Judging Agricultural Policies:

A Framework for Understanding How We Have Done It in the Past and Suggestions as to How We Should Do It in the Future

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JUDGING AGRICULTURAL POLICIES:

A FRAMEWORK FOR UNDERSTANDING HOW WE HAVE DONE IT IN THE PAST AND SUGGESTIONS AS TO HOW WE SHOULD DO IT IN THE FUTURE

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JUDGING AGRICULTURAL POLICIES:
A FRAMEWORK FOR UNDERSTANDING HOW WE HAVE DONE IT IN THE PAST AND SUGGESTIONS AS TO HOW WE SHOULD DO IT IN THE FUTURE[1]

1 Introduction

A major purpose, if not the major purpose, of economic theory is to guide in policy analysis. In many senses, the ultimate goal of the entire economic discipline is to provide policy analysis and thereby to make policy recommendations. Abstract economic and econometric theory are simply tools by which to meet this ultimate goal. Since agricultural economics is mainly an applied science, agricultural policy analysts like Luther Tweeten find themselves at the end of a long line of economic research, recipients of the work of basic theorists, and responsible for applying the tools they have received in practical ways to provide direct policy analysis and recommendations. In short, it is the duty of agricultural policy economists to apply economic theory to *judge* (assess, compare, rank) agricultural policy.

Whenever researchers try to judge a policy they have to impose value judgments, and hence are conducting normative analysis. Since agricultural economics is mainly an applied science, normative (or welfare economic) analysis of agricultural policy has a long tradition (Griliches, 1958; Nerlove, 1958; Wallace, 1962) and is nowadays an essential part of the scientific output of our profession as well as of what we teach in agricultural policy courses and textbooks (Tweeten, 1989, 1992). Given this, the purposes of this paper are (i) to present a general framework of normative policy analysis with which it is possible to "unify" the forty years of literature which uses welfare economic tools to judge agricultural policy; and (ii) to provide a "big picture" of the developments of that literature which will aid us in providing insight into how normative agricultural policy analysis should be and will be conducted in the future.

In the next section the reader is invited to view agricultural policy analysis in three different "spaces": "policy instrument space," illustrating government's potential policy choices; the classical "quantity-price space," in which economists most commonly derive their welfare (surplus) measures; and "welfare outcome space," which illustrates all potential social states as well as the trade-offs between different social groups' well-being. We argue that when these "spaces" are kept in mind, it becomes obvious that the researcher conducting normative policy analysis faces three big challenges: (1) choosing a set of policies to be examined; (2) mapping from policy instrument space to welfare outcome space; and (3) applying value judgements that rank the welfare outcomes. Here, we concentrate our discussion on challenges (1) and (3).

Section 3 discusses how the literature has gone from examining a very small discrete set of simple policies to a much broader (often continuous) set of policies that combine policy instruments simultaneously. Section 4 reveals the importance of the Pareto criterion as a basic value judgment in normative agricultural policy analysis, used to explore the limits of how government can affect welfare. While the Pareto criterion allows judgment of the efficiency of a policy, it does not consider distributive equity. However, as discussed in section 5, given the importance of the objective of redistribution in agricultural policy, agricultural economists have often departed from the purely efficiency-oriented tradition in economics and have tried to incorporate equity considerations by either adding these criteria as constraints to the social welfare function (SWF), or directly incorporating these criteria in the functional form of the SWF. Finally, in section 6 we attempt to provide insight into the future of normative agricultural policy analysis.

2 Presentation and motivation of our framework

Traditional elements of normative analysis of agricultural policy can be illustrated by means of a comparison of the effects of two alternative policies: a target price/deficiency payments policy, and mandatory acreage control. As depicted in figure 1, the basic method is to use geometric areas behind supply and demand curves, i.e. consumer and producer surplus measures, to calculate the welfare impacts of different policies. In a closed economy without government intervention an equilibrium occurs at price P_E implying a consumer welfare level of $a + b + c + d + e$, and a producer welfare level of $g + h + k$. A target price P_T implies a consumer price of P_C, consumer welfare of $a + b + c + d + e + g + h + i$, producer welfare of $d + e + f + g + h + k$, taxpayer cost of $d + e + f + g + h + i + j$, and social cost (i.e., the negative of the sum of all groups' welfare changes) of j. Acreage control pivots the supply curve S upwards to S' from some point where the restriction on land becomes binding. Producers as well as consumers face a price P_A implying consumer welfare of a, producer welfare of $b + d + g + k$, and social cost of $c + e + h$.

Let us call figure 1, with "quantity" and "price" variables on its axes, an analysis in "quantity-price space." To better understand the developments and challenges of normative agricultural policy analysis, we propose to add two more spaces as illustrated by two more diagrams in figure 2. Assuming that the target price/deficiency payments and acreage control are the only policy instruments available to government, the left-hand panel in figure 2 illustrates the "policy instrument space." The acreage control policy instrument variable, stated in terms of percentage of acreage required diverted, is placed on the horizontal axis of the panel, and the target price variable, stated in \$/bushel, is on the vertical axis. Point *P* illustrates the nonintervention situation where government uses neither the acreage control nor the target price instrument.[2] Point *Q* depicts a target price of \$4 per bushel, and point *R* shows mandatory acreage control of 15%. Any policy available to government can be represented by a point in policy instrument space. Hence, the left-hand panel helps us to better understand government's available instrument choices.

The final goal of normative policy analysis is to obtain a social ordering of alternative policies. A commonly excepted assumption in normative policy analysis is welfarism (Sen, 1979), i.e. that the judgement of the social value of a policy should be based solely on its welfare effects on individuals (or perhaps groups). Hence, the natural space to depict the effects of a policy is the "welfare space." The right-hand panel of figure 2 illustrates the welfare effects of the policies depicted in the left-hand panel. For illustration purposes (but in line with the main body of the literature) we assume that society can be divided into two social groups: farmers and nonfarmers. The three different policies depicted in the left-hand panel by points *P*, *Q*, and *R* can be respectively mapped into points *p*, *q*, and *r* in the welfare space by utilizing the market diagram in the middle "quanity-price space" panel. For example, distance $0W_f^{noninterv.}$ in the right-hand panel corresponds to area $g + h + k$ in the middle panel, distance $0W_n^{noninterv.}$ to $a + b + c + d + e$, and so the nonintervention outcome shown at point $p = (0W_n^{noninterv.}, 0W_f^{noninterv.})$ in the right-hand panel corresponds to the nonintervention policy shown at point *P* in the left-hand panel.

