or endowment available for consumption and the loss of a particular commodity (property insurance). The former is discussed in Section 2, while Section 3 is devoted to the latter. Section 4 discusses how the respective taxation of warranties offered by the goods producer and insurance provided by an insurance company can affect the choice of product quality in the market. Section 5 concludes.

[1] Papers providing rather general discussions of indirect taxation of financial services are for example Huizinga (2002), Boadway and Keen (2003), Ernst and Young (2009) and Keen (2011).

2. Case I: loss of endowment.

Consider an agent with a resource endowment *Y*. Some of it may be taxed away by a lump-sum tax T. Two contingencies exist. With probability $1-\pi$ the agent will experience a good state where $Y-T$ can be used for consumption, C_g . With probability π he will experience a bad state where he loses *L* of his endowment and will only have $Y-L-T$ available for consumption, C_b, unless some compensation scheme is in place. There is a general loss of purchasing power, which could be considered as a loss of earnings ability or even as loss of household earnings due to the death of a bread-winner, as in the case of life insurance[2]. This model is close to being identical to a model of Grubert and Mackie (2000) and Jack (2000), but the analysis will be extended somewhat beyond theirs.

We assume that initially agents are identical and normalise the population to unity. Now consider a transfer from the good state to the bad state which takes the form of an insurance premium *P* in both states used to finance a transfer *C* (compensation) to the bad state. Moreover, assume that there is a real cost *k* per unit transferred implying a total cost *kC*, which we can think of as the value added created by an insurer. Then

$$P=(1+k)\mathrm{C}\pi \tag{1}$$

where k is known as a loading factor. The expected utility is then

$$\begin{aligned}\Omega &= (1-\pi)\,\mathrm{U}(C_g)+\pi U(C_b)=(1-\pi)\,\mathrm{U}(Y-T-P)+\pi U(Y-T-P-L+C)\\ &= (1-\pi)\,\mathrm{U}(Y-T-(1+k)C\pi)+\pi U(Y-T-L-(1+k)C\pi+C)\end{aligned} \tag{2}$$

where U denotes the utility function.

Based on the assumptions above, we shall consider alternative tax regimes. First, we consider the case where only the lump sum tax is being deployed. As we know that a lump sum tax is non-distortive this will serve as a benchmark with which we can confront other tax regimes. Secondly, we shall consider the case where the lump sum tax is replaced by a consumption tax, which we can think of as a value added tax even if our simple model does not distinguish between different types of consumption taxes as we neglect purchases of intermediate goods. Where the input-output structure is taken into account it makes a difference whether there is a "proper" value added tax granting a refund of the tax paid on purchased intermediate goods or whether one simply imposes a tax on the value added without any refund[3]. Even if leaving aside some characteristics of the value added tax, the model is sufficient to address the key question raised in the debate over whether a value added tax exempting financial services distorts the consumption bundle. To focus sharply on this issue, we also abstract from other distortions such as labour supply distortions, which is the reason why we assume an exogenous resource endowment.

In general, distributional concerns are crucial in discussions of optimal taxation, which typically involves a trade-off between distribution and social efficiency. However, in the interest of a focussed discussion of efficiency we neglect agent heterogeneity and distribution. The debate about taxation of financial services has mainly been concerned with efficiency considerations, i.e. whether taxation or

[2] In practice, life insurance would include a savings component abstracted from in the present context. This was a central issue in Barham et al. (1987).

[3] The former type is based on the so-called invoice method, while the latter is based on the addition or subtraction method. In the literature on taxation of financial services, the latter is known as a financial activities tax (FAT).

missing taxation improves or distorts the resource allocation. This is an issue which is relevant regardless of concerns with distribution and can be discussed in a homogenous agent framework.

2.1 Lump sum versus value added taxation

Maximising Ω wrt C we get the first order condition

$$(1-\pi)\,U_g'(-(1+k)\pi)+\pi U_b'(-(1+k)\pi+1)=0 \tag{3}$$

which characterises the optimal allocation when a lump sum tax is available. Where *k=0*, we have the conventional full insurance result: $U_g' = U_b'$. Where $k>0$, $U_g' < U_b'$. There is less than full insurance due to the transaction cost.

Now consider a market with VAT on consumption, but no VAT on insurance, and denote the VAT rate by τ. Where the insurer is assumed to break even the premium is given by (1) , and

$$C_g = \frac{Y-P}{1+\tau} = \frac{Y-(1+k)\pi C}{1+\tau} \tag{4}$$

$$C_b = \frac{Y-L-P+C}{1+\tau} = \frac{Y-L-(1+k)\pi C + C}{1+\tau} \tag{5}$$

As is standard in insurance theory, we find the optimal insurance contract by maximising expected utility subject to the break-even constraint. We then maximise

$$\begin{aligned}\Omega &= (1-\pi)\,U(C_g)+\pi U(C_b)\\ &= (1-\pi)\,U\left(\frac{Y-(1+k)\pi C}{1+\tau}\right)+\pi\, U\left(\frac{Y-(1+k)\pi C - L + C}{1+\tau}\right)\end{aligned} \tag{6}$$

with respect to C. It is trivial that the first order condition will be the same as above, and there is no distortion and no need for a VAT on insurance to avoid distortions.

