AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Available online at www.sciencedirect.com
SCIENCE DIRECT®
Agricultural Economics 28 (2003) 225–243
AGRICULTURAL ECONOMICS
www.elsevier.com/locate/agecon

Judging agricultural policies: a survey

David S. Bullock [a,*], Klaus Salhofer [b]

[a] *Department of Agricultural and Consumer Economics, University of Illinois, 326 Mumford Hall, 1301 W. Gregory Drive, Urbana, IL 61801, USA*

[b] *Faculty of Economic Sciences, Technical University of Munich, Alte Akademie 14, 85350 Freising, Weihenstephan, Germany*

Received 29 May 2001; received in revised form 11 April 2002; accepted 22 July 2002

Abstract

This survey provides a structured picture of 40 years of literature which uses welfare economic tools to judge agricultural policy. Challenges and developments of normative agricultural policy analysis are discussed in an easily accessible graphical framework. It is shown 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. The importance of the Pareto criterion, used to explore the limits of how government can affect welfare, is revealed. Moreover, given the importance of the objective of income redistribution in agricultural policy, agricultural economists have often departed from the purely efficiency-oriented tradition in economics. It is shown that they have tried to incorporate equity considerations by either adding these criteria as constraints to the social welfare function, or directly incorporating these criteria in the functional form of the social welfare function.
© 2003 Elsevier Science B.V. All rights reserved.

JEL classification: Q18; D61; D63

Keywords: Agricultural policy analysis; Review; Welfare economics

1. Introduction

Since agricultural economics is mainly an applied science, judging (assessing, comparing, or ranking) agricultural programs has a long tradition (Griliches, 1958; Nerlove, 1958; Wallace, 1962), and nowadays is an essential part of our profession's research and teaching. Whenever researchers try to measure the social costs of a program or compare the efficiencies of alternative programs, they must impose value judgement criteria, and hence, are conducting normative (or welfare economic) analysis. The purposes of this paper are (i) to present a general graphical framework of normative policy analysis with which it is possible to 'unify' the 40 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. While some of the ideas presented here are treated in a more general; and hence, analytical way in Bullock et al. (1999), the present study significantly contributes to understanding the developments and challenges of normative agricultural policy analysis in making these ideas more easily accessible by graphical presentation.

In the next section, the reader is invited to view agricultural policy analysis in three different 'spaces':

* Corresponding author. Tel.: +1-217-333-5510; fax: +1-217-333-5538.
E-mail address: dsbulloc@uiuc.edu (D.S. Bullock).

0169-5150/03/$ – see front matter © 2003 Elsevier Science B.V. All rights reserved.
doi:10.1016/S0169-5150(03)00002-1

'policy instrument space', illustrating government's potential policy choices; the classical 'price–quantity 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).

After we introduce three policy analysis 'spaces' in Section 2, in Section 3 we discuss 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 judgement in normative agricultural policy analysis, used to explore the limits of how government can affect welfare. While the Pareto criterion allows judgement 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 income redistribution in agricultural policy, agricultural economists have often departed from the purely efficiency-oriented tradition in economics. Instead, they 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. Three spaces of normative agricultural policy analysis

Traditional elements of normative analysis of agricultural policy can be illustrated by comparing the effects of two alternative policies: a target price/deficiency payments policy, and a mandatory set-aside (acreage control) policy. As depicted in Fig. 1, the most common 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, where demand is depicted by line D and supply by line S, an equilibrium occurs at price P_E implying a consumer welfare level represented by area $a+b+c+d$, and a producer welfare level of $e+f+g$. A target price P_T implies a consumer price of P_C, deficiency payments per unit of $P_T - P_C$, consumer welfare represented by area $a+b+c+d+e+f+h$, producer welfare of $b+c+d+e+f+g+i+j$, taxpayer costs of $b+c+d+e+f+h+i+j+k$, and social costs (i.e. the sum of all groups' welfare changes) of k.[1] 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 $a+b$, producer welfare of $c+e+g$, and social cost of $d+f$.

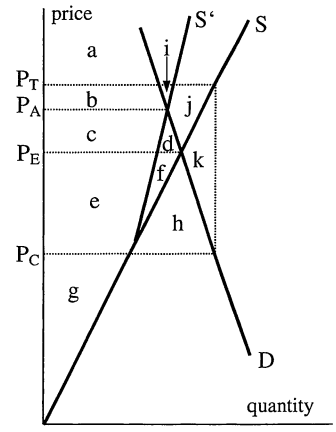

Fig. 1. Effects of target price/deficiency payments and acreage control in price–quantity space.

Let us call Fig. 1, with 'quantity' and 'price' variables on its axes, an analysis in 'price–quantity space'. To better understand the developments and challenges of normative agricultural policy analysis, we propose to add two more spaces as illustrated in Fig. 2. Assuming that the target price/deficiency payments and acreage control are the only policy instruments available to government, the left-hand panel in Fig. 2 illustrates the 'policy instrument space'. The acreage

[1] The sum of all groups' welfare changes is $-k$, but social costs are k, since the term 'costs' already indicates a negative value. The same is true for taxpayer costs.

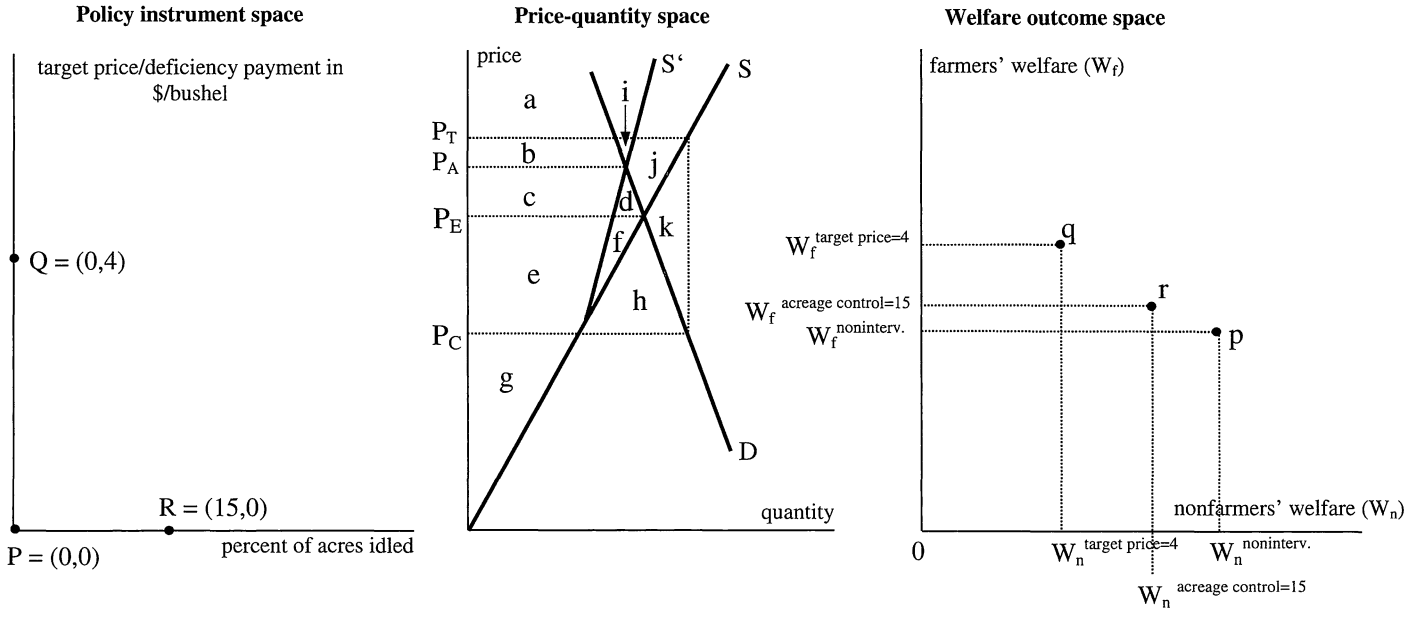

Fig. 2. Three spaces of normative agricultural policy analysis.

