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Everyone may benefit from subsidising entry to risky occupations

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Abstract

This paper shows that in the presence of costly state verification, directly or indirectly subsidising entry to risky occupations may benefit everyone. The result holds even in the presence of private insurance. Indeed, it may be desirable to prohibit private insurance in favour of subsidies to hazardous activities. These findings do not depend on the government having an advantage over the private sector in observing outcomes. The explanation is that through its influence on equilibrium price, feasible fiscal policy can shift the return distribution so as to create collective insurance more cheaply than is possible through private contracting with its requirement of costly auditing. Amongst applications is a case for a loss-making state bank offering high interest-rate loans. © 1997 Elsevier Science S.A.

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1. Introduction

Striking evidence of how risk preferences may shape occupational choice is provided by Barsky et al. (1997). Their large scale survey found that over 75% of people would reject the offer of a well paid job that offers a 50–50 chance of doubling their existing income or reducing it by a third and more than two thirds of subjects rejected the opportunity even when the downside was only a 20%

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reduction in earnings. This suggests that risk may be a substantial barrier to entering certain sectors or to acquiring specialised training when there is no guarantee of a job at the end or even that the examinations will be passed. From a social point of view it may seem that there is a strong case for people to be encouraged to take such productive gambles, particularly if the risks tend to cancel out in the aggregate. Yet on reflection it is not obvious that risk is a source of market failure.[1] Individual risk is costly as is its elimination so there is good reason for it to influence resource allocation. The usual presumption is that competitive markets deliver an optimal outcome. Simply to argue that an industry should be subsidised because it is smaller than it would be if entrepreneurs were risk neutral, or smaller than if actuarially fair insurance were available, seems as misguided as suggesting that trade with China should be subsidised because there would be more of it if only transport costs were lower.

The standard argument for corrective policy is missing risk markets.[2] Greenwald and Stiglitz (1986) provide the most comprehensive discussion. They show that when risk markets are incomplete pecuniary externalities have efficiency implications. Fiscal policy may affect the distribution of prices across states of nature and so involves risk transfer. Stiglitz and Greenwald demonstrate convincingly that there will usually be scope for welfare improving policy, but no simple policy rules emerge. In particular, no presumption is established that it is the risky activities themselves that should be encouraged. More specific and intuitive guidance is available in Arnott and Stiglitz (1986) who look at insurance in the presence of moral hazard. The main finding is that it is beneficial to tax complements to risk taking and to subsidise substitutes. Of course, this assumes that it is infeasible for private insurance companies to take comparable action. For example, taxing gasoline results in fewer journeys and hence accidents, which in turn leads to lower insurance premiums. First best would be to condition premiums on the underlying risk factor – distance travelled – but monitoring costs make this unrealistic and there is no cheap way for private insurance companies to replicate the effects of a gasoline tax.

The theme of this paper is that the enforcement costs entailed by private contracts make for a much more direct case for intervention of a simple form; a subsidy to the risky activity itself in the form of a riskless grant. In demonstrating

[1] A common view, exemplified by Arrow (1962), is that ''The economic system has devices for shifting risk but they are limited and imperfect; hence one would expect under-investment in risky activities.'' (p. 614). The conclusion is suspect since no reason is given as to why the government can avoid the costs arising in private markets or, if they cannot do so, why these costs should be ignored in choosing investment levels.

[2] Hart (1975) shows that with incomplete markets there may be multiple equilibria that can be Pareto ranked but does not enquire whether and how intervention can improve on even the best of them. Newbery and Stiglitz (1984) and Eaton and Grossman (1985) investigate how trade policy may be a surrogate for insurance but do not explain the absence of risk markets.

