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Cohesion, Insurance and Redistribution*

Federico Echenique[1] and Jon X. Eguia[2]

[1]*Division of the Humanities and Social Sciences, California Institute of Technology, Pasadena, CA 91125, USA; fede@caltech.edu*
[2]*Department of Politics, New York University, New York, NY 10012, USA; eguia@nyu.edu*

ABSTRACT

Governments use redistributive policies to favor relatively unproductive economic sectors. Traditional economic wisdom teaches that the government should instead buy out the agents in these sectors, and let them relocate to more productive sectors. We show that redistribution to a sector whose agents have highly correlated incomes generates an insurance value. Taking this insurance value into account, a buy-out is not sufficient to compensate the agents in the sector for relocating. In fact, it may be efficient for the government to sustain agents in an activity that, while less productive, is subject to correlated income shocks. US data suggests that indeed, sectors that receive transfers are subject to more correlated income shocks than others.

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Clever economists have displayed an obtuseness in this matter that is difficult to believe. They will say, not year after year but generation after generation:

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> *"Parliament, do you not realize that free trade would increase the national income?" As if the Parliament did not know this! At their most sophisticated, these economists have added: "If you must aid farmers or whomever, tax a portion of the larger income obtained with free trade and give the revenue directly to the people the tariff was intended to help." As if they had studied the comparative efficiency of subsidizing a given group by tariffs as compared with general taxes and selective subsidies.*
>
> Stigler (1982)

Redistributive policies are ubiquitous. Economists have a good understanding of why redistribution exists, but not why it takes the *form* it takes. Often, governments redistribute through tariffs, quotas, and other distortionary means. Why do they not give a direct subsidy to the policies' recipients, and avoid the deadweight loss from the distortionary redistribution? A salient example is the transfer that a protected industry receives from a tariff on international trade. This protection keeps factors of production tied to a relatively unproductive sector, when these factors could relocate (and would without protection) to a different, more productive, sector of the economy. The monetary value of the transfers is small compared to the total loss from the distortions introduced by the policy. For instance, Hufbauer and Elliott (1994) calculate that tariffs for the 21 most protected industries in the US cost consumers $32 billion. After subtracting the producer's gains and tariff revenues, the net loss for the economy is $10.7 billion.

If the government wants to redistribute wealth to favor a sector of the economy, it can choose among several policies that would give the industry the same raise in wealth. As detailed, for example, by Rodrik (1994), the most efficient policy would be a one-time lump grant to the industry, and no protection thereafter – a buy-out. This kind of redistribution does not affect the incentives to locate factors in the most productive sector. Increasingly costlier ways to redistribute are: Subsidies to employment, which keep agents tied to less productive sectors; subsidies to production, which create the incentives to raise production in a relatively unproductive industry; and tariffs, which make consumers pay more for their products and obstruct the gains from international trade. The puzzle is why redistributive policies take a form that keeps factors employed in less productive sectors, and why the government does not instead buy out these sectors.

In this paper, we offer an answer to the puzzle. We argue that redistributive policies that keep agents in a relatively unproductive sector may in fact be more efficient than a buy-out. The reason is that the political process that generates redistribution is such that it provides agents with insurance, in addition to wealth. We first note that redistributive transfers are responsive to the demands made by agents in different sectors, and that demands depend on agents' well-being. In particular, other things being equal, an agent is more likely to demand a transfer for her sector when she receives a negative shock than when she receives a positive shock. As a consequence, agents in sectors where income shocks are highly correlated will be more cohesive in their demands for sectoral transfers. Hence, a given agent who receives a negative shock will obtain a higher transfer in a high-correlation, cohesive, sector than in other sectors, because there will be more agents

like her demanding transfers to the sector. An agent is therefore better insured by the redistributive policies in a cohesive sector than in the rest of the economy, and if she accepts a buy-out she loses the insurance.

Belonging to a cohesive group has a value that is not captured by the calculations of deadweight loss. To buy out an agent from a cohesive sector, one must give her more than the expected transfer she would receive in the sector: one must compensate her for the insurance she loses when, engaged in other economic activities, she belongs to less cohesive groups. In other words, it may be cheap for a government to give a certain level of utility to a group if it engages in an activity that, while less productive, is subject to correlated individual shocks.

A first look at the publicly-available data supports the explanation we have laid out. Our theory has a clear testable implication: The data should show a positive relation between correlation of incomes and tariff protection. The publicly-available US data suggests that this is indeed the case. That said, the emphasis of our work has been on developing a theory, and further empirical work is clearly needed to test our theory conclusively.

Our explanation follows the arguments in Becker (1976) and Stigler (1982) that, unless agents make systematic mistakes, redistribution must take a less inefficient form than alternative policies. Tariffs, they argue, may be inefficient, but they must be the most efficient way of performing the redistributive task they perform.

Our first results show how a benevolent government may want to maintain agents in an unproductive sector; in a sense, we carry out the calculation that Stigler suggests in our quote. We find a specific reason for why the seemingly inefficient policies that keep agents in unproductive sectors may be better than the alternatives. They may be better because they take advantage of the correlation in incomes – a technological feature of the sector in question – to provide agents with higher utility, via insurance, for a given expected value of transfers. We then show, in a model of political participation, that the insurance effect is present even when the government is not explicitly trying to insure the agents.