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 US$/bushel, is on the vertical axis. Point P illustrates the non-intervention situation where government uses neither the acreage control nor the target price instrument.[2] Point Q depicts a target price of US$ 4/bushel, and point R shows mandatory set-aside 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 Fig. 2 illustrates the welfare effects of the policies depicted in the left-hand panel. For illustrative purposes (but in line with the main body of the literature) we assume that society can be divided into two social groups: farmers and non-farmers. The three different policies depicted in the left-hand panel by points P, Q and R can be respectively mapped onto points p, q and r in the welfare space by utilising the market diagram in the 'price–quantity space' panel. For example, distance $0W_{\mathrm{f}}^{\mathrm{noninterv.}}$ in the right-hand panel corresponds to area $e + f + g$ in the middle panel, distance $0W_{\mathrm{n}}^{\mathrm{noninterv.}}$ to $a + b + c + d$, and so the non-intervention outcome shown at point $p = (0W_{\mathrm{n}}^{\mathrm{noninter.}}, 0W_{\mathrm{f}}^{\mathrm{noninter.}})$ in the right-hand panel corresponds to the non-intervention 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 Fig. 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 the '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% (see Fig. 3). Similarly, it is technically feasible for government to set the 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 Fig. 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 in Fig. 2.

Because points P, Q and R in the left-hand panel of Fig. 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 Fig. 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 Fig. 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 Fig. 2, one commonly used method is to assume some functional forms and parameter values for demand and supply

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

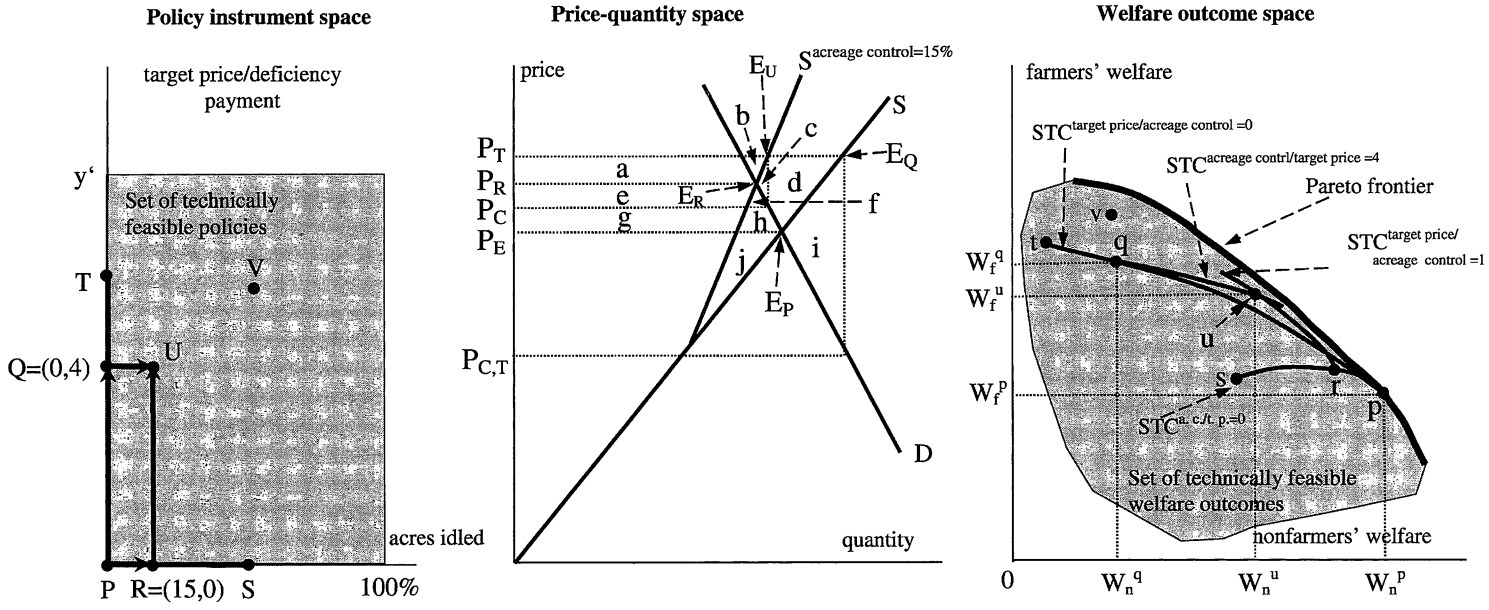

Fig. 3. Set of technically feasible policies and welfare outcomes.

curves and derive Marshallian welfare measures.[3] 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 advances have been made in all of these three areas over the last 40 years. Examples of efforts to address (i) are advances made in non-co-operative game theory (see Sexton, 1994a,b 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 et al.'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 et al., 1982; Thurman and Wohlgenant, 1989; Bullock, 1993; Thurman, 1993; Brännlund and Kriström, 1996), non-competitive market structure (Just et al., 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). These days, much applied welfare analysis is conducted using Computable General Equilibrium models (see Hertel and Tsigas, 1991; Hertel, 1998; Weyerbrock, 1998; Blake et al., 1999; Philippidis and Hubbard, 2001; van Tongren et al., 2001; Warr, 2001). One advantage of CGE models is that since they are built by assuming consumer preference relations directly, expenditure functions are 'built in', and equivalent variation can be measured directly. Of course, the reliability of any measure of equivalent variation due to a policy change depends on the appropriateness of the underlying assumptions about consumer preferences.

Even if the policy analyst is able to observe all feasible policy choices and to map them into the welfare outcome space, Fig. 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 outcome q is socially more desirable than the welfare outcome r. Clearly, to rank policies and policy outcomes one must apply value judgements. Agricultural policy analysts have employed various value judgement criteria to derive rankings of alternative policies. Presenting the welfare space enables us to compare these alternative welfaristic value judgements straightforwardly.

In what follows we concentrate on the first and third challenges of normative policy analysis listed above. In Section 3 we will discuss how agricultural economists over the past 40 years have explored the set of technically feasible welfare outcomes by filling in the set of examined policies in policy instrument space. Sections 4 and 5 will systematise the approaches used by agricultural economists to rank alternative policies by examining welfare outcome space.

3. Expanding the set of examined policies

3.1. Analysing a few simple policies

Wallace (1962) as well as other early contributors to normative agricultural policy analysis including Nerlove (1958), Johnson (1965), Dardis (1967a,b), and French-Davis (1968) pioneered the literature by introducing welfare economic tools to examine discrete sets of simple, single policy instruments. 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 'non-intervention' levels. In the left-hand panel of Fig. 3, such 'simple' policies are represented by points such as P, Q, R, S and T on the vertical and horizontal axes.

Starting with Josling (1969), Dardis and Dennison (1969), and Hushak (1971), agricultural economists

[3] Though there exist techniques to obtain exact welfare measures such as compensating and equivalent variations (see, for example, Chipman and Moore, 1980; McKenzie, 1983; Cornes, 1992; Martin and Alston, 1994; Slesnick, 1998), using the approximative Marshallian surpluses is still the most common procedure among agricultural economists, as discussed in Alston and Larson (1993). Therefore, and because of their familiar graphical representations as areas between demand and supply curves and price–quantity axes, we also use Marshallian surpluses to illustrate the second challenge of mapping from policy instrument space into welfare outcome space.

also examined the welfare effects of combined agricultural policies; and hence, points off the axes of the policy instrument space, such as U and V in Fig. 3.

