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# A Note on the Efficiency of Income Redistribution with Simple and Combined Policies

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Recent studies have investigated the efficiencies of policies that use several policy instruments simultaneously (for example, a policy that uses a production subsidy combined with a production quota). Several studies of very specific cases find that optimal combination of two policy instruments is more efficient than optimal independent use of either. In this note we demonstrate using set theory and maximization theory, that all such specific results are examples of a more general result, which is that by combining  $m$  instruments efficiently, a government can always be at least as efficient as when using a subset of those  $m$  instruments. This result holds for any of the several definitions of "efficiency" in the literature.

Comparison of the efficiencies of alternative policies has been a main topic in the agricultural economics literature since Nerlove (1958) and Wallace (1962). Many studies in this field have concentrated on ranking what we will call *simple policies*, which are those policies using single policy instruments (for example, a policy that uses a production subsidy only, or a policy that uses a production quota only). More recent studies have also investigated the efficiencies of *combined policies*, which we define as those using several instruments simultaneously (for example, a policy that uses a target price and a production quota). Several of these latter studies find, for very specific cases, that optimal combination of two policy instruments is more efficient than using either of the instruments independently. In this note we use set theory and maximization theory to demonstrate that these findings are examples of a more general result, which is that making additional policy instruments available to government allows for the attainment of a more efficient policy. That is, a policy combining  $m$  instruments efficiently will always be at least as efficient as any policy using a subset of those  $m$  instruments. This result holds for any of the several definitions of "efficiency" commonly used in the literature.

Once the question of the efficiency of combining policy instruments is viewed from our frame-

work using set theory and maximization theory, this general result is not only intuitively appealing, but rather obvious or even "trivial." But perhaps because the question at hand has not been addressed before using our framework, while so far in the literature several specific examples of this result have been presented, the generality of the result has not been recognized or appreciated. Thus, the contribution of our paper is not just the general result presented, but the presentation of the framework itself, which permits better understanding of several issues in the current literature on the efficiency of policies.

## Studies of Combined and Simple Policies

In this section we briefly review several studies that have compared the efficiencies of combined policies and simple policies. These studies all present specific examples of a policy combining two instruments efficiently being superior to policies using either of the instruments independently.

### *Output Subsidies and Production Control*

Just (1984) discussed the efficiencies of the simple policies output subsidization (or equally, a target price/deficiency payments policy) and production control, and of a combination of the two simple policies. Just's study used a stochastic setting (uncertainty in producer and consumer prices). He theoretically and empirically showed that "the

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joint use of [target price/]deficiency payments and production controls clearly dominates use of either one individually" (p. 58) when government's objective is either to maximize a weighted social welfare function (SWF) or to maximize social welfare subject to a given welfare (income) ratio between producers and consumers/taxpayers.

Similarly, Innes and Rausser (1989) and Innes (1990) proved in a different stochastic setting (uncertainty in producer price and production), and based on a weighted social welfare function, that "production control is . . . an optimal complement to a target price[/deficiency payments] program" (Innes 1990, p. 53).

Alston and Hurd (1990) analyzed the effects of the excess burden of taxation on the efficiency ranking of alternative policies using the normative criterion of "minimizing the total costs to consumers and taxpayers of achieving a given increase in producer surplus" (p. 150).<sup>1</sup> They noted that "it is always inefficient to specialize in either a[n output] subsidy or a production control for the case when the [social] opportunity cost is one dollar per dollar of government spending" (p. 150). They also proved that, for the case in which there is an excess burden of taxation, "the combined quota and output subsidy policy remains superior to the output subsidy alone" (p. 153).