this it is assumed that the monitoring costs inhibiting private risk sharing are equally applicable to government intervention. This contrasts with much of the literature which implicitly assumes that governments can costlessly implement schemes which, for unexplained reasons, the private sector cannot replicate. For example, Varian (1980) examines the merits of an income tax as a risk-sharing device but does not identify why state-dependent fiscal policy is feasible when private insurance is not. Similar comments apply to Eaton and Rosen (1980), Kihlstrom and Laffont (1983) and Boadway et al. (1991) amongst others. In contrast, the present analysis does not give the public sector an informational advantage over private agents. If risk-sharing contracts are hampered by the cost of monitoring income reports, it is unreasonable to suppose that income taxation is free of such problems. Papers by Dixit (1989b), Hoff (1991) and Skinner (1991) avoid this problem by assuming that although it is impossible or costly to observe and so tax an indigeneous agent's output or sales, some aggregate transactions can be cheaply taxed. For example, an import tax may be feasible and prove advantageous by altering domestic prices. This paper concerns an autarkic economy and we assume all output or transaction based taxes involve costly monitoring of the same order as would be involved in private insurance. In contrast, we examine fiscal policy which is based simply on occupational choice rather than an individual's actual performance. Government does not have an informational advantage but can enforce participation in the tax/subsidy scheme and recognises that a price fall is similar in its effects to an output tax but avoids the requirement of costly auditing. It is like a sales tax operated without knowing the sales of individual agents. Although, private insurance will not exist and, fiscal intervention may be beneficial.[3] The case for entry subsidies developed here is not based on the government having superior monitoring technology, but on its ability to enforce participation and its recognition of the role of price as a collective risk sharing device.

To appreciate the economics, suppose that the productivities and hence incomes of a large number of risk-averse agents engaged in a competitive occupation are independently and identically distributed. Selling price can thus be treated as deterministic. Individual income is volatile so private insurance might be expected, but monitoring costs make it unviable. Let a grant be offered to those entering the risky sector, paid for by a levy on safe-sector employment. The consequent influx of workers into the risky occupation depresses selling price in this sector. In money terms, an individual's loss from a lower price increases with the volume of sales. The overall effect of the grant plus the price fall is thus to decrease real income in good states and increase it in bad states. Given risk-aversion, this reduction in the variance of income lowers the cost of risk and as it is achieved

[3]In Dixit (1989a) and Dixit (1989b) as in our model output realisations and sales are perfectly correlated so if an indiviual's sales are observable, private insurance is feasible.

without creating risk in the safe sector, it is efficiency-enhancing. With freedom of movement between occupations, the benefits are transmitted to all.[4]

Were private insurance available on actuarially fair terms, no risk would be left to diversify and so a subsidy would be harmful for the usual reasons. In practice, it is costly to administer insurance; in particular it is necessary, and often very expensive, to verify income claims. Earnings insurance is rare, suggesting that in this context the cost of detecting and verifying fake claims is substantial. The essential merit of the subsidy is that it has a similar effect on risky sector incomes as does insurance but without necessitating the same enforcement expenditures as a private contract. Those who pay the subsidy benefit, in the form of lower prices which accrue automatically, avoiding the contracting costs involved in a private solution.[5] Even if monitoring costs are low enough to allow private insurance, the case for a subsidy still goes through. In the presence of private risk sharing, welfare is enhanced by a subsidy to the extent that it substitutes for voluntary insurance, or provides a lower cost supplement.

Although the subsidy scheme eliminates the need for costly state verification, some monitoring may nevertheless be involved. Rather than checking income reports, it must be confirmed that those claiming the subsidy really do work in the risky sector and of course individuals have an incentive to dissemble. Even so, implementation of the subsidy may be straightforward. For example, suppose an individual must choose an occupation before they, or anyone else, knows whether they have the attributes for success. The entry subsidy can then be in the form of partial remission of training fees. As training is not likely to be worthwhile unless the individual intends to enter the occupation, monitoring costs are not likely to be very great. A similar argument applies to any input used intensively in the risky sector. Alternatively, the policy may take the form of subsidised insurance. Unless the subsidy is very great, only those actually working in the risky sector have any incentive to purchase insurance so self selection will again overcome many of the problems of identifying risky workers. Another implementation mechanism is for the state to offer funds on terms that only appeal to those with risky returns, but are nevertheless more generous than private financiers could offer. The scheme

[4]Hoff (1994) provides an insightful discussion of other cases in which lump-sum transfers may augment efficiency.