We can make Stigler's suggested comparison more explicit: If a government wants to redistribute income to agents who receive a negative shock, it may use a system of individual income taxation. Varian (1980) emphasizes how income taxation affects the incentives to work, and how a social planner would have to trade-off the efficiency loss from reducing the incentives to work with the insurance effect from reducing the variance of individual income.[1] Our results, on the other hand, highlight that group transfers also provide social insurance, without the adverse effects on incentives to work. If the income shocks in a sector are highly correlated, then the average income of the sector serves as an adequate public signal of the individual income of all agents in the sector: When the sector receives a negative shock, all agents are affected. The government can then offer transfers to all agents in a particular sector when the sector is poor, and tax the agents when the sector is rich, and at the same time keep the tax on marginal individual income

[1] Forteza (1999, 2001) has also studied this trade-off, with emphasis on the time inconsistency of avoiding social insurance.

at zero. The government may offer these transfers out of concern for social welfare or strategically to entice voters.

In our results, the government insures sectors against aggregate shocks in an economy without private insurance markets. What if there are private markets for the relevant risks? We note first that in practice it is often the government and not markets who provides insurance, at least in the sectors that are relevant for our paper. Second, we present a version of our model with private-insurance markets for the aggregate shocks under consideration. We show how in this economy with private insurance markets, government redistribution still sustains an unproductive sector and increases social welfare.

The literature that tries to explain the form of redistributive policies is not large. Dixit and Longregan's (1995) and Mitchell and Moro's (2006) work is closest to ours, in the sense that they too explain why governments do not buy out the recipients of redistributive policies. To ease the exposition in the sequel, we shall refer to a generic relatively-unproductive sector as "farming." Dixit and Londregan argue that, if the government cannot commit to future transfers, individual farmers will prefer to remain farmers and not incur the costs of relocating to another sector. In their model, which builds on the political competition models of Lindbeck and Weibull (1987) and Dixit and Londregan (1996), the transfers are such that farmers who relocate are taxed to subsidize farmers who do not relocate. Dixit and Londregan's explanation relies on the farmers being in a coordination failure, each individually failing to internalize the social gains from the relocation of the group. Our explanation of the puzzle relies on quite different mechanisms; we view it as complementary to Dixit and Londregan's. We should mention, though, that it may be possible for a government to break the coordination failure in Dixit and Londregan's model by offering farmers a *conditional* buy-out offer – a buy-out offer that only comes in place if most farmers accept (offers of this kind are used in corporate take overs, for example).

Mitchell and Moro (2006) present a model where there is uncertainty about the degree of inefficiency in farming. In particular, they assume that only farmers know how much they need to be compensated in order to agree to a buy out. Mitchell and Moro show that seemingly inefficient transfers to farming may in fact be efficient, conditional on the informational asymmetry in their model. Our explanation relies on very different mechanisms, but we have in common the conclusion that policies which are traditionally regarded as inefficient may be efficient, once the right constraints are taken into account.

Acemoglu and Robinson (2001) present a model where farmers favor policies that induce more agents to enter farming, because they gain more political power in the future. Their explanation requires that larger groups obtain larger *per capita* transfers. Acemoglu and Robinson explain why incumbent farmers favor the inefficient entry-inducing policy over a non-distortionary lump-sum transfer. But their model does not explain – nor does it claim to explain – the stated puzzle: a government would still benefit from buying out the incumbent farmers by giving them the present value of the transfers they would obtain with the larger group size. Interestingly, Acemoglu and Robinson's explanation implies that sectors with larger specificity of factors receive smaller transfers. Our explanation has, if anything, the opposite testable implication (we discuss this issue in more detail below).

Dal Bó and Dal Bó (2004) present a three-sector model with one productive labor-intensive sector, one productive capital-intensive sector, and one purely wasteful sector which is also labor-intensive. They show that policies – such as tariffs – that sustain wages in a less-productive, labor-intensive, sector may be optimal, as they prevent workers from engaging in purely wasteful activities.

Coate and Morris (1995) consider policies that may or may not be inefficient, and show that the government may use these policies, even when it knows they are inefficient, because they benefit an interest group in a covert way. Coate and Morris explain policies whose inefficiency is uncertain. The puzzle we try to explain, as stated in the literature, refers to unambiguous policies. Coate and Morris deal with essentially a different phenomenon than our puzzle.[2]

SOCIALLY OPTIMAL REDISTRIBUTION

We shall demonstrate our point in a stylized model with two large groups. First, we consider a benevolent government who wants to use transfers to insure individuals. We show that the government may want to sustain a group because its income correlation makes transfers effective as insurance. As a result, the government may want to sustain a less productive sector, if it has high income correlation.

Second, we consider politicians offering transfers to voters, in a probabilistic voting model. We show how income correlation can make a sector more cohesive politically, and as a result be better insured by the process of political competition. The second model reduces to the first model of a benevolent government, and our result on maintaining a group with high correlation – a cohesive group – holds.

Consider two groups of agents, I_A and I_B, with a continuum of agents in each group; assume that $I_m = [0, 1]$, $m = A, B$.[3] Agents are identical, with one exception: the agents in group A receive perfectly correlated wealth-shocks, while those in group B receive independent wealth-shocks. The marginal distribution of wealth is the same for all agents, but the joint distribution is different across groups. Concretely, individual wealth, w_i, is drawn from a continuous distribution G with full support on $[0, 1]$, for both groups. The difference is that the w_i in group A are perfectly correlated, so that $i, i' \in I_A$ and $w_i = w$ implies $w_{i'} = w$. The w_i in group B are independent; that is, if $i, i' \in I_B$, then the event $w_i = w$ conveys no information about the realization of $w_{i'}$.