Here, we explicitly and intentionally display all three spaces in our analysis. Presenting all three spaces makes obvious three main challenges of normative policy analysis: (1) choosing a set of policies to be examined; (2) mapping from policy instrument space to welfare outcome space; and (3) applying value judgements that rank the welfare outcomes.

In regard to challenge (1), the left-hand panel of figure 2 makes clear that the three examined policies depicted are only a very limited selection of the many possible policies that could be exhibited in the entirety of "policy space." In reality government can choose different levels of both instruments and use them separately or combine them. It is technically feasible (though not necessarily politically feasible) for government to set the acreage control variable anywhere between 0% and 100%. Similarly, it is technically feasible for government to set the a target price variable anywhere from 0 up to some very high level, call it *y'*, above which the economy does not have sufficient resources to pay farmers more for their product. Given these physical limitations on policy instrument choice (and the already mentioned assumption that only two instruments are available to government), the shaded area in the left-hand panel of figure 3 represents the set of technically feasible policies. Clearly, the set of technically feasible policies is much larger than simply points *P*, *Q*, and *R*.

Because points *P*, *Q*, and *R* in the left-hand panel of figure 2 present a very limited view of government's policy choices, points *p*, *q*, and *r* in the right-hand panel present also a very limited view of the policy outcomes government can achieve. If one calculated the welfare effects of every point in the shaded area in the left-hand panel of figure 3, one would derive the set of all technically feasible welfare outcomes (Bullock, 1995). This set might look like the shaded area in the right-hand panel of figure 3. Points *p*, *q*, and *r* are members of the set of technically feasible policy outcomes, but many other points make up that set, as well. Clearly, an analysis that only considered policies *P*, *Q*, and *R* by observing outcomes *p*, *q*, and *r* would be neglecting many feasible policies, which conceptually might lead to policy outcomes that might somehow be deemed "superior" to outcomes *p*, *q*, and *r*.

The second challenge is how to map points from policy instrument space into the welfare outcome space. As depicted by the middle panel of figure 2 one commonly used method is to assume some functional forms and parameter values for demand and supply curves and derive Marshallian welfare measures.[3] Speaking more generally and systematically, to derive welfare measures, it is necessary (i) to develop an appropriate model of the sector of the economy studied, (ii) to obtain appropriate estimates of the model's parameters, and (iii) to obtain appropriate welfare measures. Numerous advancements have been achieved in all of these three areas over the last forty years. Examples of efforts to address (i) are advances made in noncooperative game theory (see Sexton, 1994a, 1994b for a survey). Examples of efforts in (ii) are Deaton and Muellbauer's (1980) method of estimating demand systems rather than single equations, and Christensen, Jorgenson and Lau's (1971) more flexible descriptions of production technology. Examples of efforts to improve welfare estimation techniques (iii) have taken into account multi-market effects (Just and Hueth, 1979; Just, Hueth, and Schmitz, 1982; Thurman and Wohlgenant, 1989; Bullock, 1993; Thurman, 1993; Brännlund and Kriström, 1996), non-competitive market structure (Just, Schmitz, and Zilberman, 1979; Wong, 1989; McCorriston and Sheldon, 1994; Peterson and Connor, 1995), and the presence of risk and uncertainty (Just et al., 1977; Konandreas and Schmitz, 1978; Wright, 1979; Helms, 1985; Larson, 1988; Fraser, 1992).

Even if the policy analyst is able to observe all feasible policy choices and is able to map them into the welfare outcome space, figure 3 makes clear a third main challenge of normative policy analysis, which is to decide how to properly rank policy choices and outcomes. For example, part of this challenge might be to whether the welfare distribution *q* is socially more desirable than the welfare distribution *r*. Clearly, to rank policies and policy outcomes one must apply some sorts of value judgments. Agricultural policy analysts have employed various value judgment criteria to derive rankings of alternative policies. Presenting the welfare space enables us to compare these alternative welfaristic value judgments straightforwardly.

In what follows we concentrate on challenges (1) and (3). Utilizing policy instrument space and the welfare outcome space, in section 3 we will discuss how agricultural economists over the past forty years have explored the set of technically feasible welfare outcomes by filling in the set of examined policies in policy instrument space. Section 4 and section 5 will systematize the approaches used by agricultural economists to rank alternative policies by examining welfare outcome space.

3 Expanding the set of examined policies

3.1 Analyzing a few simple policies

Wallace (1962) as well as other early contributors to normative agricultural policy analysis including Nerlove (1958), Johnson (1965), Dardis (1967a, 1967b), and French-Davis (1968) pioneered the literature by introducing welfare economic tools to examine discrete sets of simple, single-instrument policies. Hence, they compared the welfare effects of only a very few of the many feasible policies available to government, and the policies they examined only employed one instrument at a time, with all other instruments being set at their "nonintervention" levels. In the left-hand panel of figure 3, such "simple" policies are represented by points like *P, Q, R, S,* and *T* on the vertical and horizontal "nonintervention" axes.

Starting with Josling (1969), Dardis and Dennison (1969), and Hushak (1971) agricultural economists also examined the welfare effects of combined agricultural policies, and hence points off the "nonintervention" axes of the policy instrument space, like *U* and *V* in figure 3.

3.2 Analyzing continuous sets of policies

Josling (1974) first recognized that by continuously changing the level of the instrument of a simple policy, a curve could be mapped in welfare space to provide a broader picture of government's opportunities and constraints when using a single policy instrument. Gardner (1983) expanded Josling's analysis, and actually derived such continuous sets of welfare outcomes calling them surplus transformation curves (STCs). Hence, instead of looking at only a few points in policy instrument space, Gardner examined the effects of continuous sets of simple policies like the thick line segments between *P* and *S* or between *P* and *T* in the left-hand panel of figure 3. Calculating the welfare effects of the continuous set of policies between *P* and *S* one derives a continuous set in policy outcome space, $STC_1^{acreage\ control}$ between *p* and *s*. Similarly, calculating the welfare effects of the continuous set of policies between *P* and *T* one derives $STC^{target\ price}$ between *p* and *t*. Hence, using the Josling-Gardner framework we get a more complete picture of how government is able to affect the welfare levels of the social groups analyzed.