[5]Notice that were conventional moral hazard the only reason for incomplete private insurance, there would be no direct case for intervention. In moderating the income difference between success and failure, insurance dilutes the incentive to apply effort. The subsidy scheme has the same consequences on income and so on effort. There is nothing to be gained by the state introducing a subsidy and thereby forcing insurance on terms that would be rejected if offered privately. This is shown for a price-taking country and moral hazard by Dixit (1987) whilst Dixit (1989a) demonstrates the same conclusion in the presence of adverse selection. Market failure requires endogenous prices, which are allowed for in Dixit and Rob (1994), but their model and the issue addressed is distinct from that here. They assume aggregate shocks, and a degree of *ex post* occupational mobility. The question is not whether the risky sector should be subsidised but whether relocation should be subsidised. In the absence of risk markets such a policy is beneficial since it helps stabilise prices.

would be loss making, but the increased supply of riskily produced goods and services would more than compensate.

Perhaps closest to the analysis of this paper is Kanbur (1981) despite its diametrically opposed conclusion that risk taking should bear a higher tax. In Kanbur's model only a single good is produced. The production function is stochastic, and agents are identical and risk averse. Each person has a choice between working for a fixed wage or becoming an entrepreneur claiming residual income. Suppose a proportional income tax is levied on entrepreneurs and used to provide an income subsidy to workers. The switch to paid employment drives down the gross wage. The combined effect of the wage fall and the income tax is that the income of those remaining as entrepreneurs is higher in the low-output states, when the tax is less, and is lower in the high-income realisations. Once again, the reduction in the variance in income to those bearing risk is efficiency enhancing. Workers benefit because the income subsidy exceeds the wage fall and entrepreneurs gain through the reduction in risk.

In the Kanbur case a small lump-sum subsidy to entrepreneurs yields no benefits since its effects would be exactly offset by a wage rise. Correspondingly, in our two-sector model, the Kanbur policy of a small income tax on the risky activity is pointless since it is exactly offset by a price rise.

Kanbur's modelling differs from the present analysis in two respects: firstly, there is only one good in his set up and secondly, private risk sharing is assumed to be impossible even though an income tax can costlessly replicate its essential properties. Abandoning these assumptions reverses the policy conclusions.[6]

The next section of the paper analyses the regime in which the cost of detecting false claims is sufficiently high as to preclude private insurance. Active private insurance is introduced in Section 3 and it is shown that a subsidy to the risky occupation or to insurance provision is still beneficial. Finally, it is demonstrated that gains are greater if a subsidy is combined with direct controls which directly or indirectly limit demand for the risky good.

2. Prohibitive verification costs

The economy comprises N risk averse *ex-ante* identical individuals. There are two perfectly competitive sectors, for convenience of exposition, designated manufacturing and agriculture. In manufacturing, output per artisan is known for sure. Agriculture is subject to idiosyncratic production risk due to the weather and other natural factors. The output of a farmer thus depends on effort, which is chosen ex-ante, and on the realisation of an independently and identically distributed multiplicative shock. Assume that the sector is sufficiently large that

[6]Grossman (1984) analyses a two-sector Kanbur type model but as the country is a price taker in world markets and risk markets are assumed away, the results reported in this paper are not possible.

the average output per farmer is non-stochastic. Since the shocks are individual they cannot easily be observed by outsiders, so private insurance must involve costly monitoring. For now it is assumed that these costs are so great as to preclude private insurance. In the next section insurance is modelled explicitly.

There is free mobility between sectors but individuals must choose their occupation before the uncertainty is resolved. It follows that in equilibrium, the expected utility of farmers and artisans is equal. The government intervenes by offering a fixed subsidy, s, to those entering farming that is financed by a per capita tax, t, on those in manufacturing. The subsidy can be thought of as a state-independent transfer by artisans of a quantity of manufactures to each farmer. Define r as the ratio of the number of farmers to the number of artisans. For government budget balance

$$t = rs \tag{1}$$

The effects of a small subsidy will be examined.