Each agent i derives utility from consumption. An agent's consumption is given by her wealth and a government transfer, which can be negative or positive. A benevolent government aims to maximize social welfare by choosing transfers t_m to the individuals of group m. The utility of agent i in group m is

$$v(w_i + t_m).$$

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[2] Dixit and Londregan (1995) and Acemoglu and Robinson (2001) make the same point about Coate and Morris (1995).

[3] The assumption of a continuum of agents is analytically convenient. We ignore the technical issues discussed in Judd (1985) and Feldman and Gilles (1985).

We assume that $v : \mathbf{R}_+ \to \mathbf{R}$ is increasing, continuously differentiable, strictly concave.

A budget constraint on the government requires that the transfers must be balanced, so that $t_A = -t_B$.

The assumption that the government can only implement group (not individual) transfers is crucial. Assuming that individual wealth is exogenous and unobservable, only group transfers are possible. In a more general model, the government could set up an income tax system, which would serve to redistribute wealth across individuals, rather than across groups. But one can interpret our model as a reduced form of the more general model. Individual transfers affect agents' incentives to work; group transfers (when groups are large) do not. If income is taxed and later redistributed to those with less wealth, then every agent has lower incentives to work and would optimally choose to shirk or enjoy more leisure, with the consequent loss of production and wealth for the society. As a consequence, one would imagine that individual transfers would not fully insure the agents, and that group transfers would still be used. Our approach would apply to group transfers and after-tax wealth that still submit the agents to a significant degree of risk.

The government's choice of transfers (t_A, t_B) solves the following problem:

$$\max \int v(w_A + t_A(w_A))dG(w_A) + \iint v(\tilde{w} + t_B(w_A))dG(\tilde{w})dG(w_A)$$
$$\text{s.t. } t_A(w_A) + t_B(w_A) = 0.$$

We refer to the government's objective function as social welfare.

The government can condition the transfers on the wealth of group A, which is observable, and thus provides insurance by subsidizing group A when this group is poor, and taxing it when the group receives a high wealth shock.

For any level of wealth in group A, the government redistributes wealth from one group to another until the average marginal utility from consumption is equal in both groups.

Let T_m be the expected transfer to an individual in group m, i.e., $T_m = \int t_m(w)dG(w)$, $m = A, B$. The first result is that belonging to group A and receiving the corresponding wealth-dependent transfers is better than receiving the expected transfer that accrue to group-A agents. Whereas, belonging to group B is worse than receiving the expected transfer that accrue to group-B members.

Lemma 1 *The government's optimal transfers t_A^*, t_B^* satisfy*:

(1) $\mathbf{E}v(w_A + t_A^*(w_A)) > \mathbf{E}v(w_A + T_A)$, *and*
(2) $\mathbf{E}v(w_B + t_B^*(w_A)) < \mathbf{E}v(w_B + T_B)$,
where w_A and w_B are the (random) wealths of group-A and group-B individuals, respectively.

Proof: To save on notation, let $x(w) = t_A^*(w_A) = -t_B^*(w_A)$ and $T = T_A$. The first-order condition of the government's maximization problem requires that, for every w:

$$v'(w + x(w)) = \int_0^1 v'(\tilde{w} - x(w))dG(\tilde{w}). \tag{1}$$

Since v' is decreasing, $x(w)$ is monotone decreasing. Then there is $\bar{w}$ such that if $w \leq \bar{w}$ then $x(w) \geq T$ and if $w \geq \bar{w}$ then $x(w) \leq T$.

First, if $w \leq \bar{w}$,

$$v(w + x(w)) - v(w + T) = \int_T^{x(w)} v'(w + s)ds \geq v'(w + x(w))\big[x(w) - T\big]$$

and if $w \geq \bar{w}$ then

$$|v(w + x(w)) - v(w + T)| = \int_{x(w)}^T v'(w + s)ds \leq v'(w + x(w))|x(w) - T|.$$

So, either way,

$$v(w + x(w)) - v(w + T) \geq v'(w + x(w))\big[x(w) - T\big]. \tag{2}$$

Then

$$\begin{aligned}\int v(w + x(w)) - v(w + T)dG(w) &\geq \int v'(w + x(w))\big[x(w) - T\big]dG(w)\\ &= \int\int v'(\tilde{w} - x(w))dG(\tilde{w})\big[x(w) - T\big]dG(w)\\ &= \int l(\tilde{x})\big[\tilde{x} - T\big]dH(\tilde{x})\\ &> 0.\end{aligned}$$

The first equality is from Equation (1). The second equality comes from letting H be the distribution of the random variable $x(w)$, and

$$l(x) = \int v'(\tilde{w} - x)dG(\tilde{w}).$$

The last inequality follows because l is a positive, strictly monotone increasing function and $\int \big[\tilde{x} - T\big]dH(x) = 0$ by a standard argument in probability theory. So this proves that $\mathbf{E}v(w_A + t_A^*(w_A)) > \mathbf{E}v(w_A + T_A)$. The statement for group B is immediate because v is concave, and w_A and w_B are independent. ■

The intuition behind the result is straightforward: Since the transfers only depend on the wealth shock of group A, agents in A receive some insurance against this shock. Group-A agents receive positive transfers when they are poor, and pay transfers when

they are rich, while transfers to B-agents do not depend on their own wealth, but on that of group-A members. For B-agents, transfers are a mean-preserving spread over T_B. Since agents are risk averse the result follows.