Proposition1. *A value added tax exempting insurance services generates the same allocation as a lump sum tax.*

We note that the purpose of this financial service (the insurance) is to transfer purchasing power (some of the endowment) from the favourable to the unfavourable state. It may seem surprising that no VAT should be charged on the payment for this service. However, what matters is the rate of transformation between consumption in the two states. To get an additional unit of consumption in the bad state C must be increased by an amount $dC = \frac{1}{1-(1+k)\pi}$. Then the agent foregoes $\frac{(1+k)\pi}{1-(1+k)\pi}$ units of consumption in the good state. This is the rate of transformation that the agent faces regardless of whether there is a lump sum tax or a value added tax exempting insurance. This is the same result as the one established by Grubert and Mackie (2000). Below we shall take the analysis one step further.

2.2 Value added and insurance taxation

Since there is only partial insurance, one may wonder if there is a further role for tax policy in alleviating risk. Consider the case where, besides the value added tax considered above, there is conceivably a tax on the value added in the insurance sector. Denote the tax rate by θ. The expected utility is then

$$\Omega = (1-\pi)\,\mathrm{U}\left(\frac{1}{1+\tau}(Y-(1+k(1+\theta))C\pi)\right) + \pi\,\mathrm{U}\left(\frac{1}{1+\tau}(Y-(1+k(1+\theta))C\pi) - \mathrm{L} + \mathrm{C}\right) \tag{7}$$

Differentiating, we can find the effects of changing the tax rates θ and τ. Departing from a situation with no tax on insurance $(\theta = 0)$, can we enhance expected utility by introducing a (positive or negative) tax , i.e. letting θ deviate from zero while keeping tax revenue unchanged? This is equivalent to asking if there are changes in θ and τ, keeping expected utility unchanged, that will increase tax revenue. If so, one could recycle the additional tax revenue to the taxpayers to make them better off. Considering a tax perturbation $\mathrm{d}\tau, \mathrm{d}\theta$, the impact on expected utility is

$$\mathrm{d}\Omega = U'\frac{-1}{(1+\tau)^2}(\mathrm{Y}-(1+\mathrm{k})C\pi)\,\mathrm{d}\tau + \mathrm{U}_b'\frac{-1}{(1+\tau)^2}\pi(-L+C)\,\mathrm{d}\tau + U'\frac{1}{1+\tau}\left(-kC\pi\right)d\theta \tag{8}$$

where we use the notation $U' = (1-\pi)\,\mathrm{U}_g' + \pi\,\mathrm{U}_b'$ for the expected marginal utility of income.

Considering the expression for tax revenue,

$$R = \frac{\tau}{1+\tau}\left(\mathrm{Y}-(1+k(1+\theta))C\pi\right) + \frac{\tau}{1+\tau}\pi\left(-\mathrm{L}+\mathrm{C}\right) + \theta kC\pi \tag{9}$$

we realise that changing θ and τ can affect tax revenue in three ways. There are changes in tax revenue due to changes in θ and τ, respectively, when keeping the initial value of C unchanged ("mechanical effects"), and the tax revenue will be affected by any change in *C* induced by the tax reform ("behavioural effects"). In mathematical terms, we can write the changes in tax revenue as

$$\begin{aligned} dR = {} & \frac{1}{(1+\tau)^2}\left(\mathrm{Y}-(1+k\left(1+\theta\right))C\pi\right)d\tau + \frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau + \frac{1}{1+\tau}k\pi Cd\theta \\ & + \left(\theta - \frac{\tau}{1+\tau}\left(1+\theta\right)\right)k\pi dC \end{aligned} \tag{10}$$

(see eq. a3 in the appendix). Where initially $\theta = 0$,

$$dR = \frac{1}{(1+\tau)^2}\left(\mathrm{Y}-(1+k)C\pi\right)d\tau + \frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau + \frac{1}{1+\tau}k\pi Cd\theta - \frac{\tau}{1+\tau}k\pi dC \tag{11}$$

Considering tax rate changes that keep expected utility unchanged, we find, as shown in the appendix (eq. a2), that when $\theta = 0$

$$d\theta = -\frac{Y-(1+k)C\pi}{(1+\tau)\,\mathrm{kC}\pi}d\tau - \frac{\mathrm{U}_b'}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)kC\pi}d\tau \tag{12}$$

Inserting the expression for $d\theta$ yielding $\mathrm{d}\Omega = 0$ into equation (11) , we find

$$dR = \left(1 - \frac{\mathrm{U}_b'}{U'}\right)\frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau - \frac{\tau}{1+\tau}k\pi dC \tag{13}$$

To start with, neglect the change in C and focus on the former term of the right hand side. The marginal utility will be larger in the bad state than the average marginal utility, i.e. $\mathrm{U}_b' > U'$. Since also $L>C$, $dR > 0$ for $d\tau > 0$. This means that expected utility can be enhanced by lowering θ below zero and increasing τ to keep tax revenue unchanged at least as long as there is no change in C. The reason is simple. The general VAT will impose a larger tax burden in the good state where consumption, and hence the tax base, is larger, while the insurance tax with rate θ will impose the same tax in both states. It follows that by increasing τ and lowering θ more of the tax burden is shifted from the bad state to the good state, which is beneficial from the perspective of the taxpayer.