The utility of an artisan and a farmer can be written in terms of their income, Y, the relative price of the risky-sector good, p, and their chosen effort levels z.

$$V = V(Y, p, z)$$

where for artisans

$$Y = z^{\mathrm{A}} - rs$$

and for farmers

$$Y = pqz^{\mathrm{F}} + s$$

where q is the multiplicative output shock.

Define V^{A} as the utility of an artisan and V^{F} as the utility of a farmer. In equilibrium expected utility must be the same in both sectors and so

$$V^{\mathrm{A}} = EV^{\mathrm{F}} \tag{2}$$

Proposition 1. *If costly state verification precludes private insurance, a small subsidy to those entering the risky sector raises everyone's expected utility as long as the safe good is not inferior.*

Proof. Let x^{A}, y^{A} be an artisan's consumption of manufactures and of food and x^{F}, y^{F} be those of a farmer where all these variables depend upon price and income. The consumption of an individual farmer will depend upon the realisation q, but it is assumed that the equilibrium number of farmers is sufficiently large for $\bar{x}^{\mathrm{F}}$, the average consumption of manufactures per farmer, to be treated as non-stochastic. Noting that the effects on effort of increasing s drop out by the envelope theorem, when evaluated at $s = 0$

$$\frac{\mathrm{d}V^{\mathrm{A}}}{\mathrm{d}s} = -rV_Y^{\mathrm{A}} + V_p^{\mathrm{A}} \frac{\mathrm{d}p}{\mathrm{d}s}.$$

Using Roy's identity

$$\frac{dV^A}{ds} = -rV_Y^A - y^A V_p^A \frac{dp}{ds}.$$

From the artisan's budget constraint

$$y^A = \frac{z^A - x^A}{p}.$$

With $s=0$ Market clearing for manufactures requires

$$z^A - x^A = r\bar{x}^F$$

giving

$$\frac{dV^A}{ds} = -rV_Y^A \left(1 + \frac{\bar{x}^F}{p} \cdot \frac{dp}{ds}\right). \tag{3}$$

For a farmer with realisation q

$$\frac{dV^F}{ds} = V_Y^F + z^F q V_Y^F \frac{dp}{ds} + V_p^F \frac{dp}{ds}$$

Roy's identity and the farmer's budget constraint implies

$$\frac{dEV^F}{ds} = E\left(V_Y^F + \frac{x^F}{p} \cdot \frac{dp}{ds} \cdot V_Y^F\right). \tag{4}$$

From (3)

$$\frac{dV^A}{ds} > 0 \quad \text{if} \quad -\frac{\bar{x}^F}{p} \cdot \frac{dp}{ds} > 1.$$

From (2)

$$\frac{dV^A}{ds} = \frac{dEV^F}{ds}. \tag{5}$$

From (3), (4) and (5)

$$-\frac{\bar{x}^F}{p} \cdot \frac{dp}{ds} = \frac{r\bar{x}^F V_Y^A + \bar{x}^F E V_Y^F}{r\bar{x}^F V_Y^A + E[x^F V_Y^F]}$$

hence

$$\frac{dV^A}{ds} > 0 \quad \text{if} \quad E[V_Y^F(x^F - \bar{x}^F)] < 0. \tag{6}$$

For a risk-averse agent V_Y^F is decreasing in Y and, if manufactures are not an inferior good, x^F is increasing in Y implying

$$E[V_Y^F(x^F - \bar{x}^F)] < 0 .$$

Hence, if manufacturers are not an inferior good, from Eq. (6) $dV^A/ds > 0$ and a small subsidy raises everyone's expected utility.

A partial equilibrium perspective provides insight into this result. The fixed entry grant attracts workers to the risky sector and so output price falls. The grant is state independent but a price fall lowers revenue by most when output is high. Net income is thus less dependent on the productivity realisation. Given risk aversion, in the new safer equilibrium, the expected income of risky-sector workers must be lower than before. That is, output price falls by more than the per-unit cost of the subsidy. This overshifting is the source of the efficiency gain.