Our second result is that twice the expected transfer to A-agents is not enough to compensate them for becoming B-agents.

Proposition 2 *An agent prefers to be a member of group A than to receive $2T_A$ for sure and then become a member of group B. Formally*:

$$\mathbf{E}v(w_A + t_A^*(w_A)) > \mathbf{E}v(w_B + 2T_A + t_B^*(w_A)).$$

Proof: The result follows from Lemma 1, because

$$\begin{aligned}\mathbf{E}v(w_A + T_A) &= \mathbf{E}v(w_B + T_A)\\ &= \mathbf{E}v(w_B + 2T_A + T_B)\\ &> \mathbf{E}v(w_B + 2T_A + t_B^*(w_A)).\end{aligned}$$

The first inequality holds because individual wealth is drawn from the same distribution G for both groups. The second equality follows from the budget balance requirement $T_A = -T_B$. The inequality follows the concavity of the function v. ■

The results should be interpreted as follows. Suppose the government considers buying out agents in group A by offering a compensation for relocating to group B. Consider two possible offers, an individual and a collective buy-out.

In an individual buy-out, an A-agent relocates to group B, but she imagines that the redistributive policy remains in place, so that group-A agents continue receiving transfers t_A^* financed by $-t_B^*$. Then she gives up an expected transfer of T_A as an A-agent, and pays an expected $-T_A$ as a B-agent, so the relevant compensation would be $2T_A$. Proposition 2 says that $2T_A$ is not enough compensation for the proposed relocation.

In a collective buy-out, all the members of A are bought out, and there is no more redistribution. The relevant compensation is then T_A, as an A-agent loses the expected value of transfers. But since there are now no transfers, and the marginal distribution of wealth is the same for both groups, Equation 1 in Lemma 1 implies that T_A is not enough compensation for the relocation.

In either case, the insurance value of belonging to group A makes the buy-out less efficient than a simple calculation of expected transfers would suggest.

In fact, social welfare strictly decreases if group A is bought out. To see this, first note that the social welfare with transfers is necessarily higher than without transfers, as t_A^* and t_B^* are not identically zero when v is strictly concave. Second, since the marginal distribution of wealth is G in both sectors, fixing the transfers at zero in all states yields the same individual expected utility for every agent as a forced relocation of all A members to group B with no compensation yields – with no transfers, agents are indifferent about group membership. Third, a buy-out with compensation $T_A \neq 0$ reduces social welfare

relative to a buy-out with no compensation, since it represents a mean-preserving spread in the distribution of wealth of risk-averse agents by making some richer and some poorer.

As we mentioned in the introduction, the question is why the government does not buy-out less productive sectors. Yet in our model, both groups had identical (marginal) wealth distributions. Our modeling assumption sought to identify and isolate the insurance effect caused by a group's cohesiveness, but the results have obvious implications for truly less productive groups.

Suppose that sector A is less productive, so that wealth in sector A is $w_A - \alpha$ for some fixed productivity gap $\alpha > 0$. If the productivity gap is small relative to the insurance effect we have identified, it is second-best efficient to sustain sector A; second-best, that is, to some ideal transfers that could depend on agents' individual levels of wealth.

Corollary 3 *There is α^* such that, if $\alpha \leq \alpha^*$, then buying out group A leads to a decrease in social welfare.*

The corollary is straightforward: For $\alpha = 0$, it is strictly better in terms of social welfare to keep sector A over buying it out; it follows from continuity of the utility functions that the sum of expected utilities is still strictly higher keeping sector A afloat with state-dependent transfers if the productivity gap in favor of B is positive but small enough. On the other hand, it is efficient to buy out a sector if this sector is sufficiently less productive, despite how costly it may be to compensate individuals for the insurance effect we identify. In general, there is a trade-off between the productivity gains determined by α and the size of the insurance effect caused by a sector's cohesiveness.

The model we have developed demonstrates the insurance value of transfers to cohesive groups. However, it does so abstracting from any political considerations, adopting the convenient but unrealistic approach of a social planner. In the remainder of the section we show that the same results follow from the model of political competition with probabilistic voting due to Lindbeck and Weibull (1987).

In Lindbeck and Weibull's model, two parties compete for votes by offering transfers – in a sense they buy votes. Crucially, a voter is more willing to sell her vote when she is poor than when she is rich. So transfers are more effective, and therefore higher, when they are given to a poor group. As a result, insurance is naturally built into Lindbeck and Weibull's model.[4]

The two groups of agents I_A and I_B are now voters.[5]

Two political parties, Y and Z compete for the votes of the agents. A generic party is denoted by j. We assume (following Lindbeck and Weibull) that voters have some intrinsic preference for one of the parties, but parties do not know this preference.

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[4] See Persson and Tabellini (2000) and Grossman and Helpman (2001) for a discussion of this model, and Hillman (1982) for a contrast between social welfare and political support concerns for enacting redistributive policies.