Examples of studies using this framework to examine the welfare effects of single policy instruments are Thomson and Harvey (1981), Gardner (1985, 1987), Just (1985), Antle

(1991), Williams and Wright (1993, pp. 378 - 383), Isosaari (1993), Maier (1993a, pp. 126 - 143, pp. 216 – 225), Wright (1993), and Giannakas and Fulton (2000a).[4]

In the late 1980s and early 1990s, several researchers extended Gardner's (1983) approach to show how multiple STCs can be combined to study the welfare effects of combined policies (i.e., policies which employ more than one policy instrument) (Innes and Rausser, 1989; Alston and Hurd, 1990; Gardner, 1991, 1992; Bullock 1992; de Gorter, Nielson, and Rausser, 1992). Other studies using STCs for combined policies include Kola (1993), Salhofer (1993), Garcia and Lothe (1996), and Alston and James (forthcoming). Their procedure is illustrated in figure 3, where point *U* in the left-hand panel represents a combined policy, and point *u* in the right-hand panel shows its outcome. Because two policy instruments are used, the outcome of the combined policy can be found by tracing along two STCs. First, using the target price/deficiency payments instrument only we can change the policy from non-intervention point *P* to point *Q* in the left-hand panel which changes welfare from point *p* to point *q* along $STC^{\text{target price}}$ in the right-hand panel. Then, using the acreage control instrument only (but keeping the target price equal to the distance *PQ*), one can change the policy from point *Q* to point *U*, thus changing welfare from point *u* to point *v* along $STC_2^{\text{acreage control}}$.

Using the procedure discussed above, one can map any line segment from the policy instrument space into welfare space and hence get a more complete view of the trade-offs of alternative policies. Following the logic of the development of the literature, it becomes clear that, conceptually at least, we could map the whole set of technically feasible policies from the policy instrument space into the welfare outcome space to derive the whole set of technically feasible policy outcomes. Once having identified all of government's possibilities to affect the welfare of groups and society, the goal is to judge and rank alternative welfare outcomes. To be able to do this one must apply some sorts of value judgment criteria.

4. Finding Pareto efficient policies

A value judgement criterion commonly accepted among economists is the Pareto criterion. According to this value judgement criterion, a policy *A* is preferred (or Pareto superior) to a policy *B*, if *A* makes at least one person (or in this context group) better off than he or she is under *B*, while no one (group) is made worse off.[5] A policy is said to be Pareto efficient (or Pareto optimal) if no technically feasible policy implies a Pareto superior welfare outcome. Clearly, the "north-east" boundary of the set of technically feasible welfare outcomes in figure 3 represents the set outcomes of Pareto efficient policies, commonly called the Pareto frontier.

In the agricultural economics literature of the past fifteen years or so, the importance of the Pareto frontier as a limit to how government can affect welfare has been considered by several researchers in independent work. Just (1984, pp. 58, 130) and Alston and Hurd (1990) first derived a Pareto frontier for a very special case of two instruments: (i) a production quota and a (ii) target price/deficiency payments. As copied in the middle panel of figure 4, they show that a Pareto efficient combination of these two instruments is to fix the quota at the nonintervention output level and set the target price level according to the desired level of welfare transfer to farmers.[6] (For example if the desired welfare transfer is P_EP_Tab, one has to set the target price at P_T) Hence, in this case the set of Pareto efficient policies is point *P* plus the line segment *QR*. This set of Pareto efficient policies maps to the Pareto frontier, which in this case is a straight 45° line from the nonintervention point *p* to point *r* in welfare outcome space.[7] Because, the Pareto efficient combination of these two policy instruments is relatively straight forward in a sense that one instrument is fixed at a certain level while only the other instrument is varied, Just (1984) and Alston and Hurd (1990) where able to derive this Pareto frontier based on graphical analysis only. However, in most other cases the set of Pareto efficient policies is not a straight line parallel to one of the axes, but perhaps may look more like point *P* plus curve *ST* in the left-hand panel of figure 5, which implies a non-linear

Pareto frontier like *pt* in the right-hand panel. In such a case, the points on the Pareto frontier and can only be derived with some mathematical optimization procedure.[8]

To derive Pareto efficient policy instrument combinations and/or Pareto frontiers researchers have utilized two different approaches: (i) to find the highest possible welfare of one group while holding the other group's welfare constant; and (ii) to find the highest possible value of a (weighted) SWF.

Utilizing approach (i) Alston, Carter, and Smith (1993) showed that points on the Pareto frontier can be derived by maximizing the welfare of nonfarmers given some predetermined welfare level of farmers. (Equivalently, one could minimize the cost to nonfarmers given some determined welfare transfer to farmers.). As the authors note (footnote 7, p. 1002), their approach may be thought of as a procedure for defining an "efficient surplus transformation curve" (a Pareto frontier) for a given set of available policy instruments. This method can be explained with reference to figure 5. First, the welfare of farmers is fixed at some level W_f' while looking for the combination of policy instruments that ensures a welfare for nonfarmers which lies as far as possible to the right. The maximized nonfarmers' welfare level is shown as W_n', and the point $u = (W_n', W_f')$ is on the Pareto frontier. By changing the fixed value of farmers' welfare in the maximization problem's constraint from W_f' to other levels, the entire Pareto frontier *pt* as well as the set of Pareto efficient policy instrument combinations P plus *ST* can be calculated and traced out.[9]

Bullock (1991, 1996) developed a technique for finding Pareto efficient policies and policy outcomes for the general *m*-policy instrument, *n*-social group model. Bullock (1991) proved formally that a policy is Pareto efficient if and only if it solves simultaneously *n* constrained maximization problems. As proved by Bullock, Salhofer and Kola (1999), Bullock's (1991, 1996) method of solving *n* constrained maximization problems simultaneously is equivalent to the simpler method proposed by Alston, Carter, Smith (1993) of solving a single constrained maximization problem only if the solution to their problem is unique, and therefore corresponds to a well behaved set of feasible welfare outcomes.

Gallagher (1988), Maier (1993b), Salhofer (1993, 1997), Moschini and Sckokai (1994), Bullock and Salhofer (1998a), Swinnen and de Gorter (1998), and Giannakas and Fulton (2000b) use techniques similar to Alston, Carter and Smith's (1993) and Bullock's (1991, 1996) to derive theoretical or empirical optimal combinations of two or more policy instruments and hence points on Pareto frontiers. Bullock (1994, 1996), Bullock and Salhofer (1995), and Salhofer (1995, 1996) actually derive Pareto frontiers.

An alternative method used to derive Pareto efficient policies is to maximize a weighted utilitarian (i.e., linear) social welfare function.[10] Given some weights to farmers and nonfarmers, a Pareto efficient policy outcome like *u* (and the corresponding Pareto efficient policy *U*) in figure 5 are derived where the marginal rate of substitution (the slope of the corresponding social indifference curve (SIC)) equals the marginal rate of transformation (the slope of the set of feasible welfare outcomes).

