Efficiency of Competition in Insurance Markets with Adverse Selection

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Abstract: There is a general presumption that competition is a good thing. In this paper we show that competition in the insurance markets can be bad when there is adverse selection. Using the dual theory of choice under risk, we are able to fully characterize both the competitive and the monopoly market outcomes. With a continuum of types the efficiency of competition is less trivial. In effect monopoly is shown to provide better insurance but at the cost of driving out some agents from the market. Performing simulation for different distributions of risk, we find that monopoly in general performs (much) better than competition in terms of the realization of the gains from trade across all traders in equilibrium. The reason is that the monopolist can exploit its market power to relax the incentive constraints. When we consider the effect of redistributive profit taxation on the individuals, we show that monopoly gains a majoritarian support when a political accountable agent has to choose between monopoly with redistribution and competition.

Keywords: monopoly, competition, non-expected utility, insurance, adverse selection.
JEL classification: G22, G82, H20

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1 Introduction

In this paper we address the critical question: how and how well do competition on the markets handle the fundamental problems of information. With imperfect information, market actions or choices convey information and we know from earlier work (e.g. Rothschild and Stiglitz, 1976) that existence problems can arise in competitive markets because the slight change in the action of the informed side of the market discretely changes beliefs of the other side of the market. While information asymmetries inevitably arise, the extent to which they do so and their consequences on the realization of the gains from trade depend on the how the market is structured. This raises the fundamental question of the interplay between two forms of market imperfections: imperfect information and imperfect competition. There is no particular reason why competition should be better in the presence of imperfect information. The simplest way by which this would not be true is when the firm could exploit its market power to relax the incentive constraints.

The aim of this paper is to evaluate the efficiency of competition on the insurance market in the presence of adverse selection. Using the benchmark model of Rothschild and Stiglitz (1976), we contrast the competitive equilibrium outcome with the monopoly equilibrium outcome à la Stiglitz (1977) and we compare their relative efficiency. Following Rustichini et al (1994), the (expected) efficiency of an equilibrium is the fraction whose numerator is the expected gains from trade across all traders in the equilibrium and whose denominator is the expected gains from trade across all traders with full information. Using this criterion we compare the monopoly outcome with one seller of insurance contracts and many potential buyers with different risks against the competitive outcome imposing zero profit on each contract that might be offered in equilibrium. It is well known that with a continuum of types Rothschild-Stiglitz competitive equilibrium does not exist, but since then various alternative concepts of equilibrium have been proposed, based either on game theoretic refinements or on a more Walrasian perspective, that prove the existence of competitive equilibria. Even though no general agreement has been reached so far about the equilibrium concept, the general intuition in the classical as well as more recent literature is that competition typically results in the provision of a set of contracts that fully separate types (Chiappori, 2006). In this paper we refer to the concept of reactive equilibrium developed by Riley (1979) and Enger and Fernandez (1987) for which the Pareto dominant full separating zero profit outcome is the unique reactive equilibrium. However, the same outcome is the competitive equilibrium in the frameworks analyzed by Hellwig (1987) as well as more recent work by Bisin and Gottardi (2006) and Dubey and Geanakoplos (2002).

Our paper continues a line of research begun by Stiglitz (1977), who analyzed monopoly insurance mostly with two types of agent with expected utility, and compared the equilibrium outcome with the (two-type) competitive outcome. However his comparison analysis did not come out neatly when dealing with a continuum of types. Dahlby (1987) studies the same issue in a two-type insurance model with expected utility, but again without using the expected efficiency criterion to compare competition and monopoly. We perform this analysis in a non-expected utility approach and with a continuum of risks. It turns out that by using the dual theory approach of Yaari (1987), we are able to provide a clearcut comparison between monopoly and competition.

The dual theory has the property that utility is linear in income, and risk aversion is expressed entirely by a transformation of probabilities in which bad outcomes are given relatively higher weights and good outcomes are given relatively lower weights. In our simple two-state model the probability of bad outcome is weighted up by a loading factor. As we shall see this formulation of risk aversion without diminishing marginal utility allows the derivation of a rich set of insights. Although most of the classical results in insurance theory appear to be robust to such departures from the expected utility model, one important implication to the demand of insurance deserves to be emphasized and will play a major role in the rest of the analysis: under the dual theory, a risk averse individual has constant marginal willingness to pay for insurance whereas under expected utility a risk averse individual has decreasing marginal willingness to pay.[1] A related key difference is about the order of risk aversion.[2]When risk aversion is of order 1 as in the DT, it could be optimal for a policyholder to buy full insurance even above the fair price. This is because he derives positive benefits from the last dollar of coverage. By contrast under EU, risk aversion is of the second order and the benefit from the last dollar of coverage is zero. Therefore nobody would find profitable to buy complete insurance slightly above fair price in the EU model eventhough this is common practice.[3]