[5] We depart from Lindbeck and Weibull (1987) in assuming a continuum of voters. They have an arbitrary number of groups, with a finite number of voters in each. We believe this difference does not drive the substance of our results.

Each voter i derives utility from consumption, c_i, and from which party is in office. Voter i's utility is

$$\begin{cases} v(c_i) + a_i & \text{if } Y \text{ wins} \\ v(c_i) + b_i & \text{if } Z \text{ wins.} \end{cases}$$

The numbers a_i and b_i reflect the voter's preference for parties Y and Z, respectively.

Each party j promises transfers t_m^j to the individuals of group m. So, if party j wins, voter i of group m consumes $c_i = w_i + t_m^j$. Substitute c_i in voter i's utility, and we conclude that i votes for party Y if

$$b_i - a_i < v(w_i + t_m^Y) - v(w_i + t_m^Z).$$

The parties do not know the values of $b_i - a_i$. But they believe each $b_i - a_i$ is independently and identically distributed according to some distribution F. Then the probability that some voter $i \in I_m$ votes for Y is

$$F\big[v(w_i + t_m^Y) - v(w_i + t_m^Z)\big].$$

The timing of Lindbeck and Weibull's political game is as follows:

(1) Wealth levels are realized.
(2) Each party $j = \{Y, Z\}$ offers balanced per-capita transfers (t_A^j, t_B^j). Each party's objective is to maximize the expected number of votes it receives.
(3) Elections are held.

The parties learn the realized distributions of wealth: they learn the value of group-A agents' wealth, as their realized distribution is always degenerate, and know that the distribution of group-B voters' wealth is G. The latter is constant, so parties condition transfers on the realized wealth of group-A voters.

Given wealth w for group-A voters, and promised group transfers (t_A^j, t_B^j), the expected number of votes for Y in group A is

$$\int_0^1 F\big[v\big(w + t_A^Y\big) - v\big(w + t_A^Z\big)\big]di = F\big[v\big(w + t_A^Y\big) - v\big(w + t_A^Z\big)\big],$$

and the expected number of votes for Y in group B is

$$\int_0^1 F\big[v\big(\tilde{w} + t_B^Y\big) - v\big(\tilde{w} + t_B^Z\big)\big]dG\big(\tilde{w}\big).$$

Given wealth w for the group-A voters, party Y wants to maximize (and Z minimize)

$$F\big[v\big(w + t_A^Y\big) - v\big(w + t_A^Z\big)\big] + \int_0^1 F\big[v\big(\tilde{w} + t_B^Y\big) - v\big(\tilde{w} + t_B^Z\big)\big]dG\big(\tilde{w}\big).$$

We assume that the distribution function F is differentiable, with convex and compact non-singleton support, and strictly positive density on its support.

Proposition 4 *There is a unique Nash equilibrium of the political competition game. This equilibrium is symmetric, and both parties propose the vector of per-capita transfers* (t_A^*, t_B^*) *that maximize social welfare.*

The proposition follows easily from Lindbeck and Weibull's (1987) results.

The equilibrium transfers coincide with the transfers chosen by a benevolent government. Sector A is not bought out, but rather, state-dependent transfers insure its members and provide an additional value that makes them better-off than receiving merely a compensation in the amount of the expected transfer.

If the productivity gap in favor or sector B is small, relative to the insurance value of the cohesive groups, both a benevolent government and a vote-maximizing party would prefer to maintain sector A over buying out its members.

LIMITATIONS OF PRIVATE INSURANCE

We have derived our results under the assumption that there are no private insurance markets. We have shown how seemingly inefficient policies may in effect be providing insurance that the market does not provide, so the role of insurance markets is important in our results.

Private insurance contracts may provide payments conditional on individual or aggregate shocks. Insurance against individual shocks could guarantee a first-best outcome, and hence affect our results. However, a standard moral-hazard argument precludes insurance of individual shocks; in the words of Arrow (1968): "If the amount of insurance payment is in any way dependent on the decision of the insured as well as on a state of nature, then the effect is much the same as that of any excise tax and optimality will not be achieved by the competitive system." Indeed, the issue of individual shocks is similar to the issue of individual income taxation – see also our reference to Varian (1980) in the introduction, and the related discussion.

We focus our discussion on aggregate, sector-wide, shocks; these are the shocks insured by the government in the previous section. In principle, private insurance markets could insure sector A against its aggregate shock in wealth without government intervention (the individual shocks in sector B remain uninsurable).

We make two points. The first is empirical: In the cases we care about (e.g., Agriculture), governments in practice intervene and complement private insurance. In some instances, no private market provides insurance independently of the government. The second argument is theoretical: Trade in Arrow–Debreu securities does not preclude a role for government.

Empirical evidence on agricultural insurance in the United States is consistent with a prominent role for the government. As noted by Chambers (1989), the development of a competitive market for agricultural insurance in the United States has been unsuccessful, and crop insurance requires a government subsidy. The government subsidizes crop insurance through the Risk Management Agency of the Department of Agriculture and

redistributes transfers toward agriculture, keeping the sector alive instead of compensating farmers for the costs of relocating to more productive sectors of the economy.