The next question is then how C is affected. We see from eq. (6) that the first order condition for the optimal choice of C is

$$\Omega'(C) = \frac{d\Omega}{dC} = \frac{1}{1+\tau}\left\{-(1-\pi)\pi\,\mathrm{U}_g'(1+k(1+\theta)) + \pi\,\mathrm{U}_b'\left(1-(1+k(1+\theta))\pi\right)\right\} = 0 \tag{14}$$

The second order condition is $\Omega''(C) < 0$.

To study the induced change in C, we make use of the first order condition and perform comparative statics. Consider a change in τ accompanied by a change in θ that has an offsetting effect on expected utility, as expressed by (12). This means that when we differentiate wrt τ we consider this total derivative rather than the partial derivative. As derived in the appendix (eq. a7),

$$\begin{aligned}\frac{dC}{d\tau} &= \left((1-\pi)\,\mathrm{U}_g'\frac{1}{1+\tau}k\pi + \pi\,\mathrm{U}_b'\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}\frac{1}{\Omega''(C)} \\ &+\left[\frac{-\mathrm{U}_b''}{\mathrm{U}_b'} - \frac{-\mathrm{U}_g''}{\mathrm{U}_g'}\right](1-\pi)\,\mathrm{U}_g'\frac{1}{(1+\tau)^2}(1+k)\pi\left(\frac{\mathrm{U}_b'}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)}\right)\frac{1}{\Omega''(C)} \\ &-(1-\pi)\,\mathrm{U}_g'\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(C-L)\right]\frac{1}{\Omega''(C)}\end{aligned} \tag{15}$$

We have decomposed the effect into three main terms. The first term is positive. Increasing τ and lowering θ lowers the marginal cost of insurance and is a case for buying more insurance. The second term is also positive. We can interpret this as an income effect making the agent worse off in both states. With the standard assumption that the absolute risk aversion is decreasing in income, this partial effect is that the agent wants more insurance. The last term, however, is negative. Increasing τ reduces the real value of the net loss and hence the marginal utility of income in the bad state. This means that the marginal value of the indemnity diminishes, which weakens the inducement to buy insurance. C will decline only if the last term outweighs the first and second terms. We can summarise the effects as follows.

Proposition 2. *Consider a general consumption tax (VAT) with rate τ and a special subsidy or tax on insurance with rate θ. Introducing an insurance subsidy financed by increasing τ, will alleviate the risk and increase the expected utility faced by the representative agent in the absence of any behavioural response. A further benefit is that the marginal cost of the insurance premium diminishes inducing a welfare enhancing increase in insurance. There may be a counteracting effect as the mitigation of risk may discourage the acquisition of insurance. Making the plausible assumption that the counteracting effect is less than offsetting, there is overall a beneficial welfare effect.*

In the debate about taxation of financial services, it has been argued that the VAT exemption of many financial services should be abolished to make the resource allocation more socially efficient. Proposition 2 suggests that in the current setting no such case exists. There is rather an argument for a subsidy.

As is common in optimal tax analysis, we have neglected any administrative cost of taxation. However, it seems plausible that introducing a novel tax or subsidy will involve a cost. An immediate implication is a further erosion of any argument for a tax on insurance. Clearly, the cost will also weaken the case for a subsidy implying that the benefits from a subsidy must outweigh the administrative cost for a subsidy to be worthwhile. The most robust policy conclusion from our analysis is therefore that there is hardly a case for imposing a positive tax on the kind of insurance addressed above. There may be a case for introducing a subsidy, which, however, is less compelling in the presence of administrative costs.

3. Case II: Loss of commodity: property insurance

How in principle one would like to deal with the various aspects of taxes on property insurance has not been much discussed in the literature. Barham et al. (1987) focus on VAT on the item being insured assuming costless provision of intermediation services, but argue in general that "the intermediation service provided by insurances companies is what should be taxed" (op. cit. p. 181).