3.2. Analysing continuous sets of policies

Josling (1974) first recognised 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 Fig. 3. Calculating the welfare effects of the continuous set of policies between P and S one derives a continuous set in policy outcome space, $\mathrm{STC}^{\text{acreage control/target price=0}}$ between p and s. Similarly, calculating the welfare effects of the continuous set of policies between P and T one derives $\mathrm{STC}^{\text{target price/acreage control=0}}$ 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 analysed.

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 et al., 1993). Other studies using STCs for combined policies include Kola (1993), Salhofer (1993), Garcia and Lothe (1996), and Alston and James (2002). Their procedure is illustrated in Fig. 3. Let us assume government combines a target price of US$ 4 with an acreage control policy of 15%. This combined policy is depicted by point U in policy instrument space. Obviously, there are many possible paths from point P to point U. Two examples are $P \rightarrow Q \rightarrow U$ and $P \rightarrow R \rightarrow U$. The path $P \rightarrow Q \rightarrow U$ first increases the target price from US$ 0 to US$ 4, and afterwards increases the acreage control from 0 to 15% while keeping the target price constant at US$ 4. Moving along the vertical axis from P to Q in policy instrument space gradually increases the producer price in price–quantity space from P_{E} to P_{T} while decreasing the consumer price from P_{E} to $P_{\mathrm{C,T}}$. The (producer) price–quantity equilibrium moves from E_{P} to E_{Q}. This implies a redistribution of welfare from non-farmers to farmers along $\mathrm{STC}^{\text{target price/acreage control=0}}$ in welfare outcome space. At a target price of US$ 4, farmers' welfare (producer surplus) increases by area $a+b+c+d+e+f+g+h$ in price–quantity space, or distance $W_{\mathrm{f}}^{q} - W_{\mathrm{f}}^{p}$ in welfare outcome space. Non-farmers' welfare (consumer surplus minus taxpayer costs) decreases by $a+b+c+d+e+f+g+h+i$ in price–quantity space, which is distance $W_{\mathrm{n}}^{p} - W_{\mathrm{n}}^{q}$ in welfare outcome space.

In the second step the target price is kept constant at US$ 4 while the acreage control is increased from 0 to 15%. This is illustrated by a horizontal movement from Q to U in policy instrument space. Increasing acreage control rotates the supply curve in the price–quantity space to the left, increasing the consumer price from $P_{\mathrm{C,T}}$ to P_{C}. The (producer) price–quantity equilibrium moves from E_{Q} to E_{U}. This implies a redistribution of welfare from farmers to non-farmers along $\mathrm{STC}^{\text{acreage control/target price=4}}$. Changing the acreage control from 0 to 15% (given a target price of US$ 4) decreases farmers' welfare by area $c + d + f + h + j$ in price–quantity space, or distance $W_{\mathrm{f}}^{q} - W_{\mathrm{f}}^{u}$ in welfare outcome space. It increases non-farmers' welfare (consumer surplus minus taxpayer costs) by $d + i$ in price–quantity space, or distance $W_{\mathrm{n}}^{u} - W_{\mathrm{n}}^{q}$ in welfare outcome space. The overall welfare effect of going from P to U is an increase in farmers' welfare of $a+b+e+g-j$, which is $W_{\mathrm{f}}^{u} - W_{\mathrm{f}}^{p}$, and a change in the welfare of non-farmers of $-(a+b+c+e+f+g+h)$, which is $W_{\mathrm{n}}^{u} - W_{\mathrm{n}}^{p}$.

A different path from P to U first increases the acreage control from 0 to 15%, i.e. a movement from

[4] Norton et al. (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.

P to R. This shifts/rotates the supply curve in Fig. 3 to the left from S to $S^{\text{acreage control}=15}$, and implies a new equilibrium E_R at price P_R. This implies a redistribution of welfare from non-farmers to farmers along $\text{STC}^{\text{acreage control/target price}=0}$ in welfare outcome space. At an acreage control of 15%, farmers' welfare changes by $e + g - j$, non-farmers' welfare by $-(e + f + g + h)$, and the new welfare distribution is given by point r in the right-hand panel. The second step is to increase the target price, i.e. to move vertically from R to U in policy instrument space. This increases the producer price from P_R to P_T and decreases the consumer price from P_R to P_C. Welfare is redistributed from non-farmers to farmers along $\text{STC}^{\text{target price/acreage control}=15}$. Increasing the target price to US$ 4 changes farmers' welfare by $a + b$ and non-farmers' welfare by $-(a + b + c)$. The total welfare effect to farmers of going from P to U is again $a + b + e + g - j$, which is $W_f^u - W_f^p$. Non-farmers' welfare change is $-(a+b+c+e+f+g+h)$ which is $W_n^u - W_n^p$.[5]

Using the procedure discussed above, one can map any line segment from 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. 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 do this one must apply value judgement criteria.

4. Finding Pareto efficient policies

A value judgement criterion commonly accepted among economists is the Pareto criterion. According to this 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.[6] 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 Fig. 3 represents the set of Pareto efficient policies, commonly called the Pareto frontier.

In the agricultural economics literature of the past 15 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, p. 58, p. 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 Fig. 4, they showed that a Pareto efficient combination of these two instruments is to fix the quota at the non-intervention output level and set the target price level according to the desired level of welfare transfer to farmers.[7] For example, if the desired welfare transfer is $P_E P_T ab$, 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 non-intervention point p to point r in welfare outcome space.[8] 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) were able to

[5] While in this simple, single market example both paths imply the same final surplus changes, this does not hold in general. It is well known that in the case of multiple price changes or simultaneous price–income changes, Marshallian surplus measures may face a path-dependency problem (Silberberg, 1972). However, this is a problem of the exact measurement of welfare. Whatever path we take from P to U in policy instrument space, the welfare distribution from p to u in welfare outcome space will be the same if the welfare changes are calculated correctly.

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

[7] Assuming that government can raise revenue without distorting other markets, setting the quota in the agricultural market at the non-intervention production level enables government to raise the target price above the non-intervention price level without attracting additional 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.