Further, Rodrik (1998) presents evidence that even where private insurance could soften income shocks, the government provides social insurance to compensate for aggregate risks to the economy. In particular, Rodrik finds that a more open economy, which is subject to greater external shocks by virtue of its openness, correlates with larger government spending. According to Rodrik, the best explanation for this correlation is that government spending provides social insurance against external risk: "Societies seem to demand (and receive) an expanded government role as the price for accepting larger doses of external risk. In other words, government spending appears to provide social insurance."

We now turn to a theoretical exploration of private insurance by introducing Arrow–Debreu securities for aggregate, sector-wide, shocks. We show first how the resulting equilibrium allocation differs from the one chosen by the government. So the presence of securities does not preclude a role for the government. We then consider a specific example where we show that, even with a private market in Arrow–Debreu securities, the less-productive sector would relocate, but government intervention prevents relocation.

We reproduce first the set-up from our model with a benevolent government. Let the distribution of wealth in each sector be G, and let the perfectly-correlated wealth level for all agents in sector A be $w_A - \alpha$, where w_A is drawn from G and α represents the productivity gap that makes sector A less productive (see Corollary 3).

The government's choice of transfers (t_A, t_B) solves the same problem as in previous sections: The first-order condition gives that, for every w_A,

$$v'(w_A - \alpha + t_A(w_A)) = \int v'(w_B - t_A(w_A))dG(w_B). \tag{3}$$

To allow for private insurance contracts, we introduce Arrow–Debreu securities for the uncertain state of the world, represented by the wealth level w_A. Let there be one asset for each level of w_A, such that the asset corresponding to a given state pays off one monetary unit if this particular state occurs, and zero otherwise. Assume that, prior to the resolution of uncertainty, there exist markets where agents can trade these assets in order to share risks and transfer wealth across states. Denote by p_{w_A} be the price of the asset corresponding to state w_A.

Consider the maximization problem of a member of group A. Let q_{w_A} be the quantity of the asset corresponding to wealth w_A that this individual buys. Then she has to solve

$$\max \int v(w_A - \alpha + q_{w_A})dG(w_A)$$
$$\text{s.t.} \int p_{w_A} q_{w_A} dw_A = 0.$$

The constraint $\int p_{w_A} q_{w_A} dw_A = 0$ is the agent's budget constraint. If the agent does not trade, she possesses zero units of each asset. If she wishes to insure herself against state w_A, contracting to receive q_{w_A} extra monetary units if state of the world w_A occurs,

then the cost of this insurance is $p_{w_A} q_{w_A}$ and the agent must contract to pay (to receive a negative q) in other states, so that in the aggregate, the costs and earnings of all amounts contracted to receive or pay in each state compensate each other. Alternatively, we can interpret that the agent only buys insurance to receive positive quantities in each state, but pays an up front fee for this insurance. Then, the budget constraint requires that aggregating across all states, the cost of the net excess of contracted payments minus the fee ϕ is equal to zero and the maximization problem is as follows:

$$\max \int v(w_A - \alpha + q_{w_A} - \phi) dG(w_A)$$
$$\text{s.t.} \int (p_{w_A}(q_{w_A} - \phi)) dw_A = 0.$$

Note that the two interpretations of the maximization problem, either with positive and negative contingent payments, or with strictly positive contingent payments and an up-front fee, are equivalent. We follow the first for ease of notation.

Assume that G has a strictly positive density, g. Then we can write the Lagrangian for this problem as:

$$\mathcal{L}((q_{w_A}); \lambda) = \int \{v(w_A - \alpha + q_{w_A}) - \lambda q_{w_A} p_{w_A}/g(w_A)\} dG(w_A).$$

Thus, the first-order condition is, for each w_A,

$$v'(w_A - \alpha + q_{w_A}) - \lambda p_{w_A}/g(w_A) = 0. \tag{4}$$

Now consider a member of Group B, who chooses a portfolio $(q^B_{w_A})$, with $q^B_{w_A}$ being how much she buys of the asset corresponding to level of wealth w_A. Her maximization problem is

$$\max \iint v\big(w_B + q^B_{w_A}\big) dG(w_B) dG(w_A)$$
$$\text{s.t.} \int p_{w_A} q^B_{w_A} dw_A = 0$$

Using Fubini's Theorem, the Lagrangian for this problem is

$$\mathcal{L}\big((q^B_{w_A}); \mu\big) = \int \left\{ \int v\big(w_B + q^B_{w_A}\big) dG(w_B) - \mu q^B_{w_A} p_{w_A}/g(w_A) \right\} dG(w_A).$$

Thus, the first-order condition is, for each w_A,

$$\int v'\big(w_B + q^B_{w_A}\big) dG(w_B) - \mu p_{w_A}/g(w_A) = 0. \tag{5}$$

Equilibrium requires that the purchases of q_{w_A} and $q^B_{w_A}$ be in zero net demand. In a symmetric equilibrium, all A-agents choose the same q_{w_A} and all B-agents the same $q^B_{w_A}$.