To address property insurance, we still assume there is a population of identical individuals normalised at unity. Now consider a case where resources can be expended on two goods, one of which can be lost or damaged. For simplicity we consider a (total) loss. There is a resource endowment *Y* available for acquiring the goods. We consider the following setting. An agent buys *B* units of the good that can be lost and *X* units of the other good. The unit cost of both commodities is set equal to unity. An agent can also purchase insurance that guarantees that *C* units will be available even if there is a loss of the initial quantity. A loss occurs with probability π. To be guaranteed that a unit is available, possibly after a series of losses, $\rho = \dfrac{1}{1-\pi}$ units must be acquired per agent[4]. The price and production cost of each unit is set equal to unity. The transaction cost of paying compensation to the insured is $k\rho C$ where *k* is a positive constant, and the insurance guarantees C units when the initial amount is lost. The total insurance premium is then $\pi(1+k)\rho C$. Full insurance would imply that $C = B$. An individual derives

[4] Note that $\dfrac{\pi}{1-\pi}$ is the sum of an infinite geometric series of losses that arises when a fraction π of the first unit is lost, a fraction π of the replacement is lost, and so on ad infinitum. $\rho = 1 + \dfrac{\pi}{1-\pi}$.

utility $u(X)$ from X and utility $v(B)$ from B. Both functions are assumed to be increasing and strictly concave. The budget constraint is

$$Y = X + B + \pi(1+k)\rho C + T \tag{16}$$

where *T* is a lump sum tax. The resource endowment is used for buying *X*, *B*, and insurance and paying the tax. We then have that X is received with certainty, while B is received when loss is avoided with probability $1-\pi$, and C is the indemnity received when the loss occurs with probability π.

Then the expected utility is

$$u(X) + (1-\pi)v(B) + \pi v(C) = u(Y - B - \pi(1+k)\rho C - T) + (1-\pi)v(B) + \pi v(C) \tag{17}$$

Maximising wrt *B* and *C* we get the first order conditions

$$-u' + (1-\pi)v'(B) = 0 \tag{18}$$

and

$$-u'\pi(1+k)\rho + \pi v'(C) = 0 \tag{19}$$

which characterise the first best socially efficient allocation. It follows that

$$(1-\pi)v'(B)(1+k)\rho = v'(C) \tag{20}$$

and $C \leq B$ according as $k \geq 0$. There is full insurance when there is no transaction cost and partial insurance when there is a strictly positive transaction cost.

Now consider the case where there is a consumption tax (VAT) with rate τ. The tax-inclusive price of each consumption good is $1+\tau$. We can interpret the transaction cost as the value added of the insurance company. We assume there is potentially a tax with rate θ on the transaction cost. The budget constraint of the agent is then.

$$Y = (1+\tau)X + (1+\tau)B + \pi(1+\tau)\rho C + \pi(1+\theta)k\rho C \tag{21}$$

The expected utility is

$$u\left(\frac{Y}{1+\tau} - B - \pi\rho C - \pi\frac{1+\theta}{1+\tau}k\rho C\right) + (1-\pi)v(B) + \pi v(C) \tag{22}$$

The optimal choice of *B* and *C* is then characterised by the first order conditions

$$-u' + (1-\pi)v'(B) = 0 \tag{23}$$

$$-u'\pi\rho\left(1 + \frac{1+\theta}{1+\tau}k\right) + \pi v'(C) = 0 \tag{24}$$

Comparing with (19), we see that the social efficiency condition is fulfilled if $\theta = \tau$.

Proposition 3. *Suppose insurance is needed against the loss of a particular commodity. Then to achieve social efficiency, the value added tax should be levied also on the insurance service.*

To provide some intuition for this result, we may think of a consumer who wants to have a bicycle. However, a fraction of the purchased bicycles brakes down. For the sake of the argument, suppose that every second one brakes down. Then, on average, one must produce two bicycles for each one being available to a consumer with the second one financed through an insurance scheme that is costly to operate. With a producer price equal to one, the cost of each bicycle the consumer has at his disposal is then two plus the cost of providing the insurance. For the relative consumer price of bicycles to reflect the relative cost, the value added tax imposed on other commodities must also be levied on the full cost of bicycles, i.e. including the transaction cost of insurance.

4. Warranties vs insurance

In many cases producers provide what is equivalent to insurance for the customers by offering a warranty guaranteeing that if a purchased item breaks down the producer will replace it free of charge. This guarantee will impose a cost on the seller that must be covered by a mark-up of the price on which a value added tax is levied. It may not be obvious whether the producer or an insurance company is the more efficient insurer. One may argue that a company specialising in insurance is likely to be more efficient. On the other hand, the producer may have the advantage of specialised knowledge about the particular item it produces so that a warranty may be preferable. However, a VAT exempt insurance company will have a tax advantage that may enable it to outcompete the producer offering a warranty. There may be a distortion in disfavour of warranties.