Recently some works by Jeleva and Villeneuve (2004) and Chassagnon and Villeneuve (2005) deal with a seemingly related argument: the insurance market under adverse selection with subjective risk per-

[1]Fortunately, as shown in Doherty and Eeckhoudt (1995) and Machina (1989, 1995) many of the implications of expected utility theory for the optimal insurance design carry over to the non-expected utility approach.

[2]For the definition of the order of risk aversion, see Segal and Spivak (1990). An excellent survey of the various definitions of risk aversion is provided in Cohen (1995).

[3]See Mossin (1968).

ception. In these works, risk aversion is still expressed by the decreasing marginal utility of wealth, but probabilities are modified in the expected utility function according to a subjective perception. In the monopolist framework with two types a rich set of equilibrium allocation is defined, depending on the relative perception of the risk of the two types.[4] Among these results, a pooling equilibrium is a possible outcome, just as in our paper, essentially for the same reason: the order of risk aversion. The second best allocation with two types differs from our results (see Section 3).[5] Indeed, by allowing for overinsurance and restricting the analysis to utility function with smooth indifference curves ("no kink" at full coverage) they show that there is no positive profit in the second best allocation, and that there is no pooling contract with full coverage in the second best. These conclusions rest heavily on the fact that the no-kink assumption implies that "pessimistic types", that have a perception of the risk higher than reality, prefer risky outcomes (with over-insurance) to sure outcome (with full insurance). Moreover this approach is not appropriate for our welfare analysis. The fact that agents make mistake in their perception of the risk makes the welfare analysis of competition potentially misleading (i.e. should we take into account such misperception of risk when comparing competitive outcome versus the monopoly outcome?).

It would be absurd to suggest that the dual theory provides a better model than the expected utility. The latter has obvious appeal and has provided so many useful results in insurance theory. Nonetheless, we feel there is some gain from studying the properties of our simple non-expected utility model, even if only to derive some clear insights on the efficiency of competition in the presence of adverse selection. Indeed another distinctive property of insurance under DT is that the demand of insurance cannot decrease with wealth. In contrast the EU model makes the comparison between competition and monopoly difficult since by charging a higher premium (relative to competition) for a given coverage the monopoly increases the marginal willingness to pay for insurance.[6] As a result Dahlby (1987) showed that equilibrium coverage can be either higher or lower in a monopoly.

The key finding is that the monopoly outcome, in general, is more efficient than the competitive outcome (according to our expected efficiency criterion). The reason why monopoly performs better than competition is that the monopolists can *exploit its market power* to offer contracts

[4] Jeleva and Villeneuve (2004).

[5] Chassagnon and Villeneuve (2005).

[6] Dahlby (1987) shows that the marginal willingness to pay for insurance is a decreasing function of wealth when the absolute risk aversion is decreasing.

that better satisfy the incentive constraints. More precisely, the monopolist can offer contracts with implicit transfers across agent types that can relax the incentive constraints and implement a larger set of allocations. This is one of many examples of the interplay between market imperfections (see Stiglitz 1975 and Jaffee and Stiglitz 1990). The economy, in effect has to trade off between two different imperfections: imperfections of information or imperfections of competition, with no particular reason that these imperfections will be balanced optimally.

When we consider the effect of redistributive profit taxation on the individuals, we show that monopoly gains a majoritarian support when a political accountable agent has to choose between monopoly with redistribution and competition. Moreover, assuming a Rawlsian perspective, monopoly with redistribution of profits is in general better than competition.

The paper is organized as follows. In Section 2 we present the model. Section 3 contains the monopolist and competitive equilibria with a continuum of types. In Section 4 simulation results are provided about the participation rate under monopoly and the expected efficiency of competitive and monopoly markets. Section 5 analyzes the distributive effects of profit taxation and Section 6 concludes.