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

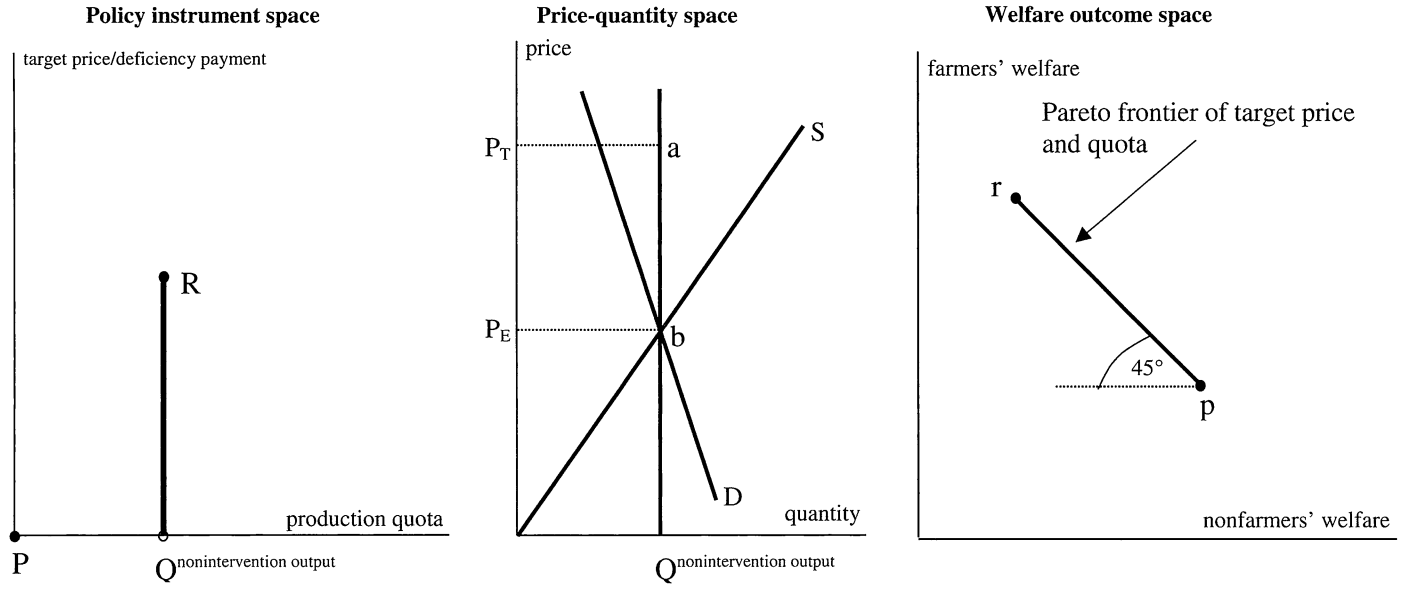

Fig. 4. Optional combination of target price/deficiency payments and production control.

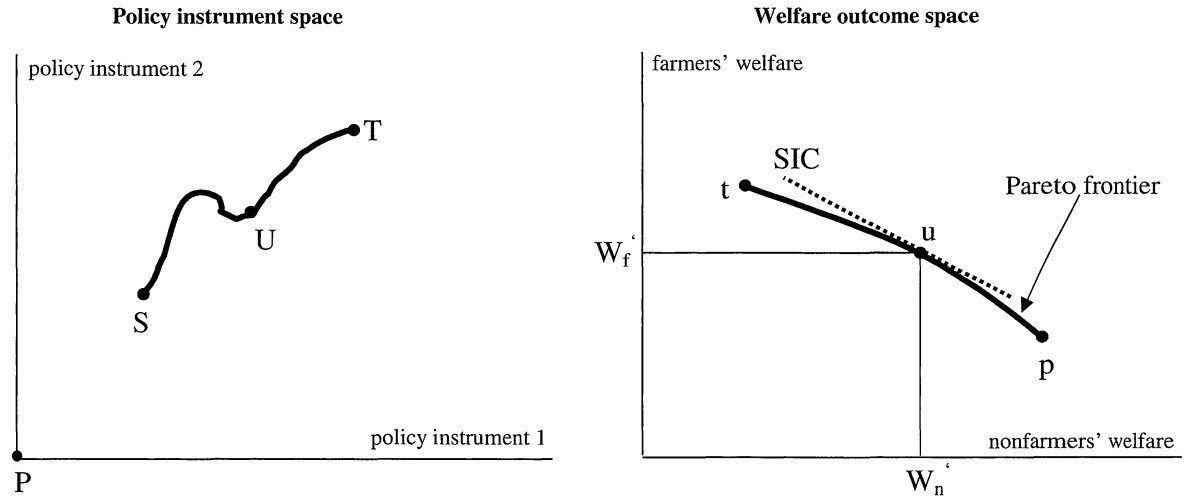

Fig. 5. Optimal combination of two policy instruments.

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 in policy instrument space, but perhaps may look more like point P plus curve ST in the left-hand panel of Fig. 5, which implies a non-linear Pareto frontier such as pt in the right-hand panel. In such a case, the points on the Pareto frontier can only be derived with some mathematical optimisation procedure.[9]

To derive Pareto efficient policy instrument combinations and/or Pareto frontiers, researchers have utilised 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.

Utilising approach (i), Alston et al. (1993) showed that points on the Pareto frontier can be derived by maximising the welfare of non-farmers given some predetermined welfare level of farmers. (Equivalently, one could minimise the cost to non-farmers 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 Fig. 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 non-farmers which lies as far as possible to the right. The maximised non-farmers' 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 maximisation 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.[10]

[9] In each of Figs. 3–5, we present the non-intervention point p as being Pareto efficient, and therefore as leading to a welfare point P on the Pareto frontier. As long as the conditions of the First Fundamental Theorem of Welfare Economics are met, non-intervention will be Pareto efficient in equilibrium. But of course, in the real world, these conditions are not necessarily met, and non-intervention may not be Pareto efficient. Examples in which the conditions in the First Theorem are not met include declining average cost industries (as in Romer's (1991) New Growth Theory), externalities such as agricultural R&D that affect total factor productivity, and technological spillovers from other sectors, such as with information technology (Newbery and Stiglitz, 1981).

[10] 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).

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 maximisation problems. As proved by Bullock et al. (1999), Bullock's (1991, 1996) method of solving n constrained maximisation problems simultaneously is equivalent to the simpler method proposed by Alston et al. (1993) of solving a single constrained maximisation 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); Giannakas and Fulton (2000b) use techniques similar to Alston et al. (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), Salhofer (1996) actually draw empirically derived Pareto frontiers by repeatedly solving optimisation problems as described in Alston et al. (1993) or Bullock (1991, 1996) for various optimisation constraints.

An alternative method used to derive Pareto efficient policies is to maximise a weighted utilitarian (i.e. linear) social welfare function (SWF).[11] Given some weights to farmers and non-farmers, a Pareto efficient policy outcome such as u (and the corresponding Pareto efficient policy U) in Fig. 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) numerically solved the implied optimisation 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 et al. (1993), 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 optimisation problem. So far, no whole Pareto frontier and/or set of Pareto efficient policies has been calculated utilising 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 judgement 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 (and to 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 value judgements about distributive equity.

A complete ranking of all feasible welfare outcomes is provided by a Bergson–Samuelson SWF, which in our simple two social group case is $W = W(W_n, W_f)$. Every SWF implicitly contains value judgements (in addition to the Pareto criterion, as long as it is non-decreasing 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) $SC = -(\Delta W_f + \Delta W_{fn})$ criterion. Both criterion are either based on the assumption that increasing the

[11] In the context of Walrasian equilibrium theory, Varian (1992) provides a proof that maximising a social welfare function leads to Pareto efficiency, and that Pareto efficient allocations maximise a linear social welfare function for some choice of welfare weights, given concavity assumptions about individuals' utility functions.

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 et al., 1987; Murphy et al., 1993), they have also been criticised 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 categorise them into three different formulations of the objective function:

(i) a utilitarian SWF with a predetermined welfare level for farmers or non-farmers;
(ii) a utilitarian SWF with a predetermined welfare ratio between farmers and non-farmers (or, equivalently, a Leontief-type SWF); and
(iii) a weighted linear SWF.

5.1. A utilitarian SWF with a predetermined welfare level for 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 maximised the welfare of non-farmers given some predetermined welfare level of farmers or minimised the cost to non-farmers 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 et al. (1993), Gisser (1993), Maier (1993b), Salhofer (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).

Fig. 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 level of farmers is the socially desired (exogenously given) one. According to this value judgement criterion, welfare outcome s is socially preferable to r and the optimal welfare outcome is t.

Next, assume the government's agricultural policy objective is to transfer as much welfare to farmers as possible given some predetermined (socially acceptable) cost. This is the income-transfer objective criterion. Practically, it is to maximise farmers' welfare given some welfare level of non-farmers. This was first discussed in Josling (1974) and applied in Bullock and Salhofer (1995, 1998a). Fig. 6 also illustrates this income-transfer objective criterion. Suppose again that the actually observed welfare outcome is $r = (W_n', W_f')$ and that the actual observed welfare level of non-farmers is the socially desired (exogenously given) one. According to this value judgement criterion welfare outcome u is socially preferable to r and welfare outcome v is optimal.