However, efficient form of insurance may not be the key issue. The reason why a producer offers a warranty is usually that he wants to signal that the item is of good quality when the customers cannot directly observe quality. What kind of warranty or insurance that is offered may therefore have implications for the choice of quality. To simplify, assume there are two possible qualities. If the quality is good, the probability of breakdown is π[5]. If the quality is poor the probability is $\Pi > \pi$. The production cost of good quality is 1. The production cost of poor quality is $\kappa < 1$. Suppose the cost of administering the guarantee/insurance is respectively $K(\pi)$ and $K(\Pi)$ in the two states, where *K* is the administrative cost per breakdown. We assume that $K(\Pi) > K(\pi)$. Management of the larger risk is more costly. It is implicit that it is equally costly for the producer to provide a warranty and the insurance company to provide insurance for the same kind of risk.

To establish a benchmark, assume that providing superior quality is the least costly and socially preferable alternative when taking all cost items into account. In the case of poor quality and a warranty, the cost of the producer is $\kappa + \Pi\kappa + K(\Pi)$. For each unit produced at a cost κ , on average Π units break down and must be replaced at a cost $\Pi\kappa$. In addition, there is an administrative cost of insurance

[5] Assuming that also a replacement unit can break down insurance guaranteeing that a unit will be available would require production of more units, in line with the case considered in Section 3. For simplicity, we neglect this complication, as it would not add any further insight.

equal to $K(\Pi)$. Analogously, in the case of good quality and a warranty the cost is $1+\pi+K(\pi)$. Our benchmark is then that the social optimum is characterised by

$$1+\pi+K(\pi)<\kappa+\Pi\kappa+K(\Pi) \tag{25}$$

As above, denote the VAT rate by τ. Assuming that competition drives the price down to unit cost, we note that where insurance takes the form of a warranty from the producer,

$$\left(1+\tau\right)\left(1+\pi+K(\pi)\right)<\left(1+\tau\right)\left(\kappa+\Pi\kappa+K(\Pi)\right), \tag{26}$$

and the market with tax-inclusive prices realises the socially efficient allocation.

Now consider insurance provided by an insurance company in the respective regimes where the insurer can or cannot detect the true quality.

First, assume that the insurance company knows the quality. Is it possible that the producer will opt for low quality? Suppose that it does. Also assume that $1+\pi>\kappa+\Pi\kappa$, while $K(\Pi)>K(\pi)$. For low quality to be chosen, it must be the cheaper alternative in the market allowing for all cost items. This means that with separate insurance

$$(1+\tau)(\kappa+\kappa\Pi+K(\Pi))-\tau K(\Pi)<(1+\tau)(1+\pi+K(\pi))-\tau K(\pi),$$

which is equivalent to

$$\kappa+\kappa\Pi+K(\Pi)<1+\pi+K(\pi)+\frac{\tau}{1+\tau}\left[K(\Pi)-K(\pi)\right].$$

This is obviously a possibility where the tax term is sufficiently large. Since the production cost is taxed while the transaction cost is not it is more important to avoid a large production cost which in this case is achieved by choosing low quality. This market outcome requires that it is not contested by a producer opting for high quality and offering a warranty. In that case the tax- and warranty-inclusive price would be $\left(1+\tau\right)\left(1+\pi+K(\pi)\right)$. This alternative would not be competitive if $\left(1+\tau\right)\left(1+\pi+K(\pi)\right)>(1+\tau)(\kappa+\kappa\Pi+K(\Pi))-\tau K(\Pi)$, which is equivalent to $\left(1+\pi+K(\pi)\right)>(\kappa+\kappa\Pi+K(\Pi))-\frac{\tau}{1+\tau}K(\Pi)$, which may hold if the tax term is sufficiently large. Low quality and separate insurance are chosen due to preferential tax treatment.

We may assume that the insurer does not know whether the quality is high or low. Then the insurer would have to pool the risks in case different qualities were being produced. When the customer is insured and pays the same premium whatever the quality he will choose the lower-priced product. The producers will then have to produce as cheaply as possible and choose the lower quality, and we are back to the case just considered above. Again, it may happen that the high-quality alternative is socially preferable but not competitive in the market.

Proposition 4. *When a warranty from the producer is taxed while insurance services are tax exempt, it is a conceivable, but not a necessary outcome, that low quality is chosen in the market even if high quality is socially preferable. The inefficient outcome will occur if the VAT rate is sufficiently large.*

5. Concluding remarks

Two major insurance cases have been examined. In one case there is a risk of a general loss of resources available for consumption (loss of an initial endowment). It is shown that when consumption is taxed in either contingency there should be no tax on the value added in the insurance sector to achieve the non-distorted allocation that would be achieved when deploying a lump-sum tax. However, as there is incomplete insurance, more of the tax burden can be shifted to the good high-consumption state by lowering the tax on insurance payable in either state and increasing the tax on general consumption imposing a higher burden in the good state. An alternative case is one where the risk is loss of a specific good. This means that obtaining a unit with certainty requires the purchase of more than one unit on average as an additional amount is required to replace what is lost. As the replacement requires efforts to provide insurance (a value added in the insurance sector), the consumer should be faced with the entire extra cost due to the random loss, and all the cost items should be taxed to preserve relative prices. Otherwise, there is a distortion of the consumption bundle. Comparing insurance through a producer warranty with insurance provided separately by an insurance company, it is conceivable that tax exemption of the latter will distort the choice of product quality.