2 The model

There are two possible states of the world: the "no accident" state and the "accident" state. Individuals differ only by their probability of accident, in which case they face a (fixed) damage $d = 1$. There is no moral hazard since individuals cannot affect their probability of accident which is fixed. There is a continuum of risk in the economy distributed according to a cumulative probability function $F(\theta)$ with density $f(\theta) > 0$ on a closed and compact interval $\theta \in \left[\underline{\theta}, \overline{\theta}\right]$ (with $0 \leq \underline{\theta} < \overline{\theta} < 1$).
Adverse selection is introduced by assuming that individual risk is private information, while the distribution of risks is common knowledge. We model individuals' risk preferences using Yaari (1987)'s dual theory (DT). We first give a general description of this approach before applying it to our model. Let wealth X be a random variable distributed over $[\underline{x}, \overline{x}]$ according to the distribution function $\Psi(x)$. Yaari's representation of preferences is dual to the expected utility theory (EU) in the sense that it is linear in wealth but non linear in probabilities. Probabilities are transformed by a function Φ defined on the distribution function

$\Psi(x)$.[7] More precisely, DT preferences over X are given by

$$V(X) = \int x \; \Phi'(\Psi(x)) \; d\Psi(x)$$

where $\Phi(0) = 0$, $\Phi(1) = 1$ and $\Phi'(.) > 0$. $\Phi'(.)$ are non-negative weights adding up to one. Attitude towards risk is conveyed entirely by the shape of $\Phi(.)$. Risk aversion is characterized by the concavity of $\Phi(.)$, i.e. $\Phi''(.) < 0$. In this case, bad outcomes (with low $\Psi(X)$) receive higher weights than good outcomes (with high $\Psi(X)$). In other words, $V(X)$ is the certainty-equivalent of X computed as a weighted average of outcomes in which bad outcomes are given high weight while good outcomes are given low weight. Since $V(X)$ is linear in wealth, this approach separates attitude towards risk from attitude towards wealth.

We now apply DT to our simple two-state setting. For an individual with wealth w facing a damage $d = 1$ with probability θ, an insurance contract (δ, π) with coverage rate $\delta \in [0, 1]$ and premium $\pi > 0$ yields the random variable $X = (w - \pi - (1 - \delta), \theta; w - \pi, 1 - \theta)$. We thus define the utility associated to this insurance contract as

$$\begin{aligned} V(\theta; \delta, \pi) &= \phi(\theta)(w - \pi - (1 - \delta)) + (1 - \phi(\theta))(w - \pi) \\ &= w - \pi - \phi(\theta)(1 - \delta) \end{aligned}$$

where risk aversion is represented by $\phi(\theta) > \theta$ (and $1 - \phi(\theta) < 1 - \theta$).[8] In this paper, we further assume that $\phi(\theta) = (1+\alpha)\theta$, with $0 \leq \alpha \leq \frac{1-\bar{\theta}}{\bar{\theta}}$ (the upper bound guaranteeing that $\phi(\theta) \leq 1 \; \forall \theta$). Making α independent of w accords with our desire to disentangle risk aversion from income and will greatly simplify the analysis. Using this formulation, type-θ utility function from insurance contract (δ, π) is

$$V(\theta; \delta, \pi) = \omega - \pi - (1 + \alpha)(1 - \delta)\theta$$

where the utility loss from the residual risk $(1 - \delta)\theta$ is inflated by the markup factor $1 + \alpha$. Now, comparing the utility with insurance against the utility without insurance we can define the reservation premium for each type. This is the premium $\pi \equiv \tilde{\pi}(\theta)$ that solves

$$\begin{aligned} V(\theta; \delta, \pi) &= V(\theta; 0, 0) \\ \omega - \pi - (1 + \alpha)(1 - \delta)\theta &= \omega - (1 + \alpha)\theta \end{aligned}$$

[7] Alternatively this probability transformation function could be defined on the decumulative distribution function $1 - \Psi$ such as in Yaari (1987).

[8] Note that in our model with a *discrete* random variable, risk aversion translates into the transformation of the discrete density function $\phi(\theta) > \theta$ rather than the concave transformation of the distribution function $\Phi''(\Psi) < 0$ as for *continuous* random variable. In both cases risk aversion implies that bad outcomes are given higher weight and good outcomes lower weight.

so that the reservation premium of type θ for coverage δ is:

$$\tilde{\pi}(\theta;\delta) = (1+\alpha)\delta\theta$$

Moreover the surplus of the agent is defined as the difference between the reservation price and the price effectively paid:

$$\begin{aligned} S(\theta;\delta,\pi) &= \tilde{\pi}(\delta;\theta) - \pi \\ &= (1+\alpha)\delta\theta - \pi \end{aligned}$$

Assuming $\pi > 0$, with free participation, those agents for which $\tilde{\pi}(\delta;\theta) < \pi$ will drop out of the market.