Gardner (1987, pp. 231 – 233; 1991, 1992) circumvented the implied optimization procedure by calculating a great number of instrument combinations to find the one with the highest possible value to the SWF.

Gardner (1988, 1995), Innes and Rausser (1989) , Innes (1990a), McCorriston and Sheldon (1991), de Gorter, Nielson and Rausser (1992), Guyomard and Mahé (1994), Alston and Spriggs (1998), Swinnen and de Gorter (1998), Alston et al. (1999), and Giannakas and Fulton (2000a) derive theoretical or empirical points on Pareto frontiers of two or more instruments by actually solving an optimization problem. So far, no whole Pareto frontier and/or set of Pareto efficient policies has been calculated utilizing this technique. However, Yaron and Ratner (1990) discussed in the context of a water allocation problem how one can obtain the whole Pareto frontier by parametrically varying the weights of the SWF.

5 Considering distributive equity

While the Pareto criterion allows judgment of the efficiency of a policy, it does not consider distributive equity. All points on the Pareto frontier are efficient and hence Pareto incomparable to each other (like many other points within the set of feasible welfare outcomes). To find the "most efficient" policy (or to be able to rank certain Pareto incomparable points within the set of feasible welfare outcomes) one has to apply some value judgments about distributive equity.

A complete ranking of all feasible welfare outcomes is provided by a Bergson-Samuelson social welfare function (SWF), which in our simple two social group case is $W = W(W_n, W_f)$. Every SWF implicitly contains value judgments (in addition to the Pareto criterion, as long as it is nondecreasing in its arguments) about distributive equity.

In applied normative economic analysis the most common specific functional form of a SWF and hence the most common value judgement criterion used to derive a complete ranking of welfare outcomes and/or the socially optimal policy is a "utilitarian" (or "Benthamite") SWF. In our illustrative example of two social groups the utilitarian SWF is $W = W_n + W_f$. A policy *A* is socially preferred to a policy *B* if its welfare outcome lies on a higher social indifference curve (SIC, a contour of the SWF), which in the case of a utilitarian SWF are 45° lines. The optimal policy lies on the highest obtainable SIC. Equivalent to using a utilitarian SWF, the same ranking may be derived by the lowest social cost (or deadweight loss) $SC = -(DW_f + DW_{fn})$ criterion. Both criterion are either based on the assumption that increasing the welfare of a wealthy person by one unit is of equal social value to increasing the welfare of a poor person by one unit, or that any desired welfare distribution can be achieved by costless lump-sum transfers.

Though the Benthamite SWF and the SC criteria are commonly used in agricultural economics (e.g. Otsuka and Hayami, 1985; Lichtenberg and Zilberman, 1986; Leu, Schmitz and Knutson, 1987; Murphy, Furtan and Schmitz, 1993), they have also been criticized by many noted agricultural economists over a long period (e.g. Nerlove, 1958, p. 223; Josling, 1974, p. 242; Rausser, 1982; Gardner, 1983; Just, 1984, pp. 17-19). The quintessence of this critique is that given that lump-sum transfers are not possible in reality and that the main objective of many agricultural policies is to redistribute welfare to farmers, one has to take this objective into account when judging a policy. Given this, agricultural economists have often departed from the traditional utilitarian value judgement criterion, and have tried to incorporate equity considerations into their normative analysis. While at a glance it may seem that many different methods have been used to consider distributive equity, we are able to categorize them into three different formulations of the objective function: (I) a utilitarian SWF with a predetermined welfare level for farmers or nonfarmers; (II) a utilitarian SWF with a predetermined welfare ratio between farmers and nonfarmers (or, equivalently, a Leontief-type SWF); and (III) a weighted linear SWF.

5.1 A utilitarian SWF with a predetermined welfare level to one of the two social groups

According to this approach a policy *A* is preferred to a policy *B* if it leads to a higher social welfare level, given some predetermined welfare level for one of the two social groups. Within this approach two subdivisions corresponding to two different views of government (society) objectives can be identified. In accordance with Hueth (2000) we will call them: (i) the income-support objective; and (ii) the income-transfer objective.

According to the income-support objective, government's objective is to ensure, at least cost, a predetermined level of welfare for farmers. Practically, researchers following this approach have either maximized the welfare of nonfarmers given some predetermined welfare level of farmers or minimized the cost to nonfarmers given some predetermined transfer to farmers. Examples of studies using this view of the government objective are Josling (1974), Gallagher (1988), de Gorter and Meilke (1989), Alston and Hurd (1990), Alston, Carter and Smith (1993), Gisser (1993), Maier (1993b), Salhofer (1995, 1996, 1997), Blandford and Dewbre

(1994), Moschini and Sckokai (1994), Bullock and Salhofer (1995, 1998a), OECD (1995), Alston and Gray (1998), Swinnen and de Gorter (1998), and Giannakas and Fulton (2000b).

Figure 6 illustrates the income-support objective criterion: Suppose that the actually observed welfare outcome is $r = (W_n', W_f')$. Suppose further that the actually observed welfare of farmers is assumed to be the socially desired (exogenously given) one. According to this value judgment criterion, welfare outcome *s* is socially preferable to *r* and the optimal welfare distribution is *t*.

Next, assume governments agricultural policy objective is to transfer as much welfare to farmers as possible given some predetermined (socially acceptable) cost. Practically, it is to maximize farmers' welfare given some welfare level of nonfarmers. This was first discussed in Josling (1974) and applied in Bullock and Salhofer (1995, 1998a).

Figure 6 again illustrates the income-transfer objective criterion: Suppose again that the actually observed welfare outcome is $r = (W_n', W_f')$ and that the actually observed welfare of nonfarmers is the socially desired (exogenous given) one. According to this value judgment criterion welfare outcome *u* is socially preferable to *r* and welfare distribution *v* is optimal.

5.2 A utilitarian SWF with a predetermined welfare ratio between farmers and nonfarmers

According to this approach a policy *A* is preferred to a policy *B* if it leads to a higher social welfare given some predetermined ratio between farmers and nonfarmers. Josling (1974) as well as Gardner (1983, pp. 228-229) recommended and Just (1984) applied this value judgement criterion. Assuming again that the actually observed welfare ratio between farmers and nonfarmers is the socially desired one, welfare outcome *w* in figure 6 is optimal.