This paper has neglected a number of aspects of value added taxation and insurance. It has been assumed that there is no tax on insurance when the services of insurance companies are tax exempt. However, there is an implicit tax when insurance companies buy inputs from other sectors, and the VAT on these intermediate goods are not refundable when the sector is VAT exempt. Another aspect of the input-output structure is that VAT exemption introduces a bias in favour of in-house production rather than outsourcing of activities needed for producing the output of insurance companies, or any other tax-exempt business.

The paper has addressed insurance purchased by consumers, but buying insurance can also be part of business activities. For instance, equipment used in firms can break down due to some random event. Suppose a particular sector is exposed to risk of a loss or damage, against which insurance is acquired. The insurance premium, including the transaction cost, is then a cost of production in this sector[6]. For consumer prices to reflect relative production costs a VAT must be levied on the total cost of production in this sector as in any other sector. This is analogous to the insurance against the loss of a particular commodity considered in section 3.

Appendix

Differentiating the expected utility

$$\Omega = (1-\pi)\,\mathrm{U}\left(\frac{1}{1+\tau}(Y-(1+k(1+\theta))C\pi)\right)+\pi\,\mathrm{U}\left(\frac{1}{1+\tau}(Y-(1+k(1+\theta))C\pi)-\mathrm{L}+\mathrm{C}\right),$$

we can find the effects of changing the tax rates θ and τ :

[6] In principle, owners of businesses might obtain insurance without paying premiums to insurance companies by diversifying their ownership, but realistically also businesses will buy insurance.

$$\mathrm{d}\Omega = U'\frac{-1}{(1+\tau)^2}(\mathrm{Y}-(1+\mathrm{k}(1+\theta))C\pi)\,\mathrm{d}\tau + \mathrm{U}_b'\frac{-1}{(1+\tau)^2}\pi(-L+C)\,\mathrm{d}\tau + U'\frac{1}{1+\tau}\left(-\mathrm{k}\,C\pi\right)d\theta \qquad \text{(a1)}$$

Consider a change in τ accompanied by a change in θ that offsets the effect on expected utility. Setting $\mathrm{d}\Omega = 0$, we obtain

$$U'(1+\tau)kC\pi d\theta = -U'(\mathrm{Y}-(1+\mathrm{k})C\pi)\,\mathrm{d}\tau - \mathrm{U}_b'\,\pi(-L+C)\,\mathrm{d}\tau$$

$$d\theta = -\frac{\mathrm{Y}-(1+\mathrm{k}(1+\theta))C\pi}{(1+\tau)kC\pi}\mathrm{d}\tau - \frac{\mathrm{U}_b'}{U'}\frac{\pi(-L+C)}{(1+\tau)kC\pi}\mathrm{d}\tau \qquad \text{(a2)}$$

Differentiating the expression for tax revenue

$$R = \frac{\tau}{1+\tau}\left(\mathrm{Y}-(1+k(1+\theta))C\pi\right) + \frac{\tau}{1+\tau}\pi\left(-\mathrm{L}+\mathrm{C}\right) + \theta kC\pi\,,$$

we get

$$dR = \frac{1}{(1+\tau)^2}\left(\mathrm{Y}-(1+k\left(1+\theta\right))C\pi\right)d\tau + \frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau - \frac{\tau}{1+\tau}k\pi Cd\theta + \pi kCd\theta$$
$$-\frac{\tau}{1+\tau}\left((1+k(1+\theta))\pi\right)dC + \frac{\tau}{1+\tau}\pi dC + \theta k\pi dC$$

$$dR = \frac{1}{(1+\tau)^2}\left(\mathrm{Y}-(1+k\left(1+\theta\right))C\pi\right)d\tau + \frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau - \frac{\tau}{1+\tau}k\pi Cd\theta + \pi kCd\theta$$
$$-\frac{\tau}{1+\tau}\pi dC - \frac{\tau}{1+\tau}k\pi dC - \frac{\tau}{1+\tau}k\theta\pi dC + \frac{\tau}{1+\tau}\pi dC + \theta k\pi dC$$

$$dR = \frac{1}{(1+\tau)^2}\left(\mathrm{Y}-(1+k\left(1+\theta\right))C\pi\right)d\tau + \frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau + \frac{1}{1+\tau}k\pi Cd\theta$$
$$+\left(\theta - \frac{\tau}{1+\tau}\left(1+\theta\right)\right)k\pi dC \qquad \text{(a3)}$$

Where initially $\theta = 0$,

$$dR = \frac{1}{(1+\tau)^2}\left(\mathrm{Y}-(1+kC\pi\right)d\tau + \frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau + \frac{1}{1+\tau}k\pi Cd\theta + \frac{\tau}{1+\tau}k\pi dC \qquad \text{(a4)}$$