To succeed the subsidy must be claimed only by those genuinely working in the risky sector. This may itself present a non trivial monitoring problem.[7] The best approach may be an indirect one. Subsidising (taxing) inputs used intensively in the risky (safe) sector using lump-sum taxes (subsidies) to achieve government budget balance provides a state independent boost to the risky sector so precipitatates the benefits specified in Proposition 1.[8] A particular case is subsidising the training neccesary to enter the risky sector.

3. Active insurance markets

When risk-averse agents face uncertainty there are market incentives to introduce risk-sharing and risk-pooling schemes, though costly state verification limits their scope. The previous section supposed these costs were prohibitive but they are now assumed sufficiently low to allow some private risk shifting. The expected utility maximising form of an insurance scheme where transfers depend upon reported income and monitoring is costly is derived by Mookherjee and Png (1989). It is shown here that in the presence of such a scheme a subsidy continues to make everyone better off.

From the point of view of those in the risky sector, the relative price of the risky sector good and any per-capita subsidy are treated as given when deciding how much insurance to acquire. For simplicity, the two-state case with fixed effort

[7]The problem is however different to that in providing private insurance where it is income reports that must be monitored rather than or as well as occupation.

[8]Extending the model to include non labour inputs is straightforward. Suppose one (but not both) of the goods is traded internationally. Intermediate inputs are also traded internationally and must be chosen *ex ante*. Factor taxes and subsidies affect input proportions but as with variable labour supply, by an envelope result this will not affect the demonstration that if the impact effect of the input policy is to boost the risky sector, a strict Pareto gain is achieved.

levels is analysed.[9] Also, it is assumed for now that occupation is observable. If a per capita subsidy is paid directly to individuals, the insurance scheme involves those reporting a high income making a payment, while those claiming a low outcome receive a net transfer. Since agents with high realisations have an incentive to misreport their income, monitoring is necessary. A proportion of those declaring the adverse outcome are selected at random for investigation, where it is assumed that for a cost of k the true realisation is observable. Those lying are fined while those who are checked and are found to have made an honest report are rewarded by a small additional payment. The reasoning behind paying a truth-telling bonus is that this is a way of increasing the expected income of those who experience the adverse outcome which does not affect the incentive to lie of those whose income realisation is high. For any given choice of transfer payments, the larger the penalty that can be imposed on those who misreport their income, the lower the proportion of low income claims that must be monitored to induce honest revelation. The maximum size of the possible penalty will depend upon what level of utility is thought to be the socially acceptable minimum.[10] Overall, the scheme must break even.

The insurance scheme which maximises the expected utility of those in the risky sector, subject to given prices and total subsidy, will exhibit the same post-transfer income levels in both the case where the subsidy is paid directly to individuals and when it is paid as a per capita subsidy to the insurance scheme. In this second formulation, the scheme involves selecting transfers pT_1, to those reporting low incomes, pT_3 to those reporting high incomes (which may be negative or positive depending on the level of subsidy), a bonus, pB for those who are monitored and found to be honest and the probability, π, of monitoring those reporting a poor outcome. From the revelation principle, only schemes which entail truth telling need be considered. Let V_0 be the penalty level of utility for those who are found to have misreported. Let f_L be the probability of a low realisation, q_L, and $(1-f_L)$ be the probability of a high outcome, q_H. Assume that monitoring an individual's income requires k_M units of safe sector output and k_F units of risky sector output. Define $T_2=T_1+B$, $g_1=f_L(1-\pi)$, $g_2=f_L\pi$, $g_3=(1-f_L)$, $q_1=q_L$, $q_2=q_L$ and $q_3=q_H$. A private scheme will treat p and s as given. Measuring incomes in terms of the safe good, the form of the scheme is as follows:

T_i, $i=1$ to 3, and π maximise

[9]Just as in the absence of insurance, effort effects drop out by an envelope theorem leaving the results unchanged but we do not clutter the derivation.