Just (1984) showed that this value judgment criterion can also be represented by a SWF with right-angled social indifference curves (SICs). Such a SWF can be expressed by a Leontief-type SWF $W = min\ (\theta_f W_f, \theta_n W_n)$ where the welfare distribution ratio is given by θ_f/θ_n. If $\theta_f/\theta_n = 1$ this value judgment criterion is equal to the Rawlsian maximin criterion (Tuomala, 1990).

5.3 A weighted linear SWF

According to the weighted linear SWF approach, a policy *A* is preferred to a policy *B* if it leads to a higher social welfare level, defined as $W = \phi_f W_f + \phi_n W_n$ with $\phi_f > \phi_n$. Just (1984), Paarlberg (1984), Gardner (1985, 1988, 1991, 1992, 1995), Innes and Rausser (1989), Innes (1990a, 1990b), Chambers (1992), de Gorter, Nielson, and Rausser (1992), Alston and Spriggs (1998), Swinnen and de Gorter (1998), Alston et al (1999), and Giannakas and Fulton (2000a) judged policies using this value judgment criterion.

In figure 6 this value judgment criterion is illustrated by linear SICs with slopes less than 45°. According to this value judgment criterion the optimal welfare outcome would for example be in point *x*.

6. Outlook

Again, researchers conducting normative policy analysis face three important challenges: (1) choosing a set of policies to be examined; (2) mapping from policy instrument space to welfare outcome space; and (3) applying value judgements that rank the welfare outcomes.

As demonstrated above, substantial developments have taken place in regard to the first challenge. The literature's gradual expansion of the set of examined policies has led to a corresponding gradual expansion of the examined feasible set of welfare outcomes, from welfare outcomes of a few specific policies, to Josling-Gardner surplus transformation curves, to Pareto frontiers. Given recent advances in computer hardware and software it is no longer a problem in empirical work to calculate the welfare effects of a great number of alternative combinations of several instruments or to calculate Pareto efficient combinations of more than two instruments (e.g. Salhofer 1997). However, while for the (very commonly used) simple case of two social groups (farmers and nonfarmers) presented here, a graphical illustration of a feasible welfare outcome set or a Pareto curve is possible and useful, it is now also important to consider how to obtain and present meaningful welfare measures and outcomes for the case of more than two social groups. Or to put it differently, now that we are able to create a great amount of information very cheaply, it is time to think about how to make use of it.

Another way the advances in computational power are already used and will be used even more in the future is in regard to challenge (2). In mapping from policy instrument space to welfare outcome space researchers have to deal with many uncertainties including functional forms, parameter values, market structure and so forth. Given this, the welfare outcome implied by each policy is only known with some uncertainty. Very recently, computer-intensive methods have been introduced in the agricultural economics literature to obtain a fuller picture of the statistical properties of welfare measurements based either on bootstrapping (Efron, 1979; Freedman and Peters, 1984; Dorfman, Kling and Sexton, 1990; Kling and Sexton, 1990), Monte Carlo simulations (Krinsky and Robb, 1986, 1990, 1991; Adamowicz, Fletcher and Graham-Tomasi, 1989; Adamowicz, Graham-Tomasi and Fletcher, 1989) or Baysian inference (Zhao, Griffiths, Griffith and Mullen, 2000).[11] Recent applications of these methods in the field of agricultural policy analysis include Tremblay and Tremblay (1995), Jeong, Bullock and Garcia (1999), Jeong, Garcia and Bullock (forthcoming) (bootstrapping), Alston, Chalfant and Piggott (1998, 2000) (Monte Carlo simulation), Davis and Espinoza (1998), Griffiths and Zhao (1999), Zhao, Griffiths, Griffith and Mullen (2000), Salhofer, Schneider and Streicher (1999), and Sinabell, Salhofer and Hofreither (1999) (Baysian inference).

In regard to the third identified challenge of normative agricultural policy analysis, the most important development is that agricultural economists have often departed from the traditional utilitarian value judgement criterion of minimizing social costs, and have tried to incorporate equity considerations. However, given the applied nature of agricultural policy research, those equity considerations have been incorporated in very simple ways, either by a weighted linear SWF or by placing constraints on the minimizing social cost criterion, but always with some emphasis on farm income. Commonly, society is divided into two groups: farmers and nonfarmers. In addition some researchers divide nonfarmers into consumers and taxpayers. The appropriateness of this practice must be judged while considerating other observations. First, according to Tweeten (2000) only very small farms exhibit considerable less wealth than average U.S households. Second, Tweeten and Zulauf (1997) pointed out that the "marginal income utility does not differ significantly among farm, rural nonfarm, and urban residents" of the same income class. Third, Blue and Tweeten (1997) find that a typical U.S. low income family derives 50% more utility from an additional dollar of income than does a family with average income. Given this, it seems necessary to rethink our ways of incorporating equity considerations in normative policy analysis. First attempts to account for different income classes within the farm group are in Chambers (1985) and Hueth (2000). Another interesting starting point from which to refine our government's objective function is the Chavas (1994) article on fairness.

Finally, though income redistribution is still the most important practical goal of agricultural policy, we also observe increasing importance of other objectives, for example environmental quality. In general, as long as one accepts the basic value judgement criterion of welfarism, the theoretical normative analyses of traditional agricultural policies and environmental and resource policies lie on the same foundations. From a normative point of view both should be introduced if they improve the social state, where the measure of such improvement is a function of the welfare of all individuals. The effects of any such policies are usually best discussed in reference to welfare outcome space (Antle, 1990; Gardner, 1991). Unfortunately, since environmental quality is a public good not usually traded in markets, mapping environmental policy into welfare outcome space is often a good deal trickier than is mapping commodity policy into welfare outcome space. Nevertheless, the theoretical advantages of discussing the effects of policy by examining welfare outcome space hold for the study of environmental policy just as well as they hold for the study of commodity policy.

Footnotes:

[1] Many of the ideas presented here are also discussed in a formal (mathematical) and general way in Bullock, Kola and Salhofer (1999). Here we elaborate upon these ideas and attempt to make them more easily accessible by using a more graphical presentation.

[2] Since producers receive the maximum of the target price and the market price, setting the target price to zero effectively precludes government intervention.

[3] Though there exist other techniques for obtaining welfare measures (see, for example, Chipman and Moore, 1980; McKenzie, 1983; Cornes, 1992; Martin and Alston, 1994, Slesnick, 1998), using geometric areas behind demand and supply curves is still most common among agricultural economists (Alston and Larson, 1993).

[4] Norton, Pardey and Alston (1992), and Beach and Fernandez-Cornejo (1994) adopt the STC framework to illustrate the trade-off between efficiency and equity in the context of research policy.