Inserting the expression for $d\theta$ yielding $\mathrm{d}\Omega = 0$, we get

$$d\theta = -\frac{\mathrm{Y}-(1+\mathrm{k})C\pi}{(1+\tau)kC\pi}\mathrm{d}\tau - \frac{\mathrm{U}_b'}{U'}\frac{\pi(-L+C)}{(1+\tau)kC\pi}\mathrm{d}\tau$$

$$dR=\frac{1}{(1+\tau)^2}\left(\mathrm{Y}-(1+k)C\pi\right)d\tau+\frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau$$
$$-\frac{1}{1+\tau}k\pi C\frac{\mathrm{Y}-(1+\mathrm{k})C\pi}{(1+\tau)kC\pi}\,\mathrm{d}\tau-\frac{1}{1+\tau}k\pi C\frac{\mathrm{U}_b'}{U'}\frac{\pi(-L+C)}{(1+\tau)kC\pi}\,\mathrm{d}\tau$$
$$-\frac{\tau}{1+\tau}k\pi dC$$

$$dR=\left(1-\frac{\mathrm{U}_b'}{U'}\right)\frac{1}{(1+\tau)^2}\pi\left(-\mathrm{L}+\mathrm{C}\right)d\tau-\frac{\tau}{1+\tau}k\pi dC \tag{a5}$$

To study the induced change in *C*, we recall the first order condition (14)

$$\Omega'(C)=\frac{d\Omega}{dC}=\frac{1}{1+\tau}\left\{-(1-\pi)\pi\,\mathrm{U}_g'(1+k(1+\theta))+\pi\,\mathrm{U}_b'\left(1-(1+k(1+\theta))\pi\right)\right\}=0$$

and perform comparative statics. We differentiate the first order condition, set $\theta=0$, and find

$$\Omega''(C)\frac{dC}{d\tau}-\left((1-\pi)\,\mathrm{U}_g'\frac{1}{1+\tau}k\pi+\pi\,\mathrm{U}_b'\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}_g''\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\frac{d\theta}{d\tau}+\pi\,\mathrm{U}_b''\frac{1}{1+\tau}\left(1-(1+k)\pi\right)\left[-k\pi C\frac{1}{1+\tau}\right]\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}_g''\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right] \tag{a6}$$
$$+\pi\,\mathrm{U}_b''\frac{1}{1+\tau}\left(1-(1+k)\pi\right)\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+\pi\,\mathrm{U}_b''\frac{1}{1+\tau}\left(1-(1+k)\pi\right)\left[\frac{-1}{(1+\tau)^2}(-\mathrm{L}+\mathrm{C})\right]=0$$

Further manipulations yield

$$\Omega''(C)\frac{dC}{d\tau}-\left((1-\pi)\,\mathrm{U}_g'\frac{1}{1+\tau}k\pi+\pi\,\mathrm{U}_b'\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}_g'\frac{\mathrm{U}_g''}{\mathrm{U}_g'}\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\frac{d\theta}{d\tau}+\pi\,\mathrm{U}_b'\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}\left(1-(1+k)\pi\right)\left[-k\pi C\frac{1}{1+\tau}\right]\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}_g'\frac{\mathrm{U}_g''}{\mathrm{U}_g'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+\pi\,\mathrm{U}_b'\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}\left(1-(1+k)\pi\right)\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+\pi\,\mathrm{U}_b'\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}\left(1-(1+k)\pi\right)\left[\frac{-1}{(1+\tau)^2}(-\mathrm{L}+\mathrm{C})\right]=0$$

$$\Omega''(C)\frac{dC}{d\tau}-\left((1-\pi)\,\mathrm{U}_g'\,\frac{1}{1+\tau}k\pi+\pi\,\mathrm{U}_b'\,\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_g''}{\mathrm{U}_g'}\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\frac{d\theta}{d\tau}+(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_g''}{\mathrm{U}_g'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(C-L)\right]=0$$

where we have used that from the first order condition $\pi\,\mathrm{U}_b'\left(1-(1+k)\pi)\right)=(1-\pi)\,\mathrm{U}_g'(1+k)\pi$.

Then insert $\frac{d\theta}{\mathrm{d}\tau}=-\frac{\mathrm{Y}-(1+\mathrm{k})C\pi}{(1+\tau)kC\pi}-\frac{\mathrm{U}_b'}{U'}\frac{\pi(-L+C)}{(1+\tau)kC\pi}$.