[10]Mookherjee and Png (1989) consider utility functions with a finite lower bound. Here it is assumed that the penalty level of utility may be set by social norms.

$$\sum_i g_i V(p(q_i + T_i),\ p)$$

subject to the incentive compatibility constraint

$$V(p(q_{\mathrm{H}} + T_3),\ p) \geq (1 - \pi)V(p(q_{\mathrm{H}} + T_1),\ p) + \pi V_0 \tag{7}$$

the break-even condition

$$\sum_i p g_i T_i - g_2(k_M + p k_{\mathrm{F}}) + s \leq 0 \tag{8}$$

and to the constraint that the probability of monitoring is non-negative, $\pi \geq 0$.

In equilibrium expected utility must be the same whichever sector is entered and hence p will be endogenous and will be affected by the presence of insurance.

The proof that with a subsidy everyone is better off *ex ante* first shows that if a subsidy is introduced and entry into farming proceeds until the price of food falls just enough to leave artisans as well off, farmers must be better off. Thus, to achieve equilibrium, the number of farmers must increase yet more, driving the food price lower still and so leaving artisans better off. In equilibrium, both groups have the same expected utility, so everyone's welfare is raised.

Demonstrating that farmers must be better off when price falls just enough to leave artisans as well off as before the tax/subsidy policy, involves showing that with unchanged monitoring it is feasible for farmers to choose the same consumption plan as before. The direct effect of the price fall combined with the subsidy is that in the absence of insurance, income is higher in the bad state and lower in the good state. It follows that if the same state-contingent consumption is to be achieved as in the absence of the scheme, less insurance must be bought. An undetected false income declaration is consequently less beneficial, so the incentive compatibility constraint is satisfied with room to spare. Monitoring can thus be reduced and farmers be offered a better insurance deal than prior to the policy

Proposition 2. *If verification costs are low enough to permit private insurance and manufactures are not an inferior good, a small subsidy to the risky sector (or to insurance provision) raises everyone's expected utility.*

Proof. The per capita demand for manufactures by farmers, including the monitoring requirements, is $\bar{x}^{\mathrm{F}} + g_2 k_{\mathrm{M}}$.

Normalising output at unit level, the utility of artisans is

$$V^{\mathrm{A}} = V(1 - rs,\ p)\ .$$

Evaluated at $s=0$, using Roy's identity, the budget constraint and the market clearing condition

$$\frac{dV^A}{ds} = -rV_Y^A\left(1+\frac{\bar{x}^F+g_2k_M}{p}\cdot\frac{dp}{ds}\right). \tag{9}$$

The fall in price which just leaves an artisan's utility unchanged satisfies

$$-\frac{dp}{ds}\cdot\left(\frac{\bar{x}^F+g_2k_M}{p}\right)=1. \tag{10}$$

It will now be shown that if dp/ds satisfies (10) a farmer's utility is strictly increasing in s.

Let T_i^*, $i=1, 2, 3$, and π^* be the optimal transfers and monitoring probability when $s=0$. Constraints (7) and (8) must bind at the optimum.

For $i=1, 2, 3$ define $V^{iF}=V(pq_i+T_i),\ p)$ and x_i^F as the associated consumption of manufactures.

The change in T_i required to leave V^{iF} unchanged is

$$\frac{dT_i}{dp} = -\frac{x_i^F}{p^2}. \tag{11}$$

Suppose that in response to the introduction of a subsidy the probability of monitoring is held constant at π^* and that the transfers change according to

$$\frac{dT_i}{ds}=\frac{dT_i}{dp}\cdot\frac{dp}{ds} = -\frac{x_i^F}{p^2}\cdot\frac{dp}{ds} \quad i=1, 2, 3. \tag{12}$$

For this to be feasible (though not necessarily optimal) the break-even constraint (8) and the incentive compatibility constraint (7) must be satisfied.

Note that if dT_i/ds is given by (12)

$$\sum_i g_i\frac{dT_i}{ds} = -\frac{\bar{x}^F}{p^2}\cdot\frac{dp}{ds}.$$

Evaluating at $s=0$, $T_i=T_i^*$, and $\pi=\pi^*$, the break-even constraint binds, i.e., from (8)

$$-\sum_i pg_iT_i - g_2(k_M+pk_F)+s=0.$$

Again evaluating at $s=0$, $T_i=T_i^*$, and $\pi=\pi^*$, if dT_i/ds is given by (12) and dp/ds satisfies (10),

$$\frac{d}{ds}\left(-\sum_i pg_iT_i - g_2(k_M+pk_F)+s\right)=0.$$

The break-even constraint is still satisfied and continues to bind.