5.2. A utilitarian SWF with a predetermined welfare ratio between farmers and non-farmers

According to this approach, a policy A is preferred to a policy B if it leads to a higher social welfare given some predetermined welfare ratio between farmers and non-farmers. 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 non-farmers is the socially desired one, welfare outcome w in Fig. 6 is optimal.

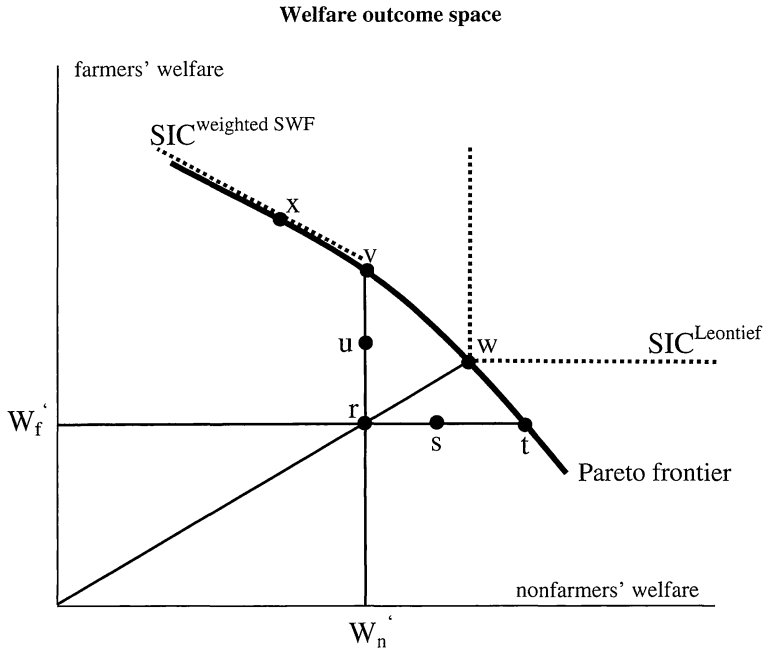

Fig. 6. How agricultural economists considered distributive equity.

Just (1984) showed that this value judgement 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 $W = \min(\phi_f W_f, \phi_n W_n)$, where ϕ_f and ϕ_n are the weights attributed to farmers and non-farmers, respectively. Hence, the welfare distribution ratio is given by $\phi_f/\phi_n = 1$. If $\phi_f/\phi_n = 1$, this value judgement criterion is equal to the Rawlsian maximum 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 $W = \phi_f W_f + \phi_n W_n$, where typically $\phi_f > \phi_n$.[12] Just (1984), Paarlberg (1984), Gardner (1985, 1988, 1991, 1992, 1995), Innes and Rausser (1989), Innes (1990a,b), Chambers (1992), de Gorter et al. (1993), Alston and Spriggs (1998), Swinnen and de Gorter (1998), Alston et al. (1999) and Giannakas and Fulton (2000a) judged policies using this value judgement criterion.

In Fig. 6, this value judgement criterion is illustrated by linear SICs with slopes less than 45°. According to this value judgement criterion the optimal welfare outcome would be in point x.

5.4. A combination of a weighted and a Leontief SWF

In a recent study, Romero (2001) suggested a more general form of a SWF that includes the Benthamite, the weighted and the Leontief SWF as a special case. According to this value judgement criterion a policy A is preferred to a policy B if it leads to a higher social welfare level, defined as $W = \min(1-\lambda)(\phi_f W_f, \phi_n W_n) + \lambda(\phi_f W_f + \phi_n W_n)$, where ϕ_f and ϕ_n are the weights attributed to farmers and non-farmers, respectively, and λ is a control parameter. If $\lambda = 1$, we have a linear weighted SWF;

[12] Here we must distinguish between a social welfare function, which is a normative construct, and a 'political preference function', which is a positive construct. Many in the agricultural economics literature have reported attempts to measure empirically the revealed 'political weights' of interest groups in the public decision making process. Conceptually, the notion of distributive equity need not play a role in the determination of such political weights. Rather, these weights might reflect the rent-seeking abilities of interest groups (see Bullock (1994) for a critique of this literature).

moreover if $\phi_f = \phi_n$, we have a classic Benthamite SWF. If $\lambda = 0$, we have a Leontief SWF; moreover if $\phi_f = \phi_n$, we have a Rawlsian SWF.

6. Outlook

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). For the (very commonly used) simple case of two social groups (farmers and non-farmers) presented here, a graphical illustration of a feasible welfare outcome set or a Pareto curve is possible and useful. However, now it is important also 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 in which advances in computational power are already in use 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 in functional forms, parameter values, and market structure. Given this, the welfare outcome implied by each policy (as well as an STC or Pareto frontier) is only known with some degree of uncertainty (von Cramon-Taubadel, 1997). 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 et al., 1990; Kling and Sexton, 1990), Monte Carlo simulations (Krinsky and Robb, 1986, 1990, 1991; Adamowicz et al., 1989, 1991) or Bayesian inference (Zhao et al., 2000).[13] Recent applications of these methods in the field of agricultural policy analysis include Tremblay and Tremblay (1995), von Cramon-Taubadel (1997), Jeong et al. (1999), Jeong et al. (2003) (bootstrapping), Alston et al. (1998, 2000) (Monte Carlo simulation), Davis and Espinoza (1998, 2000), Griffiths and Zhao (2000), Zhao et al. (2000), Salhofer et al. (2001) and Sinabell et al. (1999) (Bayesian inference).

In regard to the third identified challenge of normative agricultural policy analysis, the most important development is that in many cases agricultural economists have departed from the traditional utilitarian value judgement criterion of minimising 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 minimising social cost criterion. Interesting starting points for refining this line of research are Romero's (2000) more general SWF, and Chavas' (1994) article on fairness.

Another development in meeting the third challenge is that several recent welfare analyses have employed a wider disaggregation of social groups. Prior to this development, it was common to evaluate the effects of agricultural policy by dividing society into two (farmers and non-farmers) or three groups (farmers, consumers, taxpayers). Thus, these studies aggregated the entire agricultural industry into one group, and potentially missed important aspects of inter-agricultural politics. Examples of studies disaggregating the agricultural sector vertically, e.g. by

[13] See Bullock et al. (1999), Abler (2001) and Salhofer (2001) for a broader discussion of 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, 1986).

distinguishing between agricultural production and processing, are Mullen et al. (1989), Maier (1993a), Alston et al. (1997) and Jeong et al. (2003). Examples of horizontal disaggregation, e.g. by distinguishing between different product qualities, are Zhao et al. (2001, 2002). However, only rarely have studies disaggregated farmers by natural production conditions (such as between European Union favoured versus disfavoured areas), or by economic production conditions (small versus large farms). Nor has it been common to disaggregate farmers by income class, though this seems of obvious importance for analysing equity issues. Exceptional examples of this type of study are Chambers (1985) and Hueth (2000).

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 rest 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, 1991; 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 much 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.

Acknowledgements

The authors thank two anonymous reviewers for valuable comments and suggestions. They also thank seminar participants at the University of California Davis and the Justus-Liebig-University Giessen, as well as participants in a Symposium in Honour of Luther Tweeten at The Ohio State University for helpful discussions. Senior authorship is not assigned.

References

Abler, D.G., 2001. Elasticities of substitution and factor supply in Canadian, Mexican and US agriculture. In: OECD (Ed.), Market Effects of Crop Support Measures. OECD, Paris, pp. 57–88.

Adamowicz, W.L., Graham-Tomasi, T., Fletcher, J.J., 1989. Inequality constrained estimation of consumer surplus. Can. J. Agric. Econ. 37, 407–420.