It is straightforward to see that the functions V and S have the *Single-Crossing property* in the contract space-(δ, π), because the marginal value of coverage is increasing in θ.

3 Monopolist and competitive solutions

In this section we study the equilibrium outcomes of monopoly and competition in an insurance market with a continuum of risks.

The optimization problem of the monopolist is:

$$\max_{\pi(\theta),\delta(\theta)} \int_{\underline{\theta}}^{\overline{\theta}} \left[\pi\left(\theta\right) - \delta\left(\theta\right)\theta\right] dF\left(\theta\right)$$

subject to

$$V\left(\theta;\delta\left(\theta\right),\pi\left(\theta\right)\right) \geq V\left(\theta;0,0\right) \qquad \forall\theta\in[\underline{\theta},\overline{\theta}] \tag{1}$$

$$V\left(\theta;\delta\left(\theta\right),\pi\left(\theta\right)\right) \geq V\left(\theta;\delta\left(\widehat{\theta}\right),\pi\left(\widehat{\theta}\right)\right) \qquad \forall\theta,\widehat{\theta}\in[\underline{\theta},\overline{\theta}] \tag{2}$$

where (1) is the set of participation constraints and (2) denotes the set of incentive constraints. Analyzing the set (1) we can see that

$$V\left(\underline{\theta};\delta\left(\underline{\theta}\right),\pi\left(\underline{\theta}\right)\right) \geq V\left(\underline{\theta};0,0\right)$$

must be binding, for otherwise it would be possible to increase $\pi(\theta)$ $\forall\theta > \underline{\theta}$. This is the classical monopoly result of full rent extraction at the bottom.[9] As a result all the agents with $\theta > \underline{\theta}$ are left with information rent, and so their participation constraints are not binding.

In the following Proposition the monopolist outcome is summarized.[10]

[9] See for example Laffont and Tirole (1993).

[10] Since the results of the Proposition is obtained using standard technique it is omitted. It is available upon request.

Proposition 1 *In a monopoly insurance market with a continuum of risk, there exists*

$$\theta^* = \frac{1+\alpha}{\alpha h(\theta^*)}$$

with $h(.)$ *the non-decreasing hazard rate function, such that the equilibrium contracts are*

$$\begin{aligned} (\delta^m(\theta), \pi^m(\theta)) &= (0,0) \qquad \forall\theta \in [\underline{\theta}, \theta^*) \\ (\delta^m(\theta), \pi^m(\theta)) &= (1, (1+\alpha)\theta^*) \qquad \forall\theta \in \left[\theta^*, \overline{\theta}\right] \end{aligned}$$

Therefore the solution is characterized by a (pooling) contract that offers full coverage to all $\theta \geq \theta^*$ with a premium extracting the entire surplus from type θ^* and no insurance to all $\theta < \theta^*$. The equilibrium payoff of type θ under monopoly is:

$$\begin{aligned} V(\theta; \delta^m(\theta), \pi^m(\theta)) &= \omega - (1+\alpha)\theta \qquad \forall\theta \in [\underline{\theta}, \theta^*) \\ V(\theta; \delta^m(\theta), \pi^m(\theta)) &= \omega - (1+\alpha)\theta^* \qquad \forall\theta \in \left[\theta^*, \overline{\theta}\right] \end{aligned}$$

Monopolist (per capita) profit is

$$\Pi^m = (1+\alpha)\theta^*[1 - F(\theta^*)] - \int_{\theta^*}^{\overline{\theta}} \theta dF(\theta) \tag{3}$$

Rewriting $h(\theta^*) = \frac{f(\theta^*)}{1-F(\theta^*)}$ the pivotal type solves

$$\alpha\theta^* f(\theta^*) = (1+\alpha)(1 - F(\theta^*))$$

where the LHS is the revenue loss of an increase in θ^* due to the non-participation of pivotal type and the RHS is the revenue gain from charging a higher price on all agents above the pivotal type θ^*.

The pooling contract performs cross-subsidization among types. In fact, while θ^*-type individuals are extracted the whole surplus, higher types are left with some rent and possibly pay a premium lower than the fair price.