[5] Defining the Pareto criterion for groups rather than individuals of course requires some strong assumptions about preferences and endowments of the individuals condensed within a group, but is nevertheless common practice in applied work.

[6] Assuming that government can raise revenue without distorting other markets, setting the quota in the agricultural market at the nonintervention production level enables government to raise the target price above the nonintervention price level, yet not attract extra resources into the agricultural sector. (It is this attraction of resources from other sectors in which they were more efficiently used that creates social cost.)

[7] The Pareto frontier in this particular case is a 45° line because there is no social cost to welfare redistribution - every dollar taken from nonfarmers provides a full dollar to farmers, as discussed in the previous footnote.

[8] Note that the nonintervention point *p* is not necessarily on the Pareto frontier, but may lie southwest of it as in the case of a large country or the presence of externalities.

[9] Bullock (1994, 1996) noted how the envelope theorem implies that the Pareto frontier envelopes all Josling-Gardner STCs, and how at points along the Pareto frontier all STCs are tangent to a common hyperplane. From this finding one can deduce that an optimal combination of *m* instruments is always at least as desirable as a policy using only a subset of those *m* instruments. This result, is stated in Rausser and de Gorter (1991), and Maier (1993b), proved for two specific instruments in Just (1984), and Gardner (1988), and proved for the general case of *m* instruments in Bullock and Salhofer (1998b).

[10] In the context of Walrasian equilibrium theory, Varian (1992, pp. 333-334) shows a proof that maximizing a social welfare function leads to Pareto efficiency, and that Pareto efficient allocations maximize a linear social welfare function for some choice of welfare weights, given concavity assumptions about individuals' utility functions.

[11] See Bullock, Salhofer and Kola (1999), Abler (2000), and Salhofer (2000) for a broader discussion on sampling procedures.

The traditional approach to get statistical welfare measures are linear approximations based on Taylor series expansion (Kealy and Bishop, 1986; Bockstael and Strand, 1987).

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Figure 1: Effects of target price/deficieny payments and acraege control in price-quantity space

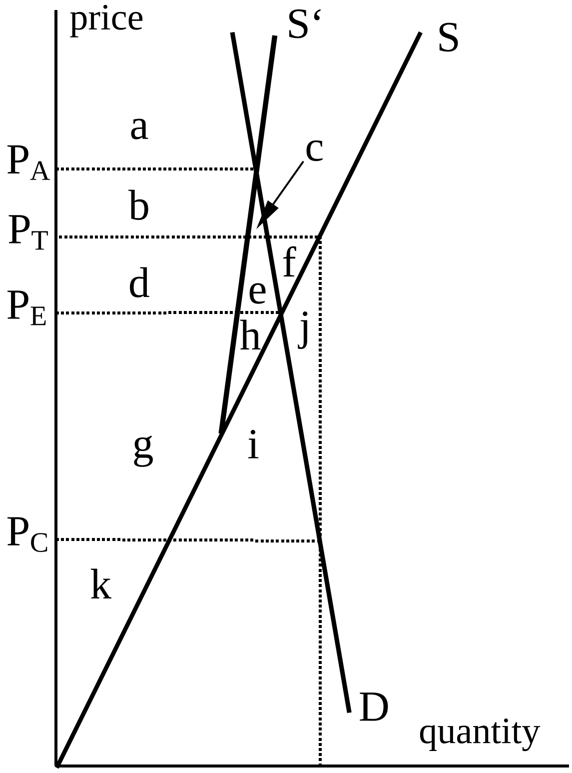


Figure 2: Three space of normative agricultural policy analysis

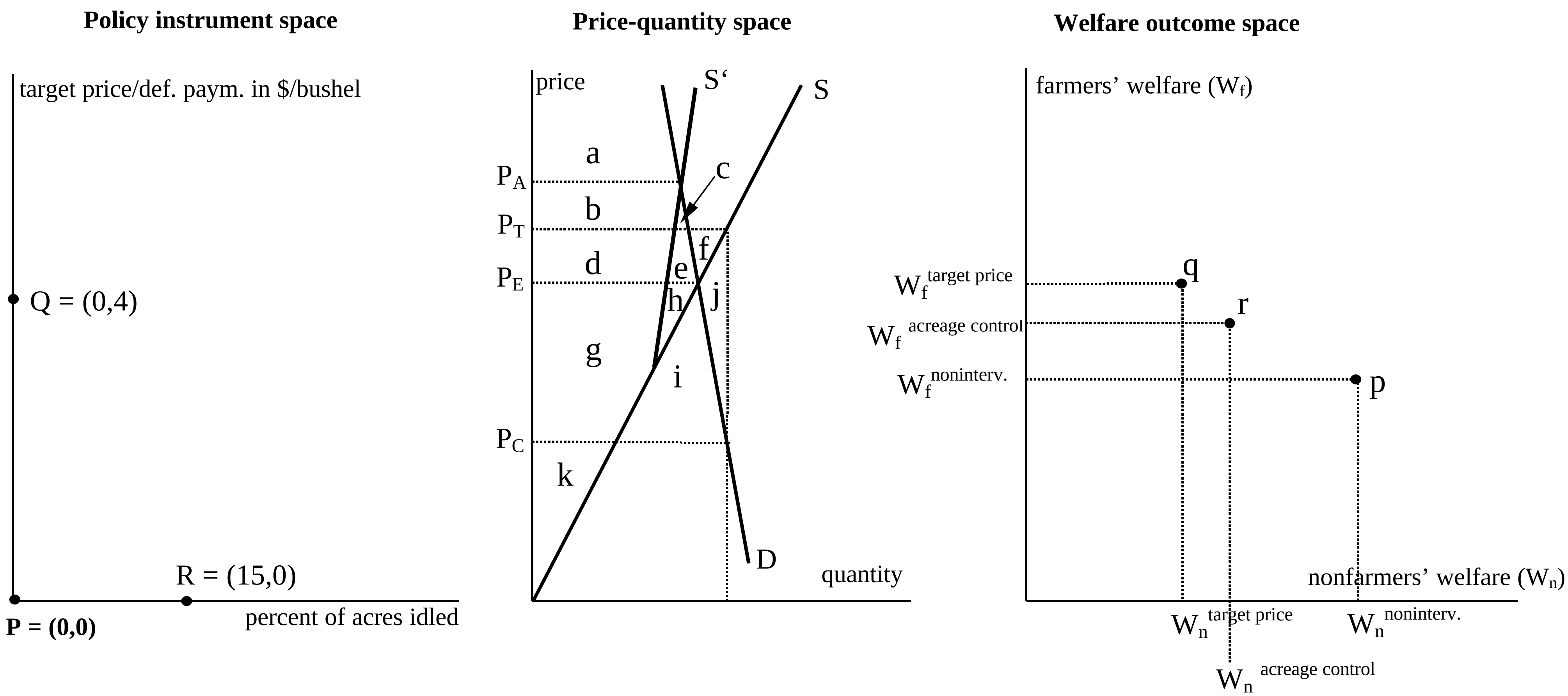
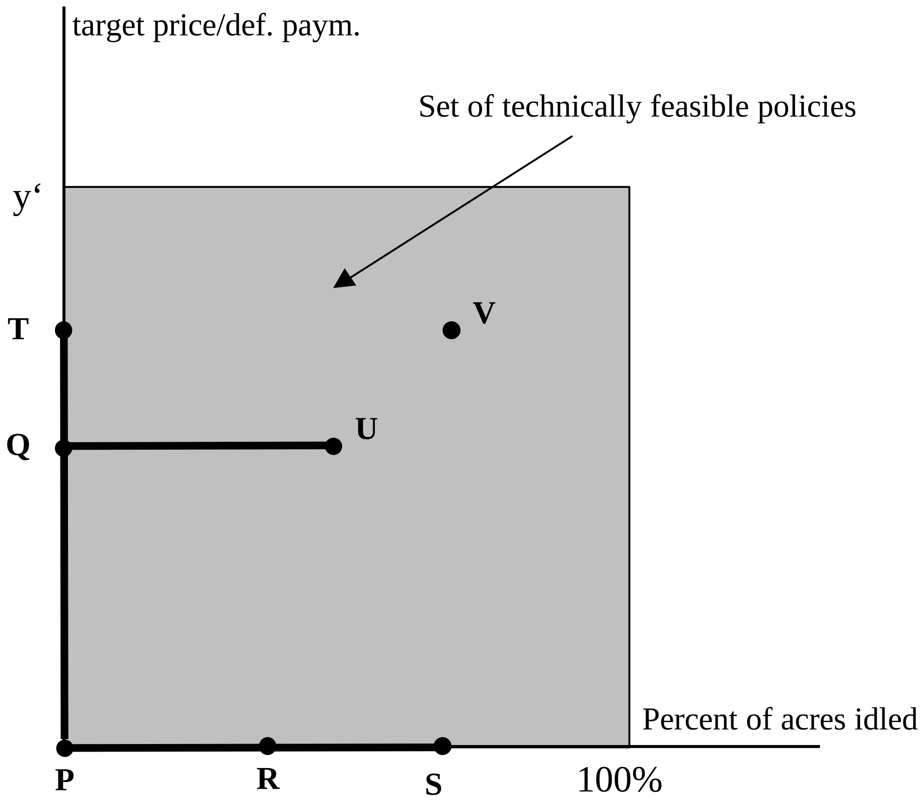