Adamowicz, W.L., Fletcher, J.J., Graham-Tomasi, T., 1991. Functional form and the statistical properties of welfare measures. Am. J. Agric. Econ. 71, 414–421.

Alston, J.M., Gray, R.S., 1998. Export subsidies and state trading: theory and application to Canadian wheat. In: Yildirim, T., Schmitz, A., Furtan, W.H. (Eds.), World Agricultural Trade. Westview Press, Boulder, pp. 281–298.

Alston, J.M., Hurd, B.H., 1990. Some neglected social costs of government spending in farm programs. Am. J. Agric. Econ. 72, 149–156.

Alston, J.M., James, J.S., 2002. The incidence of agricultural policy. In: Gardner, B.L., Rausser, G.C. (Eds.), Agricultural and food policy. Handbook of Agricultural Economics, vol. 2B. North-Holland, Amsterdam.

Alston, J.M., Larson, D.M., 1993. Hicksian vs. Marshallian welfare measures: why do we do what we do? Am. J. Agric. Econ. 75, 764–769.

Alston, J.M., Spriggs, J.D., 1998. Endogenous policy and supply management in a postGATT world. Can. J. Econ. 31 (1), 220–239.

Alston, J.M., Carter, C.A., Smith, V.H., 1993. Rationalising agricultural export subsidies. Am. J. Agric. Econ. 75, 1000–1009.

Alston, J.M., Sexton, R.J., Zhang, M., 1997. The effects of imperfect competition on the size and distribution of research benefits. Am. J. Agric. Econ. 79, 1252–1265.

Alston, J.M., Chalfant, J.A., Piggott, N.E., 1998. Advertising and consumer welfare. Unpublished manuscript. Department of Agricultural and Resource Economics, University of California, Davis.

Alston, J.M., Smith, V.H., Acquaye, A., Hosseini, S., 1999. Least cost, cheap food policies. Agric. Econ. 20, 191–201.

Alston, J.M., Chalfant, J.A., Piggott, N.E., 2000. The incidence of the costs and benefits of generic advertising. Am. J. Agric. Econ. 82, 665–671.

Antle, J.M., 1991. Farm policy reform and the environment. Am. J. Agric. Econ. 73, 917–921.

Beach, E.D., Fernandez-Cornejo, F., 1994. Setting research priorities in the public sector: a suggested framework for the AARC Center. J. Agric. Econ. Res. 45, 3–16.

Blake, A., Rayner, A., Reed, G., 1999. A computational general equilibrium analysis of agricultural liberalisation: the Uruguay Round and Common Agricultural Policy reform. J. Agric. Econ. 50, 400–424.

Blandford, D., Dewbre, J., 1994. Structural adjustment and learning to live without subsidies in OECD countries. Am. J. Agric. Econ. 76, 1047–1052.

Bockstael, N., Strand, I., 1986. The effect of common sources of regression error on benefit estimates. Land Econ. 63, 11–20.

Brännlund, R., Kriström, B., 1996. Welfare measurement in single and multimarket models: theory and application. Am. J. Agric. Econ. 78, 157–165.

Bullock, D.S., 1991. Pareto optimal income redistribution and political preference functions: an application to EC common agricultural policy. Unpublished manuscript. Department of Agricultural Economics, University of Illinois at Urbana, Champaign.

Bullock, D.S., 1992. Redistributing income back to European Community consumers and taxpayers through the common agricultural policy. Am. J. Agric. Econ. 74, 59–67.

Bullock, D.S., 1993. Welfare implications of equilibrium supply and demand curves in an open economy. Am. J. Agric. Econ. 75, 52–58.

Bullock, D.S., 1994. In search of rational government: what political preference function studies measure and assume. Am. J. Agric. Econ. 76., 347–361.

Bullock, D.S., 1995. Are government transfers efficient? An alternative test of the efficient redistribution hypothesis. J. Polit. Econ. 103, 1236–1274.

Bullock, D.S., 1996. Pareto optimal income redistribution and political preference functions: an application to EC common agricultural policy. In: Antle, J.M., Sumner, D. (Eds.), Papers in honour of D. Gale Johnson. The Economics of Agriculture, vol. 2. University of Chicago Press, Chicago, pp. 244–262.

Bullock, D.S., Salhofer, K., 1995. Is government efficient? An illustration from US agricultural policy. Bodenkultur 46, 379–391.

Bullock, D.S., Salhofer, K., 1998a. Measuring the social costs of suboptimal combination of policy instruments—a general framework and an example. Agric. Econ. 18, 249–259.

Bullock, D.S., Salhofer, K., 1998b. A note on the efficiency of income redistribution with simple and combined policies. Agric. Resour. Econ. Rev. 27, 266–269.

Bullock, D.S., Salhofer, K., Kola, J., 1999. The normative analysis of agricultural policy: a general framework and a review. J. Agric. Econ. 50, 512–535.

Chambers, R.G., 1985. Least-cost subsidisation alternatives. Am. J. Agric. Econ. 67, 251–256.

Chambers, R.G., 1992. On the design of agricultural policy mechanisms. Am. J. Agric. Econ. 74, 646–654.

Chavas, J.-P., 1994. Equity considerations in economic and policy analysis. Am. J. Agric. Econ. 76, 1022–1033.

Chipman, J.S., Moore, J.C., 1980. Compensating variation, consumer's surplus, and welfare. Am. Econ. Rev. 70, 933–949.

Christensen, L.R., Jorgenson, D.W., Lau, L.J., 1971. Conjugate duality and the transcendental logarithmic production function. Econometrica 39, 255–256.

Cornes, R., 1992. Duality and Modern Economics. Cambridge University Press, Cambridge.

Dardis, R., 1967a. The welfare cost of grain protection in the United Kingdom. J. Farm Econ. 49, 597–609.

Dardis, R., 1967b. Intermediate goods and the gain from trade. Rev. Econ. Stat. 49, 502–509.

Dardis, R., Dennison, J., 1969. The welfare cost of alternative methods of protecting raw wool in the United States. Am. J. Agric. Econ. 51, 303–319.

Davis, G.C., Espinoza, M.C., 1998. A unified approach to sensitivity analysis in equilibrium displacement models. Am. J. Agric. Econ. 80, 868–879.

Davis, G.C., Espinoza, M.C., 2000. A unified approach to sensitivity analysis in equilibrium displacement models: reply. Am. J. Agric. Econ. 82, 241–243.

de Gorter, H., Meilke, K.D., 1989. Efficiency of alternative policies for the EC's common agricultural policy. Am. J. Agric. Econ. 71, 592–603.

de Gorter, H., Nielson, D.J., Rausser, G.C., 1993. Productive and predatory public policies: research expenditures and producer subsidies in agriculture. Am. J. Agric. Econ. 74, 27–37.

Deaton, A., Muellbauer, J., 1980. An almost ideal demand system. Am. Econ. Rev. 70, 341–367.

Dorfman, J.H., Kling, C.L., Sexton, R.J., 1990. Confidence intervals for elasticities and flexibilities: reevaluating the ratios of normal case. Am. J. Agric. Econ. 72, 1007–1017.

Efron, B., 1979. Bootstrap method: another look at the jackknife. An. Stat. 7, 1–26.

Fraser, R.W., 1992. The welfare effects of deregulating producer prices. Am. J. Agric. Econ. 74, 21–26.

Freedman, D., Peters, S., 1984. Bootstrapping a regression equation: some empirical results. J. Am. Stat. Assoc. 79, 97–106.

French-Davis, M.R., 1968. Export quotas and allocative efficiency under market instability. Am. J. Agric. Econ. 50, 643–658.

Gallagher, P., 1988. The grain sector of the European community: policy formation, and implications for trade. Am. J. Agric. Econ. 70, 767–778.