Shifting to the analysis of competition, it is well known that with a continuum of types a competitive equilibrium may fail to exist. In fact Riley (2001) showed the general non-existence of the Rothschild-Stiglitz equilibrium. This existence problem can be circumvented by resorting to the *reactive equilibrium* concept introduced by Riley (1979) and developed further by Engers and Fernandez (1987). A reactive equilibrium is a set of offers such that there is no profitable deviation by any firm given that other firms can optimally react to this deviation by offering new contracts. Engers and Fernandez (1987) provide general conditions, for which the Pareto-dominant full-separating zero-profit set of contracts is the unique reactive equilibrium outcome. It turns out that those conditions hold true in our framework.[11] The key element is that firms are deterred to deviate from the full separating equilibrium by the belief that other firms will react to "skim the cream" and make such initial deviation unprofitable.

The Pareto-dominant fully separating zero-profit competitive equilibrium solves

$$\max_{\substack{\pi(.)\geq 0 \\ \delta(.)\in[0,1]}} V\left(\theta;\delta\left(\theta\right),\pi\left(\theta\right)\right) \qquad \forall\theta=[\underline{\theta},\overline{\theta}]$$

subject to (1), (2) and the additional zero profit constraint:

$$\pi\left(\theta\right)-\delta\left(\theta\right)\theta=0 \qquad \forall\theta\in[\underline{\theta},\overline{\theta}] \tag{4}$$

Following Hindriks and De Donder (2003), the solution involves the following coverage function:

$$\delta^{c}\left(\theta\right)=\left(\theta/\overline{\theta}\right)^{\frac{1}{\alpha}}\in[0,1]$$

The equilibrium payoff of type θ under competition is then:

$$V\left(\theta;\delta^{c}\left(\theta\right),\pi^{c}\left(\theta\right)\right)=\omega-\left(1+\alpha\right)\theta+\alpha\theta\left(\theta/\overline{\theta}\right)^{\frac{1}{\alpha}} \qquad \forall\theta\in[\underline{\theta},\overline{\theta}]$$

So, while in the monopoly every type $\theta\in\left[\theta^{*},\overline{\theta}\right]$ gets full insurance, with competition only the highest-risk individuals obtain full coverage and all the other individuals with lower risk obtain partial coverage. On the other hand, every $\theta\in[\underline{\theta},\theta^{*})$ gets no insurance with monopoly, while they are provided at least with partial coverage in the competitive case. Figure 1 compares equilibrium coverage with monopoly and competition for a given distribution of risks.

The crucial feature of competitive equilibrium is that the set of implementable contracts is smaller than under monopoly. Since each contract must break even – by the constraint (4) – no cross-subsidization can

[11] The conditions for existence and uniqueness of a reactive equilibrium in our model are: (1) a continuous probability distribution $F(\theta)$; (2) the profit function of insurance firms is continuous, bounded and non increasing in θ and δ; (3) $V(\theta;\delta,\pi)$ is continuous on $\Theta\times\Delta\times\Pi$ where $\Delta=[0,1]$ and $\Pi=[\underline{\pi},\bar{\pi}]$ with $\underline{\pi}=\inf\{\tilde{\pi}(\theta;\delta):\theta\in\Theta,\ \delta\in\Delta\}$ and $\bar{\pi}=\sup\{\tilde{\pi}(\theta;\delta):\theta\in\Theta,\ \delta\in\Delta\}$, is stricly decreasing in π and satisfies the Single-Crossing property; (4) the contract space is a closed set $\Delta\times\Pi$.