#### *Output Subsidies and Export Subsidies*

Gardner (1988) found that, for a small country, a combination of output subsidies (a policy that sets a certain price to producers) and export subsidies (a policy that sets a certain price to producers and consumers) is preferable to either of the simple policies alone if the government's objective is to maximize a weighted SWF with different weights to producers, consumers, and taxpayers. A similar result was derived by Alston, Carter, and Smith (1993), who showed that when government attaches a higher weight to taxpayers than to consumers because of the presence of excess burden of general taxation, any amount of transfer to producers can be achieved more efficiently (i.e., at lower social costs) by combining output subsidies and export subsidies than by using output subsidies alone.<sup>2</sup> In addition Alston, Carter, and Smith (1993) showed that in the large country case, using a combination of output subsidies and export subsidies may increase efficiency compared with using output subsidies alone.

#### *Tariff and Production Control*

Guyomard and Mahé (1994) showed, using a static general equilibrium framework, that in the case of

a small country importer, "the level of [social] utility under a production quota with a tariff is greater than the level of [social] utility under a simple tariff" (p. 34).

#### *Price Support and Research Expenditures*

De Gorter, Nielson, and Rausser (1992) used a weighted social welfare function approach to show that combining research expenditures and output subsidies can improve social welfare compared with levels achievable using research expenditures alone (p. 34). Gardner (1992) confirmed this finding for the case of a large country. He also showed that this finding does not "depend upon farmers being economic losers from technical progress" (p. 14), as hypothesized by Tweeten and Coggins (1992). Similarly, de Gorter and Swinnen (1992) showed that joint use of research expenditures and export subsidies increases social welfare subject to a minimum producer welfare constraint.

#### **The General Case: Increasing the Number of Available Instruments Can Increase Efficiency**

Let  $\mathbf{x} = (x_1, \dots, x_m)$  be a vector of policy instrument variables available to a government. A particular value of  $\mathbf{x}$  is called a "policy." Let  $\mathbf{u} = (u_1, \dots, u_n)$  describe welfare levels of  $n$  interest groups affected by government policy. Groups' welfare levels are functions of government policy  $\mathbf{u} = (u_1, \dots, u_n) = (h_1(\mathbf{x}), \dots, h_n(\mathbf{x})) = \mathbf{h}(\mathbf{x})$ .

Let  $X$  be the set of feasible policies (where by "feasible" we mean technically feasible, though not necessarily politically feasible). Then  $F = \{\mathbf{u} \mid \mathbf{u} = \mathbf{h}(\mathbf{x}), \mathbf{x} \in X\}$  is the set of feasible policy outcomes. Now let us examine the effects of one of the  $m$  policy instruments of  $X$  being constrained to a particular value: for example, let us constrain  $x_m$  to be fixed at some level  $x'_m$ . (This level may be a level at which the instrument is not effective, such as when production control is set at a very high positive number, so that it never affects actual production, or such as when a tax is set at zero. What is the same, one can simply assume that  $x_m$  is not available.) The new set of feasible policies may then be defined as  $X' = \{\mathbf{x} \in X \mid x_m = x'_m\}$ . Clearly  $X' \subset X$ ; the new set of feasible policies is a subset of the original set of feasible policies. Therefore it must be that the new set of feasible policy outcomes is a subset of the original set of feasible policy outcomes:  $F' = \{\mathbf{u} \mid \mathbf{u} = \mathbf{h}(\mathbf{x}), \mathbf{x} \in X'\} \subset F = \{\mathbf{u} \mid \mathbf{u} = \mathbf{h}(\mathbf{x}), \mathbf{x} \in X\}$ . That is, any policy outcome achievable when only a subset of the  $m$  original instruments is available is also

achievable when all  $m$  instruments are available. (That is, a government could always choose not to use some of the available instruments.) Conversely, there can be policy outcomes achievable with all  $m$  instruments that are not achievable with any subset of those  $m$  instruments. *Therefore, no matter the definition of "efficiency" (or "social welfare") used, making more policy instruments available cannot decrease, and may increase, efficiency (or social welfare).*