Garcia, R.J., Lothe, S.E., 1996. Evaluation alternative policies for the Norwegian dairy sector. In: Proceedings of the Paper presented at the VIII Congress of the EAAE, Edinburgh, 3–7 September 1996.

Gardner, B.L., 1983. Efficient redistribution through commodity markets. Am. J. Agric. Econ. 65, 225–234.

Gardner, B.L., 1985. Export subsidies are still irrational. J. Agric. Econ. Res. 37, 17–19.

Gardner, B.L., 1987. The Economics of Agricultural Policies. McGraw-Hill, New York.

Gardner, B.L., 1988. Export policy, deficiency payments, and a consumption tax. J. Agric. Econ. Res. 40, 38–41.

Gardner, B.L., 1991. Redistribution of income through commodity and resource policies. In: Just, R.E., Bockstael, N. (Eds.), Commodity and Resource Policies in Agricultural Systems. Springer, Berlin.

Gardner, B.L., 1992. Price supports and optimal spending on agricultural research. Working Paper No. 92-20. Department of Agricultural and Research Economics, University of Maryland, 1992.

Gardner, B.L., 1995. Rationalising agricultural export subsidies: comment. Am. J. Agric. Econ. 77, 205–208.

Giannakas, K., Fulton, M., 2000a. The economics of coupled farm subsidies under costly and imperfect enforcement. Agric. Econ. 22, 75–90.

Giannakas, K., Fulton, M., 2000b. Efficient redistribution using quotas and subsidies in the presence of misrepresentation and cheating. Am. J. Agric. Econ. 82, 347–359.

Gisser, M., 1993. Price support, acreage controls, and efficient redistribution. J. Polit. Econ. 101, 584–611.

Griffiths, W.E., Zhao, X., 2000. A unified approach to sensitivity analysis in equilibrium displacement models: comment. Am. J. Agric. Econ. 82, 236–240.

Griliches, Z., 1958. Research costs and social returns: hybrid corn and related innovations. J. Polit. Econ. 66, 419–431.

Guyomard, H., Mahé, L.-P., 1994. Is a production quota Pareto superior to price support only? Eur. Rev. Agric. Econ. 21, 31–36.

Helms, L.J., 1985. Errors in the numerical assessment of the benefits of price stabilisation. Am. J. Agric. Econ. 67, 93–100.

Hertel, T.W., 1998. Global Trade Analysis: Modelling and Applications. Cambridge University Press, Cambridge.

Hertel, T.W., Tsigas, M.E., 1991. General equilibrium analysis of supply control in US agriculture. Eur. Rev. Agric. Econ. 18, 167–191.

Hueth, B., 2000. The goals of US agricultural policy: a mechanism design approach. Am. J. Agric. Econ. 82, 14–24.

Hushak, L.J., 1971. A welfare analysis of the voluntary corn diversion program, 1961 to 1966. Am. J. Agric. Econ. 53, 173–181.

Innes, R.T., 1990a. Uncertainty, incomplete markets and government farm programs. South. Econ. J. 57, 47–65.

Innes, R.T., 1990b. Government target price intervention in economies with incomplete markets. Q. J. Econ. 105, 1035–1052.

Innes, R.T., Rausser, G.C., 1989. Incomplete markets and government agricultural policy. Am. J. Agric. Econ. 71, 915–931.

Isosaari, H., 1993. Policy choice under imperfect competition with an application to the Finnish sugar market. Pellervo Economic Research Institute (PTT) Publications 14. Espoo, Finland.

Jeong, K.-S., Bullock, D.S., Garcia, P., 1999. Testing the efficient redistribution hypothesis: an application to Japanese beef policy. Am. J. Agric. Econ. 81, 408–423.

Jeong, K.-S., Garcia, P., Bullock, D.S., 2003. A statistical method of welfare analysis applied to Japanese beef policy liberalisation. J. Policy Mod. (in press).

Johnson, P.R., 1965. The social cost of the tobacco program. Am. J. Agric. Econ. 47, 242–254.

Josling, T., 1969. A formal approach to agricultural policy. J. Agric. Econ. 20, 175–195.

Josling, T., 1974. Agricultural policies in developed countries: a review. J. Agric. Econ. 25, 229–264.

Just, R.E., 1984. Automatic adjustment rules for agricultural policy controls. AEI Occasional Papers. American Enterprise Institute for Public Policy Research, Washington, DC.

Just, R.E., 1985. Automatic adjustment rules in commodity programs. In: Gardner, B.L. (Ed.), US Agricultural Policy: The 1985 Farm Legislation. American Enterprise Institute for Public Policy Research, Washington, DC, pp. 355–377.

Just, R.E., Hueth, D.L., 1979. Multimarket welfare measurement. Am. Econ. Rev. 69, 947–954.

Just, R.E., Lutz, E., Schmitz, A., Turnovsky, S., 1977. The distribution of welfare gains from international price stabilisation under distortions. Am. J. Agric. Econ. 59, 652–661.

Just, R.E., Schmitz, A., Zilberman, D., 1979. Price controls and optimal export policies under alternative market structures. Am. Econ. Rev. 69, 706–714.

Just, R.E., Hueth, D.L., Schmitz, A., 1982. Applied Welfare Economics and Public Policy. Prentice-Hall, Englewood Cliffs, NJ.

Kealy, M., Bishop, R., 1986. Theoretical and empirical specification in travel cost demand studies. Am. J. Agric. Econ. 69, 660–667.

Kling, C.L., Sexton, R.J., 1990. Bootstrapping in applied welfare analysis. Am. J. Agric. Econ. 72, 406–418.

Kola, J., 1993. Efficiency of supply control programmes in income redistribution. Eur. Rev. Agric. Econ. 20, 183–198.

Konandreas, P.A., Schmitz, A., 1978. Welfare implications of grain price stabilisation: some empirical evidence for the United States. Am. J. Agric. Econ. 60, 74–84.

Krinsky, I., Robb, A., 1986. On approximating the statistical properties of elasticities. Rev. Econ. Stat. 68, 715–719.

Krinsky, I., Robb, A., 1990. On approximating the statistical properties of elasticities: a correction. Rev. Econ. Stat. 72, 189–190.

Krinsky, I., Robb, A., 1991. Three methods for calculating statistical properties for elasticities. Empiric. Econ. 16, 1–11.

Larson, D.M., 1988. Exact welfare measurement for producers under uncertainty. Am. J. Agric. Econ. 70, 597–603.

Leu, G.-J.M., Schmitz, A., Knutson, R.D., 1987. Gains and losses of sugar program policy options. Am. J. Agric. Econ. 69, 591–602.

Lichtenberg, E., Zilberman, D., 1986. The welfare economics of price supports in US agriculture. Am. Econ. Rev. 76, 1135–1141.

Maier, L., 1993a. The Costs and Benefits of US Agricultural Policies with Imperfect Competition in Food Manufacturing. Garland Publishing, New York.

Maier, L., 1993b. The relative transfer efficiency of six agricultural support policies for a small exporting country. Discussion Paper 25-W-93. Department of Economics, Politics, and Law, University of Agricultural Sciences Vienna.

Martin, W.J., Alston, J.M., 1994. A dual approach to evaluation research benefits in the presence of trade distortions. Am. J. Agric. Econ. 76, 26–35.

McCorriston, S., Sheldon, I.M., 1991. Government in imperfectly competitive agricultural input markets. Am. J. Agric. Econ. 73, 621–632.

McCorriston, S., Sheldon, I.M., 1994. Selling import quota licenses: the US cheese case. Am. J. Agric. Econ. 76, 818–827.

McKenzie, G.W., 1983. Measuring Economic Welfare: New Methods. Cambridge University Press, Cambridge.