$$\Omega''(C)\frac{dC}{d\tau}-\left((1-\pi)\,\mathrm{U}_g'\,\frac{1}{1+\tau}k\pi+\pi\,\mathrm{U}_b'\,\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_g''}{\mathrm{U}_g'}\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\left(-\frac{Y-(1+k)C\pi}{(1+\tau)\,\mathrm{kC}\,\pi}\right)$$
$$-(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_g''}{\mathrm{U}_g'}\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\left(-\frac{\mathrm{U}_b'}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)kC\pi}\right)$$
$$+(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\left(-\frac{Y-(1+k)C\pi}{(1+\tau)\,\mathrm{kC}\,\pi}\right)$$
$$+(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[-k\pi C\frac{1}{1+\tau}\right]\left(-\frac{\mathrm{U}_b'}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)kC\pi}\right)$$
$$-(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_g''}{\mathrm{U}_g'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+(1-\pi)\,\mathrm{U}_g'\,\frac{\mathrm{U}_b''}{\mathrm{U}_b'}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(-L+C)\right]=0$$

$$\Omega''(C)\frac{dC}{d\tau}-\left((1-\pi)\,\mathrm{U}'_g\,\frac{1}{1+\tau}k\pi+\pi\,\mathrm{U}'_b\,\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_g}{\mathrm{U}'_g}\frac{1}{1+\tau}(1+k)\pi\left[-\frac{1}{1+\tau}\right]\left(-\frac{Y-(1+k)C\pi}{(1+\tau)}\right)$$
$$-(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_g}{\mathrm{U}'_g}\frac{1}{1+\tau}(1+k)\pi\left[-\frac{1}{1+\tau}\right]\left(-\frac{\mathrm{U}'_b}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)}\right)$$
$$+(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_b}{\mathrm{U}'_b}\frac{1}{1+\tau}(1+k)\pi\left[-\frac{1}{1+\tau}\right]\left(-\frac{Y-(1+k)C\pi}{(1+\tau)}\right)$$
$$+(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_b}{\mathrm{U}'_b}\frac{1}{1+\tau}(1+k)\pi\left[-\frac{1}{1+\tau}\right]\left(-\frac{\mathrm{U}'_b}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)}\right)$$
$$-(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_g}{\mathrm{U}'_g}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_b}{\mathrm{U}'_b}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(Y-(1+k)C\pi)\right]$$
$$+(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_b}{\mathrm{U}'_b}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(C-L)\right]=0$$

$$\Omega''(C)\frac{dC}{d\tau}-\left((1-\pi)\,\mathrm{U}'_g\,\frac{1}{1+\tau}k\pi+\pi\,\mathrm{U}'_b\,\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}$$
$$-(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_g}{\mathrm{U}'_g}\frac{1}{1+\tau}(1+k)\pi\left[-\frac{1}{1+\tau}\right]\left(-\frac{\mathrm{U}'_b}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)}\right)$$
$$+(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_b}{\mathrm{U}'_b}\frac{1}{1+\tau}(1+k)\pi\left[-\frac{1}{1+\tau}\right]\left(-\frac{\mathrm{U}'_b}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)}\right)$$
$$+(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_b}{\mathrm{U}'_b}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(C-L)\right]=0$$

$$\Omega''(C)\frac{dC}{d\tau}-\left((1-\pi)\,\mathrm{U}'_g\,\frac{1}{1+\tau}k\pi+\pi\,\mathrm{U}'_b\,\frac{1}{1+\tau}k\pi\right)\frac{d\theta}{d\tau}$$
$$+\left[\frac{-\mathrm{U}''_g}{\mathrm{U}'_g}-\frac{-\mathrm{U}''_b}{\mathrm{U}'_b}\right](1-\pi)\,\mathrm{U}'_g\,\frac{1}{(1+\tau)^2}(1+k)\pi\left(\frac{\mathrm{U}'_b}{\mathrm{U}'}\frac{\pi(-L+C)}{(1+\tau)}\right)$$
$$+(1-\pi)\,\mathrm{U}'_g\,\frac{\mathrm{U}''_b}{\mathrm{U}'_b}\frac{1}{1+\tau}(1+k)\pi\left[\frac{-1}{(1+\tau)^2}(C-L)\right]=0$$

$$
\begin{aligned}
\frac{dC}{d\tau} &= \left((1-\pi)\,\mathrm{U}_g' \,\frac{1}{1+\tau} k\pi + \pi\,\mathrm{U}_b' \,\frac{1}{1+\tau} k\pi \right) \frac{d\theta}{d\tau} \frac{1}{\Omega''(C)} \\
&+ \left[\frac{-\mathrm{U}_b''}{\mathrm{U}_b'} - \frac{-\mathrm{U}_g''}{\mathrm{U}_g'} \right] (1-\pi)\,\mathrm{U}_g' \,\frac{1}{(1+\tau)^2} (1+k)\pi \left(\frac{\mathrm{U}_b'}{\mathrm{U}'} \frac{\pi(-L+C)}{(1+\tau)} \right) \frac{1}{\Omega''(C)} \\
&- (1-\pi)\,\mathrm{U}_g' \,\frac{\mathrm{U}_b''}{\mathrm{U}_b'} \frac{1}{1+\tau} (1+k)\pi \left[\frac{-1}{(1+\tau)^2} (C-L) \right] \frac{1}{\Omega''(C)}
\end{aligned}
\qquad \text{(a7)}
$$

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