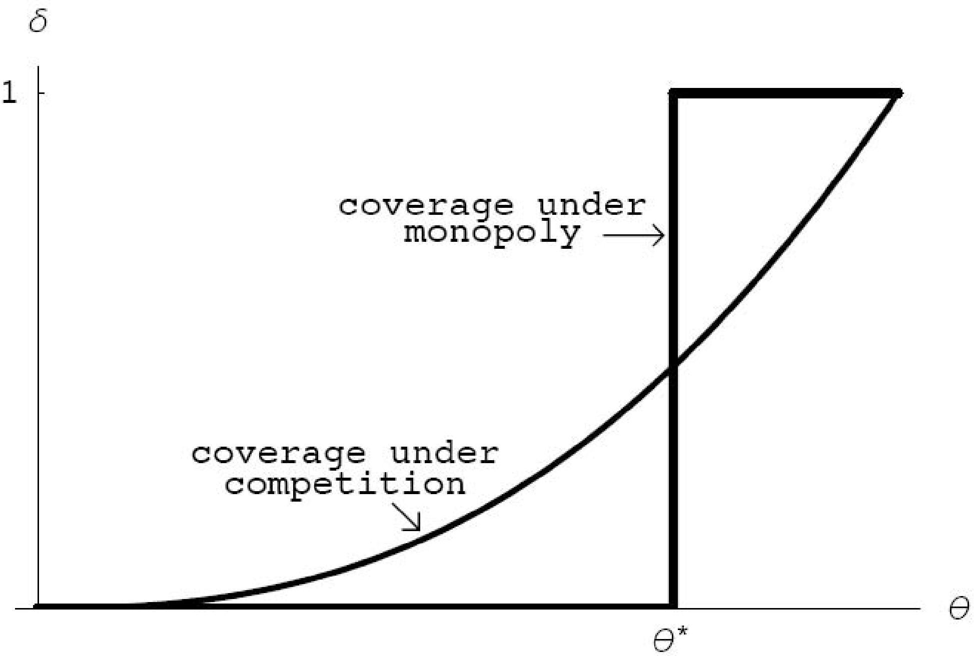

Figure 1: Relative coverage rates under competition and monopoly.

be performed among types. As a consequence, the distribution of risks in the population does not influence the screening equilibrium. In fact, there is a unique solution to the problem of maximizing the utility of each type given that every contract must break even and must be incentive compatible. In Figure 2 the effect of a change in distribution is depicted: the left panel shows a positively skewed distribution, while the right panel shows a negatively skewed distribution. While the coverage function under competition is unchanged, the level of θ^* in the left panel is lower than in the right panel. This means that when the distribution of risks is positively skewed, the monopolist charges a lower premium then when it is negatively skewed. The gain for the monopolist of including more types in the pooling becomes in fact larger than the profit loss due to the reduction in premium.

4 Welfare comparisons

In this section we perform some numerical simulations using Beta distribution of risks with non-decreasing hazard rate.
We have seen that the risk distribution affects the monopoly outcome by changing the critical level θ^*, while it does not affect the competition equilibrium outcome.

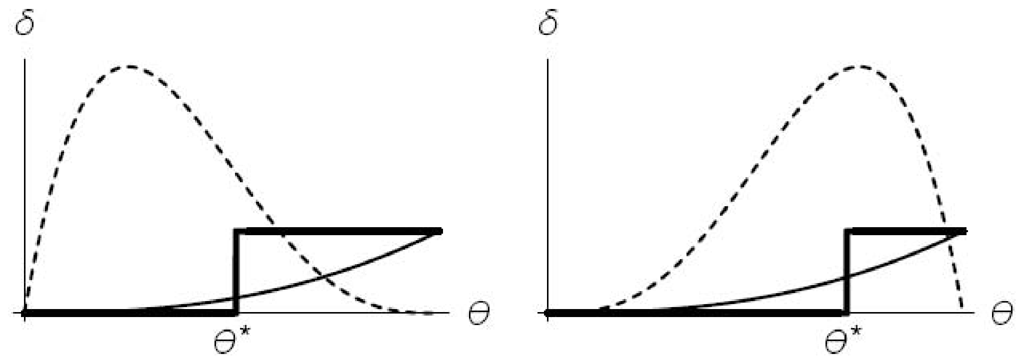

Figure 2: The effect of different distributions on coverage under competition and monopoly.

	b				
a	1	2	3	5	10
1	20.00	11.11	7.87	5.29	3.46
2	33.33	22.09	17.05	12.41	8.59
3	42.86	31.35	25.54	19.64	14.22
5	55.56	45.19	39.20	32.32	24.98
10	71.43	64.24	59.49	53.20	44.98

Table 1: Participation rate under monopoly for various distributions over risk Beta(a,b).

The effect of changing the distribution on the equilibrium monopoly participation rate is illustrated in Table 1.[12] In this Table a Beta distribution (a, b) is used to show that the participation rate increases with the concentration of the distribution (i.e., simultaneous increase in a and b). Moreover, the more negatively skewed is the distribution (i.e., higher $a - b > 0$) the higher is the participation rate. The reason is intuitive enough: since highest risks always participate to the pooling, the more individuals are concentrated in the upper part of the distribution, the higher is the participation rate. When the distribution shifts to the left, the monopolist will adjust the contract offered in order to include more risk types; but this adjustment is not enough to retain the same participation rate since decreasing θ^* as a cost in terms of profit loss on the upper part of the distribution.