Moschini, G., Sckokai, P., 1994. Efficiency of decoupled farm programmes under distortionary taxation. Am. J. Agric. Econ. 76, 362–370.

Mullen, J.D., Alston, J.M., Wohlgenant, M.K., 1989. The impact of farm and processing research on the Australian wool industry. Austr. J. Agric. Econ. 33, 32–47.

Murphy, J.A., Furtan, W.H., Schmitz, A., 1993. The gains from agricultural research under distorted trade. J. Public Econ. 52, 161–172.

Nerlove, M., 1958. The Dynamic of Supply. John Hopkins Press, Baltimore.

Newbery, D.M.G., Stiglitz, J.E., 1981. The Theory of Commodity Price Stabilisation: A Study in the Economics of Risk. Clarendon Press, Oxford.

Norton, G.W., Pardey, P.G., Alston, J.M., 1992. Economic issues in agricultural research priority setting and evaluation. Am. J. Agric. Econ. 74, 1089–1095.

OECD, 1995. Adjustment in OECD Agriculture: Issues and Policy Responses. Paris.

Otsuka, K., Hayami, Y., 1985. Goals and consequences of rice policy in Japan, 1965–1980. Am. J. Agric. Econ. 67, 529–538.

Paarlberg, P.L., 1984. When are export subsidies rational. J. Agric. Econ. Res. 36, 1–7.

Peterson, E.B., Connor, J.M., 1995. A comparison of oligopoly welfare loss estimates for US food manufacturing. Am. J. Agric. Econ. 77, 300–308.

Philippidis, G., Hubbard, L.J., 2001. The economic cost of the CAP revisited. Agric. Econ. 25, 375–385.

Rausser, G.C., 1982. Political economic markets: PERTs and PESTs in food and agriculture. Am. J. Agric. Econ. 64, 822–833.

Rausser, G.C., de Gorter, H., 1991. The political economy of commodity and public good policies in European agriculture: implications for policy reform. Eur. Rev. Agric. Econ. 18, 485–504.

Romer, P., 1991. Increasing returns and new development in the theory of growth. In: Barnett, W. (Ed.), Equilibrium Theory and Applications: Proceedings of the Sixth International Symposium on Economic Theory and Econometrics. Cambridge University Press, Cambridge.

Romero, C., 2001. A note on distributive equity and social efficiency. J. Agric. Econ. 52, 110–112.

Salhofer, K., 1993. Eine wohlfahrtsökonomische Analyse des österreichischen Roggenmarktes—das Konzept der Transfer-effizienz. Agrarwirtschaft 42, 260–266.

Salhofer, K., 1996. Efficient support policy for a small country using optimal combined policies. Agric. Econ. 13, 191–199.

Salhofer, K., 1997. Efficiency of Income Redistribution through Agricultural Policy: A Welfare Economic Analysis. European University Studies, Frankfurt, Peter Lang.

Salhofer, K., 2001. Elasticities of substitution and factor supply elasticities in European agriculture: a review of past studies. In: OECD (Ed.), Market Effects of Crop Support Measures. OECD, Paris, 89–119.

Salhofer, K., Schmid, E., Schneider, F., Streicher, G., 2001. Testing for efficiency: a policy analysis with probability distributions. Discussion Paper No. 87-W-01. Department of Economics, Politics, and Law, University of Agricultural Sciences, Vienna.

Sen, A.K., 1979. Personal utilities and public judgements: or what's wrong with welfare economics? Econ. J. 89, 537–558.

Sexton, R.J., 1994a. A survey of noncooperative game theory with reference to agricultural markets. Part 1. Theoretical concepts. Rev. Market. Agric. Econ. 62, 11–28.

Sexton, R.J., 1994b. A survey of noncooperative game theory with reference to agricultural markets. Part 2. Potential applications to agriculture. Rev. Market. Agric. Econ. 62, 183–200.

Silberberg, E., 1972. Duality and the many consumer's surplus. Am. Econ. Rev. 62, 942–952.

Sinabell, F., Salhofer, K., Hofreither, M.F., 1999. Aggregated output effects of countryside stewardship policies. In: Van Huylenbroeck, G., Whittby, M. (Eds.), Countryside Stewardship Policies: Farmers, Policies and Markets. Elsevier, Amsterdam.

Slesnick, D.T., 1998. Empirical approaches to the measurement of welfare. J. Econ. Lit. 36, 2108–2165.

Swinnen, J.F.M., de Gorter, H., 1998. Endogenous commodity policies and the social benefits from public research expenditures. Am. J. Agric. Econ. 80, 107–115.

Thomson, K.J., Harvey, D.R., 1981. The efficiency of the common agricultural policy. Eur. Rev. Agric. Econ. 8, 57–83.

Thurman, W.N., 1993. The welfare significance and nonsignificance of general equilibrium demand and supply curves. Public Fin. Q. 21, 449–469.

Thurman, W.N., Wohlgenant, M.K., 1989. Consistent estimation of general equilibrium welfare effects. Am. J. Agric. Econ. 71, 1041–1045.

Tremblay, C.H., Tremblay, V.J., 1995. The impact of cigarette advertising on consumer surplus, profit, and social welfare. Contemp. Econ. Policy 13, 113–124.

Tuomala, M., 1990. Optimal Income Taxation and Redistribution. Oxford University Press, New York.

van Tongren, F., van Meijl, H., Surry, Y., 2001. Global models applied to agricultural and trade policies: a review and assessment. Agric. Econ. 26, 149–172.

Varian, H.R., 1992. Microeconomic Analysis. Norton, New York, pp. 333–334.

von Cramon-Taubadel, S., 1997. Issues in Agricultural Competitiveness—Markets and Policies. In: Rose, R., Tanner, C., Bellamy, M.A. (Eds.), IAAE Occasional Paper No. 7. Darmouth Publishing Company Ltd./Ashgate Publishing Company, Aldershot, UK and Ashgate Publishing Company, Vermont, USA, pp. 32–38.

Wallace, T.D., 1962. Measures of social costs of agricultural programs. J. Farm Econ. 44, 580–594.

Warr, P.G., 2001. Welfare effects of an export tax: Thailand's rice premium. Am. J. Agric. Econ. 83, 903–920.

Weyerbrock, S., 1998. Reform of the European Union's agricultural policy: how to reach GATT-compatibility? Eur. Econ. Rev. 42, 375–411.

Williams, J.C., Wright, B.D., 1993. Storage and Commodity Markets. Cambridge University Press, New York.

Wong, C.M., 1989. Welfare implications of price stabilisation with monopolistic trade. Am. J. Agric. Econ. 71, 43–54.

Wright, B.D., 1979. The effects of ideal price stabilisation: a welfare analysis under rational behaviour. J. Polit. Econ. 87, 1011–1033.

Wright, B.D., 1993. Dynamic perspectives on agricultural policy issues. Am. J. Agric. Econ. 75, 1113–1125.

Yaron, D., Ratner, A., 1990. Regional cooperation in the use of irrigation water: efficiency and income distribution. Agric. Econ. 4, 45–58.

Zhao, X., Griffiths, W.E., Griffith, G.R., Mullen, J.D., 2000. Probability distributions for economic surplus changes: the case of technical change in the Australian wool industry. Austr. J. Agric. Resour. Econ. 44, 83–106.

Zhao, X., Griffith, G., Mullen, J.D., 2001. Returns to new technologies in the Australian beef industry: on-farm research versus off-farm research. Austr. Agribus. Rev. 9, 1–18.

Zhao, X., Anderson, K., Wittwer, G., 2002. Who gains from Australian generic wine R&D and promotion. In: Proceedings of the Paper Prepared for the AARES Annual Conference, Canberra, 13–15 February 2002.