Figure 3: Set of technically feasible policies and welfare outcomes

Policy instrument space



Welfare outcome space

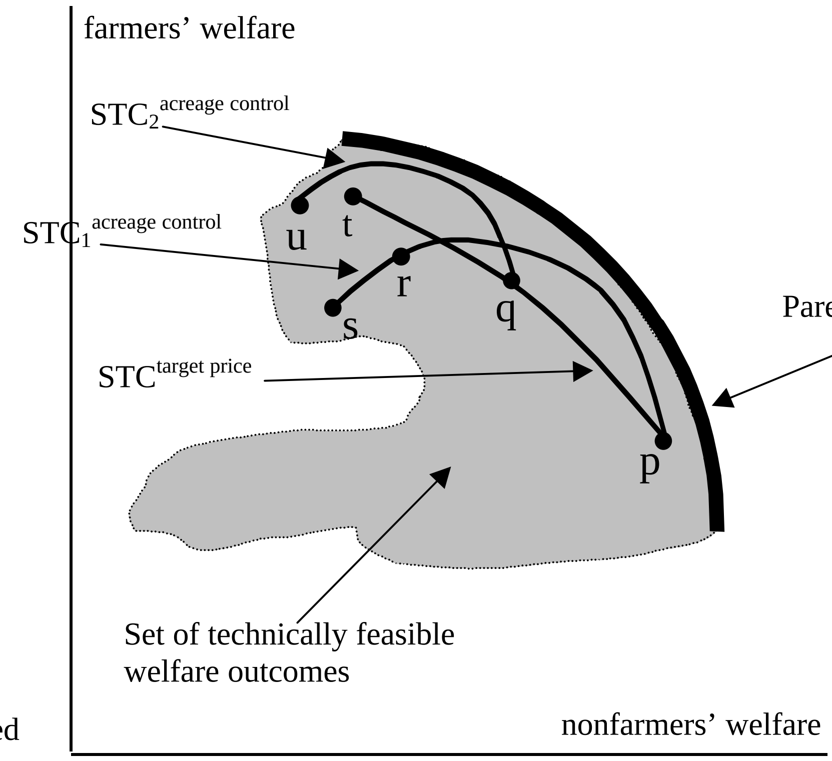


Figure 4: Optimal combination of target price/deficiency payments and production control