Following Rustichini et al (1994) we measure efficiency in terms of total surplus generated in the market as a fraction of the first best (full

[12] Table 1 and the following tables are built assuming $\alpha = 1/3$, $\underline{\theta} = 0$ and $\overline{\theta} = 0.7$.

information) surplus.

Table 2 shows the total surplus realized in the competitive and monopolist equilibria as a percentage of the total surplus under full information. Fixing the degree of risk aversion and the spread of risks we can compare competition and monopoly for different Beta distributions. The key result is that except for the uniform distribution ($a = b = 1$) and distributions for which the highest risk is the mode ($b = 1$), the monopoly realizes a higher fraction of the gains from trade.

The difference increases with the concentration and it is possible to show how the relative performance of monopoly and competition does not depend on the parameters' values.[13]

	b									
	1		2		3		5		10	
a	mon	comp	mon	comp	mon	comp	mon	comp	mon	comp
1	36.00	40.00	25.92	20.00	21.37	11.43	17.05	4.76	13.33	1.10
2	45.57	50.00	35.51	28.57	30.43	17.86	25.20	8.33	20.23	2.20
3	52.58	57.14	43.06	35.71	37.90	23.81	32.22	12.12	26.44	3.57
5	62.21	66.67	54.01	46.67	49.15	33.94	43.34	19.58	36.73	6.86
10	74.79	78.57	69.08	62.86	65.33	51.07	60.34	35.05	53.71	16.15

Table 2: Surplus under monopoly and competition as a percentage of the First Best surplus for various distributions over risk Beta(a,b).

5 Redistributive taxation

In the previous section we have seen that in general monopoly outperforms competition in terms of total output. In this Section our main concern is about distributive effect. We ask whether taxing monopolist profits and redistributing the tax revenues to individuals can make them better off with respect to competition.

Figure 3 depicts the relative performance in terms of the surplus gained by the different types under competition, monopoly and monopoly with redistribution of profits for given distribution of the population and risk aversion. The general result is that low and high risk types are better off under monopoly than under competition when profits are redistributed to individuals.[14] Only types around θ^* prefer competition to

[13] In previous versions of this paper we have shown how, varying the spread of risks and the degree of risk aversion, surplus under monopoly and competition move in the same direction without affecting the ranking.

[14] if $\overline{\theta}$ is the mode of the distribution, then the highest risks are always better off under competition. For any other continuous distribution, the highest risks are better

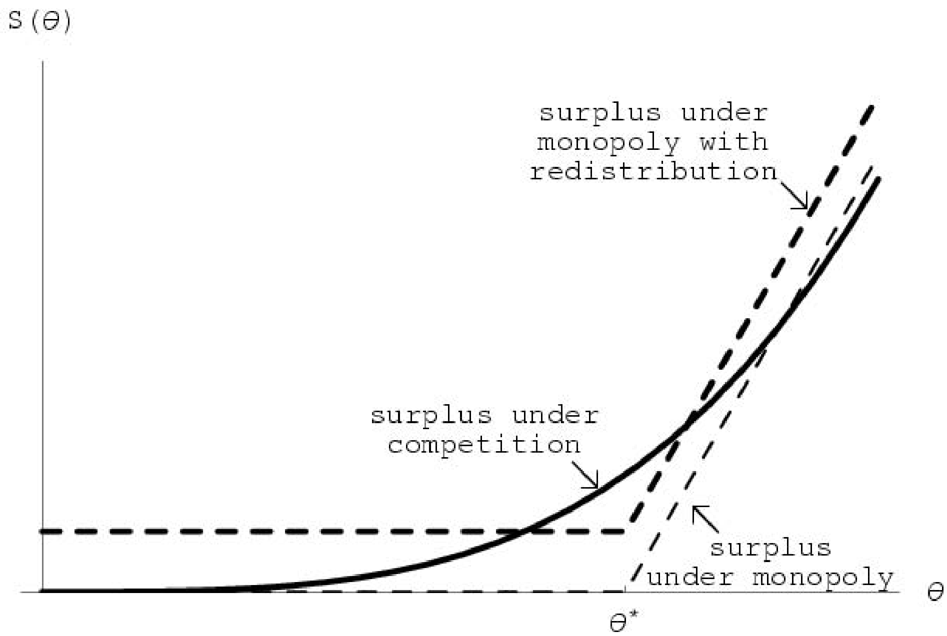

Figure 3: Benefit from insurance of the types under monopoly, monopoly with redistribution and competition.

monopoly. The reason is simple. Low types are offered no insurance under monopoly and little insurance under competition; they benefit from redistribution of profits. High types are offered full insurance under monopoly and high coverage under competition; however, they benefit from both cross-subsidization and redistribution under monopoly. Types around θ^* are better off under competition since either the monopoly extracts almost all the rent if $\theta \geq \theta^*$, or provides no insurance if $\theta < \theta^* M$.