To examine the points made above in more depth and to see how they relate to the literature, let  $W: \mathbf{u} \rightarrow R$  describe government's objective function (or a social welfare function, or some function measuring "efficiency," however defined). Let  $\text{con}[\mathbf{h}(\mathbf{x})]$  represent an optional constraint equation or inequality involving the welfare of interest groups. Let government's (or society's) decision problem be given by:

$$(1) \quad \text{Max}_{\mathbf{x} \in X} \{W(\mathbf{h}(\mathbf{x})) \text{ s.t. } \text{con}[\mathbf{h}(\mathbf{x})]\}^3$$

Hence the problem might be to maximize the sum of welfare of producers, consumers, and taxpayers subject to a given welfare ratio between producers and consumers/taxpayers, as in Just (1984); or the problem might be to maximize the welfare of consumers and taxpayers subject to having producers achieve some given welfare, as in Alston and Hurd (1990); or the problem might be to maximize a weighted linear social welfare function under no constraint, as in de Gorter, Nielson, and Rausser (1992).

Now let us examine the effects of one (or more) of the  $m$  policy instruments of  $X$  being constrained. Again, we assume that  $x_m$  must be fixed at some level  $x'_m$ . Then government's problem is

$$(2) \quad \text{Max}_{\mathbf{x} \in X' \subset X} \{W(\mathbf{h}(\mathbf{x})) \text{ s.t. } \text{con}[\mathbf{h}(\mathbf{x})]\}.$$

A policy  $\mathbf{x}^*$  found by solving the maximization problem (1) is said to be at least as efficient (or politically desirable, or socially desirable, etc.) as policy  $\mathbf{x}'$  found by solving (2) if  $W(\mathbf{h}(\mathbf{x}^*)) \geq W(\mathbf{h}(\mathbf{x}'))$ . Because the choice vector  $\mathbf{x}$  in (2) must be chosen from  $X' \subset X$ , and the choice vector  $\mathbf{x}$  in (1) can be chosen from  $X$  itself, the maximization problem (2) is more constrained than is the maximization problem in (1). It follows that for any policy  $\mathbf{x}'$  that solves (2), a policy  $\mathbf{x}^*$  can be found that solves (1) such that  $W(\mathbf{h}(\mathbf{x}^*)) \geq W(\mathbf{h}(\mathbf{x}'))$ . Therefore a government that can choose the levels of  $m$  policy instruments must be able to attain policy outcomes that are at least as efficient (socially desirable, politically desirable, etc.) as those it can attain if it has only a subset of those  $m$  policy

instruments available (or if one or more of the  $m$  policy instruments are fixed at certain levels).

## Discussion

Nothing in our analysis says that it will always be optimal to use all policy instruments available. The question of whether an additional available instrument actually will be used in the optimal instrument combination and hence will increase efficiency is an empirical inquiry depending on market conditions (e.g., demand and supply elasticities), the government (social, political) objective function, implementation costs, the consideration of multimarket effects, uncertainty, dynamic effects, and so on. The results of the quoted papers are interesting and important in showing that, given some assumed conditions, the additional instrument will actually improve efficiency. However, our analysis does show that it never hurts to make more instruments available for use. Though this general result is rather obvious once viewed from our framework, it has remained unrecognized in the literature. The importance of our results is best understood with the fact that some studies have found results of combined policies being less efficient than single policies. Our results make clear that these studies have failed to consider optimal policy instrument combinations.<sup>4</sup>

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## Notes

1 Note that this is the same as maximizing the welfare of consumers and taxpayers subject to a given level of producer welfare.

2 In fact, Gardner (1988) discussed a combination of deficiency payments and consumption tax, but as shown by Alston, Carter, and Smith (1995), this is consistent with what Alston, Carter, and Smith (1993) called a combination of output subsidies and export subsidies.

3 According to the reviewed articles and normative economics in general, government's decision problem is assumed to be welfaristic, i.e., it depends solely on individuals' (or groups') welfare.

4 For example Gisser (1993) found that a combination of target price and acreage controls was more efficient in the case of corn, wheat, rice, and cotton, but less efficient in the case of feed grains.