Hence, in equilibrium, $q_{w_A} = -q^B_{w_A}$. Let $\sigma = \lambda/\mu$. As a consequence of Equations (4) and (5), we have

$$v'(w_A - \alpha + q_{w_A}) = \sigma \int v'(w_B - q_{w_A}) dG(w_B). \tag{6}$$

Compare Equations (3) and (6): The market outcome corrects some of the inequalities in wealth, but it does not coincide with the outcome chosen by the government. In equilibrium, the ratio of expected marginal utilities in each sector is constant across states, but one sector is better off than the other in all states. A relaxation of the budget constraint is more valuable for the worse-off sector: so $\sigma \neq 1$, as the Lagrange multiplier is higher for the worse-off sector. The government strives to equalize marginal utilities, but this is not what the market achieves because the market does not correct the inequality induced by the productivity gap α, it only equalizes based on what it can insure.

The market solution for the risk-bearing problem given by the Arrow–Debreu equilibrium differs from the benevolent government solution because the government transfers not only provide insurance for risk-bearing, they also redistribute wealth in favor of the poor, increasing utilitarian social welfare.

Redistribution enables private insurance to operate, and allows the less productive sector to survive. We illustrate this point using a numerical example. The example illustrates how private insurance markets fail to preserve a less productive sector: all A-agents would migrate to the uninsurable but more productive sector of the economy. Yet, the government's redistributive transfers keep sector A alive. In the example, the market provides the insurance provided by the government in previous sections of our model. However, the government intervention is crucial for sustaining the sector and allowing the insurance market to operate.

Example 5 Let w_A equal either 1 or 2 with equal probability. Let $\alpha = 0.1$ and let $w_i = w_A - \alpha$ for any $i \in A$. For each $j \in B$, let w_j equal either 1 or 2 with equal probability. Let the realizations of w_j be independent. Let v be piece-wise linear, with

$$v'(x) = \begin{cases} 1 & \text{if } x \leq 1.6 \\ 0.5 & \text{if } x > 1.6 \end{cases}$$

In the absence of private insurance markets or government transfers, expected utility is 1.325 for A-agents and 1.4 for B-agents. Therefore, if A-agents can relocate to sector B, they do so. After the relocation the average expected utility is 1.4.

In the equilibrium of the Arrow–Debreu economy, A-agents have a weak incentive to relocate and let the sector collapse, despite the provision of private insurance. Let there be state-contingent assets 1 and 2 that pay, respectively, one monetary unit if $w_A = 1$ and one monetary unit if $w_A = 2$. In equilibrium, the relative price of the two assets is 1, A-agents buy 0.3 units of asset 1 and sell 0.3 units of asset 2 to B-agents. Expected wealth for (A, B)-agents is (1.4, 1.5) and expected utility is (1.4, 1.4), so A-agents are indifferent about relocating (and an infinitesimal decline in the productivity of sector A would break the indifference, precipitating the relocation).

On the other hand, government intervention guarantees that A-agents have a strict incentive to remain in their sector, and it increases utilitarian social welfare. The government optimal solution is to set transfers from B to A contingent on w_A in quantity $t(1) = 0.4$ and $t(2) = -0.3$ so that the expected transfer in favor of A is 0.05, expected post-transfer wealth is 1.45 in both sectors and expected utility in sectors (A, B) is (1.45, 1.3625) for an average expected utility of 1.406.

Alternatively, the government can reach its constrained optimal solution letting private insurance markets operate, and distorting the equilibrium by imposing a transfer $t(1) = 0.1$.[6] The government intervention with active private insurance markets consists on a subsidy to sustain activity in sector A. This subsidy allows sector A to survive and makes it possible for private markets to insure the sector.

Note that the government can either impose only the minimal reallocation that would then lead private markets to reach the utilitarian optimum in equilibrium, or, given that some form of intervention is necessary, it may instead impose larger transfers to reach the optimal solution directly, bypassing the markets. This is a possible explanation for government administered insurance, as documented by Chambers (1989).

Example 5 captures wealth risks and decreasing marginal utility crudely to make calculations trivial, but the insight is powerful: Private markets and risk-bearing contracts would not maintain the less-productive sector A. Redistributive transfers dictated by the government insure the sector and make it viable, and the insurability of the subsidized sector increases the aggregate social welfare relative to the equilibrium with private insurance markets.

In our paper, we have studied an instance of this social insurance: Redistributive transfers to a less productive sector with correlated income shocks. We have shown that sustaining the sector with transfers becomes a constrained efficient, second-best outcome. We have shown that even if private markets for risk-sharing exist, not only a benevolent government concerned with social welfare but also a politically motivated government concerned with winning elections would deviate from the competitive equilibrium to insure a less productive sector with redistributive, state-contingent transfers.

TESTABLE IMPLICATIONS

The main implication of our results is that we should observe a high correlation of incomes in sectors that receive transfers. The US data on household incomes in different sectors is in line with this implication: Incomes in agriculture, the textile industry, and the steel industry are more highly correlated than the average sector. We also discuss the possible link between factor specificity and redistributive transfers.

A higher correlation of incomes in a sector implies that we should observe less variance of income in our sample of households of the sector. It may be clear intuitively that this is

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[6] Trades and prices in the equilibrium of the Arrow–Debreu economy described above do not change when agents take into account the government transfer from B to A.

true, but it also follows from some simple calculations: Suppose $(X_1, \ldots X_n)$ is a sample from some population random variable X, with variance σ^2, and such that each pair X_i and X_j has correlation ρ. Then, using S^2 to denote the sample variance, it turns out that the expected sample variance is:

$$ES^2 = \left(\frac{n^2 - n + 2}{n^2}\right)(1 - \rho)\,\sigma^2$$

(we omit the trivial, but cumbersome, derivation). Thus there is a negative relation between correlation and dispersion around the sample mean. Our theory implies a smaller dispersion of incomes in the sectors that receive transfers.