If the choice between monopoly and competition is made through politically accountable agents, it is interesting to compare the political support for monopoly with redistribution of profits and competition. Table 3 shows that only when the mode of the distribution is on the highest risk ($a = 1$ and $b > 1$) monopoly does not get a majority support.

If we want to compare monopoly with redistribution and competition using the Rawls' rule, we have to take into account the surplus of the worst risk only. We can show that in most cases, monopoly is better than competition for the highest risk type, too. Moreover we can show that in many cases also monopoly *without* redistribution is better than competition from a Rawlsian viewpoint.

off under monopoly with redistribution as far as risk aversion is not too high; see the results in Table **??** on this point.

	b				
a	1	2	3	5	10
1	56.23	75.92	82.00	88.86	96.71
2	42.11	70.07	78.29	87.72	99.02
3	34.23	68.19	77.86	88.94	≃100
5	25.42	68.34	80.13	93.48	≃100
10	16.04	73.34	88.09	≃100	≃100

Table 3: Percentage of individuals that prefers monopoly with redistribution to competition for various distributions over risk Beta(a,b).

6 Conclusions

Our main finding about the inefficiency of competition has to be contrasted with recent work on the (asymptotic) efficiency of competition based on the idea that asymmetry in agent's information is relatively unimportant in a large economy (obtained by a replication process) because any single agent has only a small amount of information not known by the other agents.[15] This is the notion of *informational smallness*. As Gul and Postlewaite (1992) noted, this result holds in *private value* information problems in which agents have private information that is of direct relevance only to themselves (i.e. the agents' utility functions depend only on their own type). This is obviously not the case for the insurance problem (and for the adverse selection problem in general). Indeed in our insurance problem with a continuum of types it might seem that each agent is informationally small and yet the market outcome is very far from the full information outcome. The reason is that each agent remains informationally large in this context. Muthoo and Mutuswami (2005) obtain a similar result for the "lemons" markets. They show that efficiency is decreasing in the degree of market competition (measured by the number of sellers, fixing the number of buyers). The driving force for their result is different however. They show that first-best surplus is increasing in the number of sellers (of either high or low quality good) but the realized market surplus is unchanged. The reason is that, in the first-best, the probability of trade with a high quality seller increases with the number of sellers. In contrast the incentive constraints imply that the probability with which a high-quality seller will trade cannot be greater than the probability with which a low quality seller will trade, which is independent of the number of sellers.

Using the benchmark model of Rothschild and Stiglitz (1976), we

[15]See Gul and Postlewaite (1992), Gresik Satterthwaite (1989), Satterthwaite and Williams (1989), Rustichini et al (1994).

contrast the competitive equilibrium outcome with the monopoly equilibrium outcome à la Stiglitz (1977) and we compare their relative efficiency. The main change is that we adopt the dual theory of risk so that the comparison comes out neatly. The dual theory has the property that utility is linear in income, and risk aversion is expressed entirely by a transformation of probabilities in which bad outcomes are given relatively higher weights and good outcomes are given relatively lower weights.

Our main finding is that competition is bad and that the monopoly outcome in general is more efficient than the competitive outcome (according to our expected efficiency criterion defined as the fraction of the total surplus that is realized by the market). The reason why monopoly performs better than competition is that the monopolists can exploit its market power to relax the incentive constrains. This is one of many examples of the interplay between market imperfections. The economy, in effect has to trade off between two different imperfections: imperfections of information or imperfections of competition, with no particular reason that these imperfections will be balanced optimally.

We expect our result about the inefficiency of competition in insurance markets with adverse selection to carry over on other markets with adverse selection like the capital market or the job market. We also plan to extend this analysis to screening in the higher education market.

There is a final remark about the use of the dual theory of risk. With this specification there is no income effect on the demand of insurance. In contrast, the expected utility approach will raise the demand for insurance in the monopoly market relative to the competitive market if the absolute risk aversion is decreasing. This is because monopoly price is higher than competitive price which reduces income and thus raises the marginal willingness to pay for insurance. It is then expected that moving to the expect utility will further increase the amount of insurance in the monopoly market relative to the competitive market, thereby reinforcing our conclusion about the inefficiency of competition.

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