Now to check the incentive compatibility constraint, (7). Evaluating at $s=0$, $T=T_i^*$, and $\pi=\pi^*$

$$V(p(q_H+T_3),\ p)=(1-\pi)V(p(q_H+T_1),\ p)+\pi V_0$$

dT_3/ds was chosen to leave $v(p(q_H+T_3),\ p)$ unchanged. Define x_4^F as the consumption of manufactures that would be chosen by a farmer with income $p(q_H+T_1)$. $V(p(q_H+T_1),\ p)$ will fall if

$$\frac{dT_1}{dp}\cdot\frac{dp}{ds}<-\frac{x_4^F}{p^2}\cdot\frac{dp}{ds}$$

but from (12)

$$\frac{dT_1}{dp}\cdot\frac{dp}{ds}<-\frac{x_1^F}{p^2}\cdot\frac{dp}{ds}.$$

If manufactures are not an inferior good $x_1^F<x_4^F$. Hence if the transfers change according to (12), the incentive compatibility constraint will be satisfied and will cease to bind. The proposed plan, which left the utility of the farmers unchanged, is therefore feasible but not optimal. By making optimal adjustments to the insurance scheme the farmers can be made strictly better off. But in equilibrium workers in both sectors must be equally well off and hence dp/ds must change by more than the value that satisfies (10) and introducing a subsidy raises everyone's expected utility. □

It has so far been assumed that the insurance company can identify the sector an applicant works in. Inability to do so may not matter. Even if occupation is not observable, safe-sector workers may not be attracted by contracts designed for those in the risky sector. An artisan signing up for the insurance contract would always make a false declarations since by doing so they have less to lose than high-income farmers for whom monitoring intensity is chosen to make honesty the best policy. However, since an artisan's true income is never low, post-monitoring penalties are often incurred making the insurance contract unattractive. Examples available from the authors confirm that those in the safe sector typically would not buy an insurance scheme conditioned on the needs of those in the risky sector. Thus, occupational choice does not have to be observable for a feasible, beneficial intervention in the form of subsidised insurance.[11]

Notice that the insurance contract can be interpreted as the sale to an outside financier of a state-dependent income claim. The bank buys the promise of a fixed payment when project income is high. When income is low no repayment is due,

[11]If there is private insurance under *laissez faire*, a small subsidy is definitely beneficial and if monitoring costs preclude its appearance, it may be worth subsidising it into existence or the state offering loss making policies.

so in this state the farmer benefits by the proceeds of the sale of the claim. A proportion of low-income reports are monitored and those confirmed are paid a bonus. If a report is found to be dishonest, all returns are surrendered bar a subsistence allowance. In this setting the optimal arrangement resembles a debt contract.[12] Proposition 3 therefore potentially justifies the establishment by the state of a loss making lending agency. Before actually creating such an institution, a variety of additional moral hazard and adverse election effects should also be taken into account, but the analysis here identifies a new reason for public funding. Interest rates at the state bank would be high, reflecting that it is risky ventures that are being targeted, but still insufficient to cover the lender's costs. The social benefits of the scheme are in the form of a more than proportional reduction in the price of goods which are risky to produce. Notice also that the high default premium, though better than actuarially fair as far as risky ventures are concerned, will not normally attract those with safe projects that will never default. Again, self selection ensures that it is not necessary to identify risk exposure to implement a successful policy.

4. Direct regulation

In showing the benefit of subsidising entry to the risky occupation it has been assumed that direct controls on resource allocation are impossible. Sometimes non-price intervention may be feasible, in which case further gains are attainable. Direct controls may take various forms, but the mechanism is most clearly and simply revealed if it is supposed that it is possible to ration food consumption at no administrative cost. Discussion of other, potentially more applicable cases, follows.

