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Policy Preference Functions: The Implications of Recent Developments

Abstract: The policy preference function (PPF) approach continues to be the subject of considerable interest in agricultural economics. Recent work has added sophistication and strengthened the approach's theoretical underpinnings. In this paper, several implications of this recent work are considered. First, the distinction between the PPF and the surplus transformation curve (STC) is stressed. Estimated PPF weights are derived from what we know about the STC. We actually know very little about the PPF itself. Second, the relationship between the number of interest groups and the number of policy tools in PPF models is discussed. The relationship that is mathematically necessary may not correspond to that which is suggested by our intuition about reality. Hence, it may be that PPF modelling is often inappropriate. Finally, the stochastic nature of PPF estimates is discussed, and a simple method for quantifying the variability of these estimates is illustrated.

INTRODUCTION

The last two decades have seen a sustained interest in the policy preference function approach[1]. Recent work has added sophistication and strengthened the approach's theoretical underpinnings. For example, Bullock (1993) investigates the basic assumptions and methodology of the PPF approach; Love, Rausser and Burton (1990) develop more sophisticated methods of estimating and validating PPFs; von Cramon-Taubadel (1992) considers the interpretability of empirical PPF results.

In this paper I explore some implications of this recent work. As Bullock (p.1) points out, 'Though PPF studies have appeared frequently over the past two decades, explanation of their methodology is sparse'. His formal analysis of the basic assumptions of revealed PPF studies leads to several important insights. I begin by discussing two of these insights; the importance of the distinction between the STC and the PPF, and the relationship between the number of policy tools available to the policy maker and the number of interest groups that are influenced by these tools. Second, inspired by Love, Rausser and Burton, I discuss the stochastic nature of PPF estimates.

WHAT DO WE REALLY KNOW ABOUT THE PPF?

It is important to recognize that revealed PPF weights measure the marginal rate of transformation at a point on the STC and that this STC is conditional on the welfare measures that are assumed to motivate the pertinent interest groups. The local characteristics of the PPF itself are only deduced *indirectly* based on the *assumption* that the PPF has been maximized and, therefore, must be concave and tangent to the STC at this point[2].

Hence, empirical PPF results simply tell us that the policy maker's preferences could be represented by any function that is tangent to the STC at a certain point while restricting

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the degree of convexity of this function's contours[3]. This isn't very much; indeed, a cynic might argue that economists have, once again, mathematically belaboured a simple fact — that governments in industrialized nations generally choose to transfer income to farmers, despite the inevitable dead-weight losses.

Suppose we are interested in more. For example, suppose that we wish to identify which changes in PPF weights reflect shifts in political preferences and which changes result from shifts in the STC (von Cramon-Taubadel, p.376ff) or to predict how a policy such as the EU's intervention price for milk will respond to a change in the world market price. To address such questions, we need more information about the PPF than just its slope at a number of points in time. Broadly speaking, there are two approaches to gathering such information depending on whether or not we are willing and able to estimate an explicit functional form for the PPF (Oskam, 1988).

If we do not wish to specify a functional form, revealed preference theory provides tests that can be used to determine whether an observed series of prices and consumption bundles is consistent with stable preferences. Hence, as a first step, it is possible to use empirical PPF results to test whether a policy-maker's preferences have changed over time. However, it is well known that these tests are not strong[4]. In von Cramon-Taubadel's application to the EU's wheat and barley policies, tests of WARP and SARP indicate that the policy-maker's preferences did not change between 1973 and 1989, even though, *a priori*, we might expect that they did[5]. Applications to countries that have witnessed major changes in farm policies — New Zealand in 1984, the EU in 1992 — could help determine whether these tests can help add to what we know about the PPF.

A potentially more fruitful approach is to try to estimate a specific functional form for the PPF. If we could estimate such a function, we would, for example, be able to make conditional forecasts of policy behaviour. Oskam (1988) argues in favour of this approach and discusses several functional forms that are both simple to employ and flexible. Love, Rausser and Burton discuss the relationship between the game structure that is assumed to underlie the policy making process and the form of the PPF.

Unfortunately, most agricultural applications are likely to be hampered by a lack of degrees of freedom. In practice, we only observe one policy-maker's reaction to different sets of conditions on the political market. Because observations are usually annual, the resulting time series are short. In the case of the EU we are limited to perhaps 25 observations, which is few in comparison to the number of parameters implied by even a simple model[6]. Oskam (1988) and Oskam and von Witzke (1990) suggest increasing the number of available observations by using information contained in so-called 'non-decisions' — alternative tools and/or levels of tools that the policy-maker has considered but decided not to implement. Such information can result in a more accurate specification of the STC and, hence, add to what we know about the PPF. However, as Oskam (p.36) acknowledges, it is difficult to define a non-decision[7].