We study household-income data from 1968 to 2003 in the United States.[7] We focus on three sectors, which the literature identifies as recipients of transfers (Hufbauer and Elliott, 1994): agriculture, textiles, and steel. We use the industrial classification of the 1950 Census Bureau, for which there are 146 sectors in the economy.[8]

We calculate the standard deviation of individual income for each sector and year, first deflating incomes by the average economy-wide income. The deflation makes data across years comparable, and attenuates aggregate shocks. We then compute the average, across years, standard deviation in the three sectors of interest. Table 1 presents the results, and the average economy-wide standard deviation.

The numbers in the table are consistent with our models' testable implication.

Are the deviations significantly lower than average? To compare the deviations of income in agriculture, textiles and steel to those in the other sectors in the economy, we order the sectors (after weighting them by size) according to their income deviations, and we find the percentiles at which agriculture, textile and steel locate in the resulting distribution. The numbers are in the second column of the table, and confirm that there is less dispersion in these three sectors than in most other

Table 1. Standard deviation of sectoral income.

Sector	Std. Dev.	Percentile
Agriculture	0.628	33
Textiles	0.537	7
Steel	0.509	3
Average sector	0.671	

[7] Current Population Survey data (Bureau of Labor Statistics), obtained from the Integrated Public Use Microdata Series provided by Minnesota Population Center at the University of Minnesota. Overall sample size is about 2.6 million observations; in Agriculture, for example, we have about 2500 on average per year. The data is available at http://dx.doi.org/10.156/100.00006056_supp.

[8] In the classification, our three sectors are "Agriculture," "Apparel and accessories," and "Blast furnaces, steel works and rolling mills."

other sectors.[9] The result is clearest for textiles and steel, for which less than 7% and 3%, respectively, of the sectors have smaller deviations.

We note that we would prefer to compare individual correlations in income to the more indirect method of comparing standard deviations. But the data needed for computing individual correlations is not in the public domain.

Our theory offers a second testable hypothesis, with regards to the use of specific factors of production in sectors that receive subsidies.

Factors of production specific to a sector are factors that are used predominantly in one sector, and cannot easily be relocated to another sector. Our theory implies – somewhat indirectly – that sectors with specific factors should be prone to receiving transfers. The implication is in line with some of the previous literature, such as Baldwin (1989), Brainard and Verdier (1994) or Alt *et al.* (1996), and with existing empirical evidence (Zahariadis, 2001).[10] But there is controversy about the relation between factor specificity and transfers: Acemoglu and Robinson (2001) argue that transfers are negatively related to specificity.

We find two possible links between our theory and the effect of factor specificity on the amount of sectoral transfers.

First, it is plausible that some specific factors also represent a large fraction of the incomes in their respective sectors. For example, skilled labor is often both specific, and an important line in the industry's cost structure. In that case, shocks to the sector (or to the factor) result in a high correlation of the incomes in the sector. Our theory then implies that the sector is expensive to buy out; hence, we should observe that sectors with specific factors receive transfers.

This first link is a direct consequence of the theory, under the additional assumption on the importance of the specific factors in a sector. Our second link is possibly valid more generally, but has a less direct relation to our theory: it focuses on the insurance value of the transfers to sectors who suffer asymmetric shocks, rather than to sectors with correlated income.

A sector which employs a specific factor is subject to income shocks caused by fluctuations in the productivity or cost of this factor. These shocks need not be correlated with the shocks to the productivity of the factors employed in other sectors. Thus, we expect a sector with specific factors to have income shocks that are less correlated with the general state of the economy than the income shocks of sectors which all rely in the same common factors of production. When a sector suffers an asymmetric shock that does not affect other sectors, the overall economy is in better conditions to afford transfers to the affected sector, while sectors whose shocks are correlated are in need of transfers precisely when the economy as a whole cannot afford them. As a result, sectors

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[9] If the reader is concerned about scale effects, we note that we get qualitatively the same results when we use the coefficient of variation instead of the standard deviation.

[10] Zahariadis (2001) studies 13 OECD countries and concludes that factor specificity has a significant positive effect on the amount of sectoral transfers. More indirectly, Alt *et al.* (1999), in a case-study of Norway, argues that specificity is positively related to the pressure for transfers.

with asymmetric shocks become more likely targets of redistributive transfers with an insurance purpose.

CONCLUSION

Redistributive policies, such as subsidies and tariffs, distort the incentives to locate resources efficiently in the most productive sectors of the economy. It is a well-known puzzle why governments fail to redistribute wealth using lump-sum transfers, which do not introduce such distortion.

We have provided a solution to this puzzle: State-dependent subsidies to a sector with high income correlation provide an insurance value to the members of the sector which is superior to the value of the expected transfer. To provide the same level of welfare with a lump-sum grant, the government would have to finance an additional compensation for members of cohesive groups.

We have also discussed the testable implications of this model. The most straightforward implication is that, in sectors that receive transfers, income correlation ought to be high. Again, we have presented some suggestive evidence that this is the case. A conclusive empirical study, fleshing out the testable implications of the different explanations of inefficient redistribution, is called for, but beyond the scope of this paper.

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