Proposition 3. *Assuming food is not inferior, with optimal entry subsidies rationing food consumption is welfare enhancing.*

Proof. At the subsidised equilibrium let food consumption be rationed just below the level chosen by a high-income farmer and suppose that ration coupons are not transferrable. It will now be shown that there is a new equilibrium with unchanged commodity prices at which everyone is better off. Holding prices fixed at the initial level, by a standard envelope result, marginal rationing leaves each farmer's

[12]The non-standard feature is the bonus to those monitored. In practice, moral hazard between the monitor and those defaulting may make it difficult to build this feature into the debt contract. Then again, sympathy with those you get to know may mean that those monitored do actually get better terms. Whether or not it is an advantage to be monitored or even if monitoring is deterministic, the argument for subsidised loans goes through. Note also that in this model there is no explicit intertemporal dimension so a ''loan'' contract is solely a risk-sharing device. In practice loans typically serve a dual role. In a multi-state model the optimal contract would have some equity like features.

utility unchanged. The reduction in per capita food demand will, however, require a switch of some producers into manufacturing. As there is a tax on manufacturing jobs but employment in agriculture is subsidised, the transfer of workers moves the government budget into surplus. The surplus can be disbursed to the two types of workers so as to leave both occupations equally attractive. So, there is a new equilibrium in which prices are the same but the fiscal burden on artisans is lighter. Hence, everyone is better off. □

It is a moot point whether rationing is feasible in practice, but the underlying principle applies in other contexts. Suppose monitoring is intensive in the risky good. Then, under weak assumptions, restricting insurance coverage reduces demand for the risky good and so has the beneficial effects traced above. Moreover, it may be easier to enforce a total ban on insurance than a partial ban. For non-marginal changes the direct effect of the restriction is negative, but the fiscal benefits may still outweigh these costs so that banning insurance raises expected utility.

Proposition 4. *With optimal entry subsidies, prohibiting private insurance may raise everyone's expected utility.*

Proof. A proof by example is available from the authors.

The general message is that if the subsidy to the risky activity is accompanied by restrictions which lower demand for it (another example of a policy having this effect is seemingly pointless restrictions on the uses to which a good may be put) then benefits will be even further increased. Analytically, the role of the subsidy is to create first-order risk sharing benefits. The accompanying resource transfer has standard dead-weight cost, though initially they are of second-order magnitude. If it is possible to block at least some of the subsidy induced resource transfer, efficiency is enhanced.

5. Conclusions

It has been shown that in a simple economy with occupational mobility, a grant to those entering the risky activity makes everyone better off. One application is to training subsidies for those entering occupations requiring substantial human capital formation but where it is difficult, even for the entrant, to predict eventual aptitude.[13] Taxing inputs specific to safe sectors at higher rates than those used in risky sectors may also be an appropriate method of implementation. Likewise,

[13]If shocks are uncorrelated across periods some self insurance is possible by using savings to smooth consumption. Where the realisation is of lifetime ability, this possibility does not apply.

subsidising insurance is a way of ensuring that take up is genuinely restricted to those in the risky sector.

Perhaps the most important and practical application is to the state purchasing stakes in risky ventures. The standard objection to such a proposal is that if the benefits of risk sharing outweigh the costs why does the market fail to supply the service? Sometimes it is implicitly assumed that the government has better information than the private sector. The analysis here suggests such schemes may be justified even if the state has no advantage over private financiers in observing income realisations.

The results arise because private risk-sharing contracts require costly monitoring, expenditures which are excessive from a social perspective.[14] A grant to those undertaking risky ventures encourages entry, lowers price and, just as in a private scheme, reduces the income variance of those in the risky sector. The gain to those who pay the subsidy is that price falls by more than enough to recoup their outlay. Risk sharing is thus accomplished without the need for elaborate contracts with expensive enforcement mechanisms. In effect, the subsidy provides cheap insurance and so yields two advantages; there is the cost saving from substituting a less expensive risk sharing device and, more importantly, it is now worth undertaking some risky activities that would not otherwise have been viable.

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[14]This is similar in spirit to de Meza and Gould (1992) who show that the cost of enforcing rights may make common property preferable to private property.

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