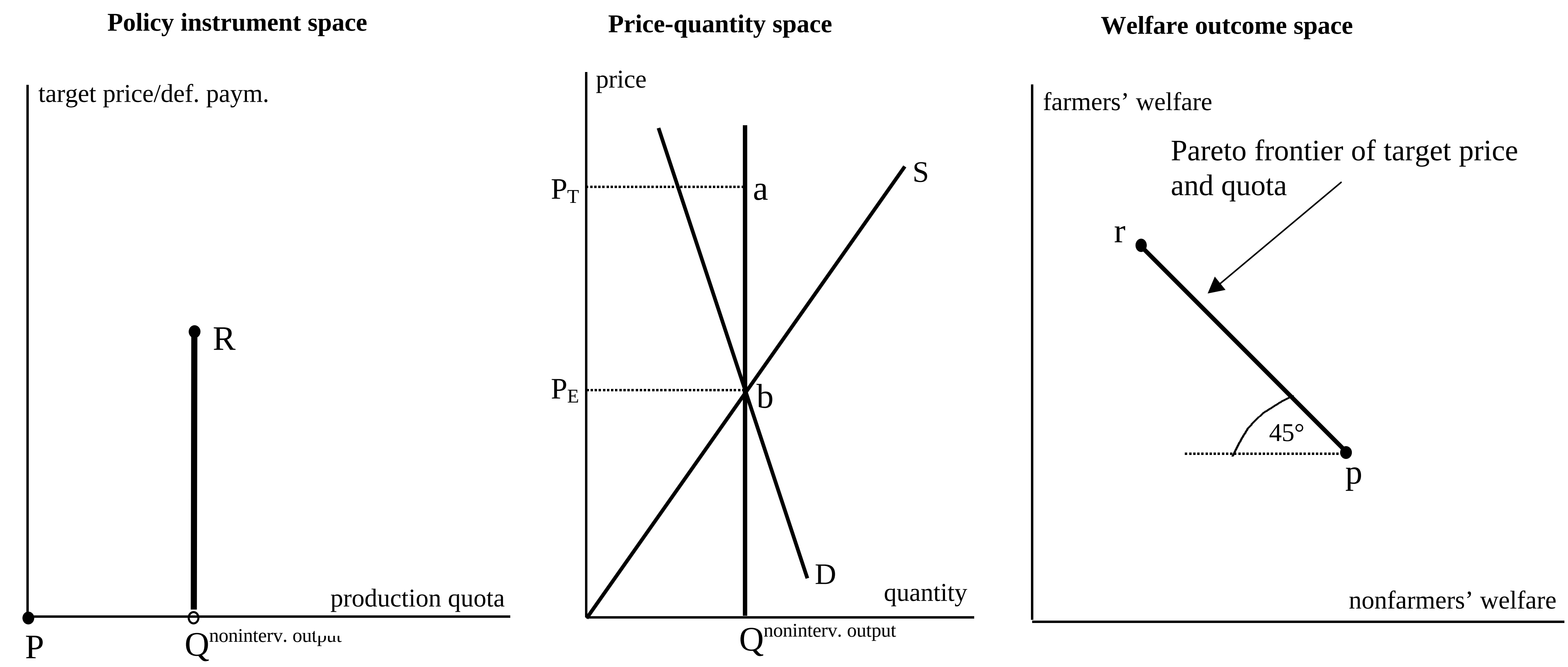
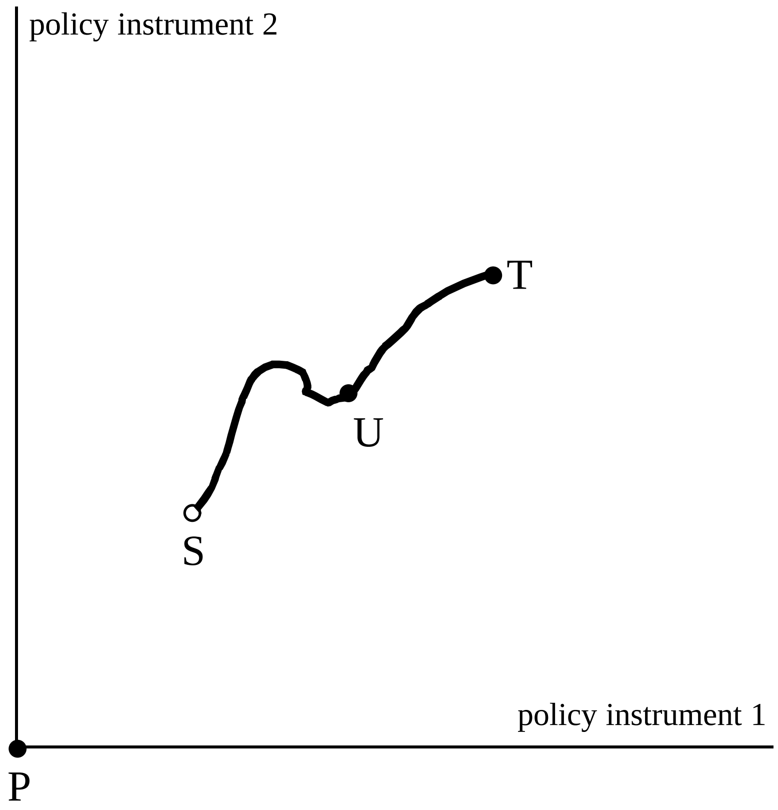


Figure 5: Optimal combination of two policy instruments

Policy instrument space



Welfare outcome space

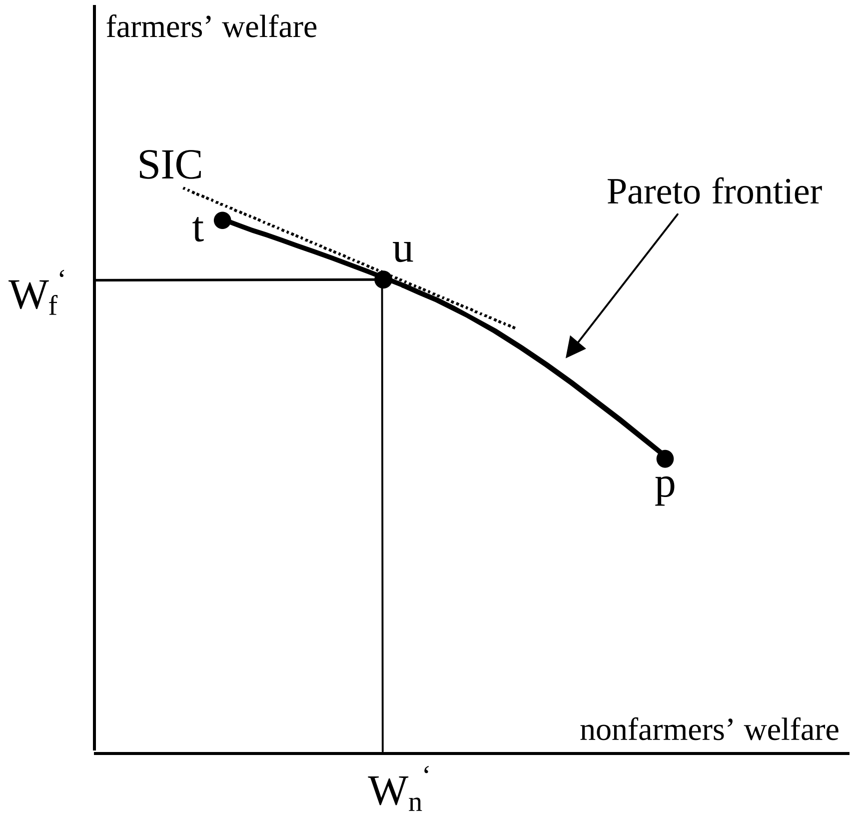


Figure 6: How agricultural economists considered distributive equity