In the procedure outlined by Love, Rausser and Burton the question of degrees of freedom is addressed first by considering at least $g-1$ policy tools simultaneously, where g is the number of PPF parameters, and second by using time series data. As will be discussed below, the first suggestion may not be feasible. As regards the use of time series, it was pointed out above that these are generally short. Moreover, Love, Rausser and Burton (p.11) note themselves that empirical PPF analysis typically deals with reduced form specifications that do not explicitly define an underlying political structure. This abstraction is necessary because the variables that describe the political structure —

lobbying costs and strategies, for example — are generally unobservable. However, the functional form of the PPF and the PPF weights themselves depend on these variables. Hence, if the political structure is not constant over time, it is not reasonable to treat time series data as a series of observations on one function.

Finally, it is important to recognize that all increases in our knowledge of the PPF that result from assumptions regarding its form are entirely conditional on these assumptions. There is no sense in which the data have been made to reveal more; we have more information *ex post* because we have added it *ex ante*. No matter how we twist and turn, empirical PPF weights only describe the slope of a many dimensional and possibly shifting function at a relatively small number of discrete points.

INTEREST GROUPS AND POLICY TOOLS: THE STRUCTURE OF PPF MODELS

Bullock (1993, p.10ff) analyses the relationship between the number of distinct interest groups whose welfare the policy maker is manipulating (n), and the number of policy tools at the policy-maker's disposal (m). The structure of the PPF model is such that a unique solution — in other words, a unique set of PPF weights — is only guaranteed if the number of available tools equals the number of interest groups less one, $m = n - 1$. If $m < n - 1$, an infinite number of solutions exist, and if $m > n - 1$, there will be either one solution or none at all. In the latter case, a solution will only exist if government policies are efficient, in other words, if the relative PPF weights implied by the chosen levels of each policy tool are equal[8]. Bullock (p. 18) suggests that in the case where the number of policy tools is 'too large' relative to the number of interest groups $(m > n - 1)$, the PPF method will 'generally' fail to find a solution.

This result has important implications for many aspects of PPF work. Consider first Love, Rausser and Burton's result that in order to estimate the PPF, the number of policy tools considered must greater than or equal to the number of PPF parameters less one, $m \geq g - 1$. g will depend on both the functional form that is chosen and n, the number of interest groups considered. Generally, g will be considerably larger than n; in the example discussed above (Footnote 4), $g = 9$ and $n = 3$. However, if $m \geq g - 1$ and $g > n$, then $m > n - 1$ and we are unlikely to find a unique solution to the PPF problem. Hence there appears to be a contradiction between the constraints that must be imposed to estimate PPFs and the conditions that ensure that the PPF can be solved for a unique set of weights.

This result also has implications for the construction of PPF models. In constructing a PPF model, it is generally necessary — if only for reasons of simplicity — to make aggregation assumptions regarding m and n. However, as Bullock (p.12) states, 'If after objective preliminary study the $m = n - 1$ assumption does not seem reasonable, it may be that the political power of interest groups cannot be reasonably measured using PPF methodology'. Intuition on the relative sizes of m and n can run in two directions. Arguments such as Lee's (1989, p.188) — that nearly 20 interest groups lobbied in connection with sugar policy in the 1985 US Farm Bill — suggest that n may be larger than m and is certainly larger than PPF studies usually assume. On the other hand, it may be that many of these groups had largely overlapping interests, thus reducing n.

Furthermore, the size of m depends on how we define feasible policies, or what is included in Oskam's definition of a non-decision. An example is the EU's wheat policy. If we consider only the intervention price — which has determined producer and consumer prices for most of the CAP's history — then $m = 1$ and it is only possible to derive relative PPF weights for two interest groups. If we wish to derive weights for three groups, m must be increased. One option is to assume that the intervention price is really two tools, a producer price and a consumer price, that have been explicitly pegged the same level year after year. Another option might be to add a policy tool in the form of a non-decision. For example, we could assume that the policy maker has considered the use of deficiency payments each year, but decided not to implement them, that is, set them equal to 0. If this is a valid approach, then m can be made quite large indeed and we may find ourselves permanently faced with the difficult $m > n - 1$ situation.

THE STOCHASTIC NATURE OF ESTIMATED PPF WEIGHTS

To quote Love, Rausser and Burton (p.20), 'A major criticism of previous work on PPFs is that the stochastic nature of estimated parameters has been swept aside'. The authors proceed to identify two sources of uncertainly in the PPF. One source might be labelled economic. Uncertainty arises — even if we assume that we have identified the correct measure for interest group welfare — because we are not sure exactly how policy changes are translated into changes in interest group welfare. The other source is political. The policy-maker cannot be sure that the welfare changes he generates will have the desired political results because he does not know exactly how welfare changes are translated into interest group activity by the political process — in essence, the policy-maker does not know exactly what the PPF weights are.

The latter, or political, source of uncertainty may not be important for attempts to estimate reduced form PPFs. The policy-maker may not be sure exactly which set of PPF weights prevails and, hence, which set of transfers maximizes his utility. Nevertheless, we can reasonably assume that he will base his decision on a set of expected weights. Hence, it may be possible to ignore political uncertainty as long as we are not interested in estimating the parameters that relate PPF weights to underlying political variables. In a sense, we can acknowledge this source of uncertainty and proceed to analyse the 'expected' PPF.

It is more difficult to dismiss economic uncertainty. PPF weights are derived by measuring the slope of the STC at the point that corresponds to the chosen levels of policy tools. Our estimates of this slope are conditional on the estimates of market parameters such as elasticities that we employ. Again, we might assume that the policy-maker bases his decision on a set of expected values for these parameters; nevertheless, we do not know what these expected values are. If the policy-maker's expected parameters differ from those that we employ, then the PPF weights that we calculate will differ from those that are actually implicit in his decisions.

The following analysis takes a very simple and purely illustrative approach to investigating the impact of this problem on the confidence that we can have in estimated PPF weights. A simple two-group (producer and consumer/taxpayer) PPF model of the EU's wheat market was constructed as outlined in Sarris and Freebairn (1983) using linear supply and demand functions and supply and demand elasticities of 0.2 and −1.3, respectively. Assume that these elasticities have been estimated econometrically and are significantly different from 0 at exactly the 5 percent level. Hence, they have *t*-values of roughly 2 and standard errors of 0.1 and 0.65, respectively[9]. Next, although we do not know exactly what elasticities the policy-maker uses, assume that different values are used according to these distributions. In other words, assume that the policy-maker is most likely to use elasticity values that are close to our econometric estimates and, following a *t*-distribution, less likely to use values that differ.

For each marketing year between 1973 and 1991, the PPF model was solved 5000 times, each time using actual EU data on wheat prices and quantities, and a pair of elasticity values drawn randomly from the above distributions[10]. The result was a set of 5000 consumer and producer PPF weights — p and c respectively — for each year. Using these results, the range that contains 95 percent of the p/c ratios was calculated for each year. This analysis was repeated under the assumption that the supply and demand elasticities are significant at the 1 percent {0.1 percent} level (*t*-values of roughly 2.6 {3.3} and standard errors of 0.077 and 0.5 {0.061 and 0.4}, respectively) and the results are presented in Figure 1.

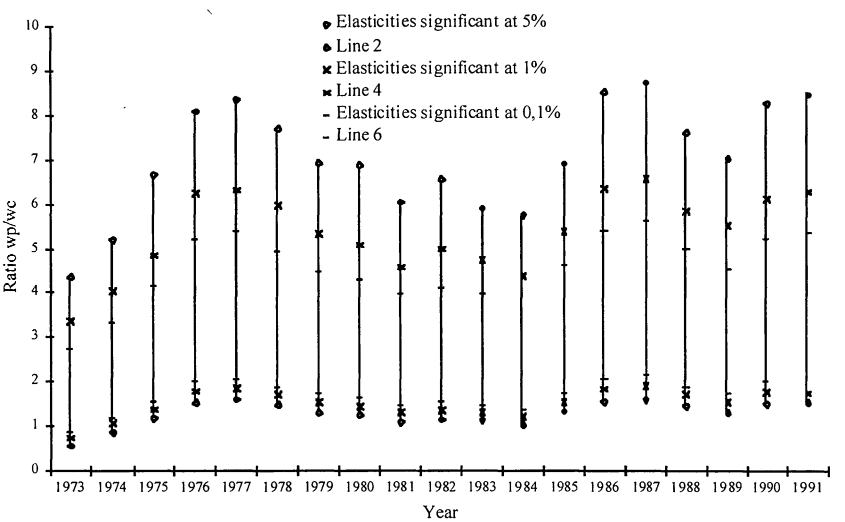

Figure 1 *The Ratio of Producer to Consumer PPF Weights: Simulated 95 Percent Confidence Intervals for EU Wheat Policy 1973–1991*

The ranges displayed in Figure 1 are large, even under the assumption that we have relatively precise knowledge of the supply and demand elasticities that the policy-maker uses. This suggests that we cannot be very certain of estimated PPF weights and that ignoring the stochastic nature of these estimates might be misleading. For example, Bullock (1993, p.16ff) estimates a simple PPF model of the US wheat market that includes 2 groups (producers and consumer/taxpayers) and 2 policies (acreage control and an export subsidy). Since $m > n - 1$, this model will only yield a solution if policy is efficient as discussed above. Bullock's results indicate that policy is not efficient since the ratios p/c corresponding to the two policy tools are not equal; one ratio is 1.09 and the other is 2.04[11]. However, this difference is well within the ranges displayed in Figure 1 and may not be large enough to enable us to conclude with reasonable certainty that policies are inefficient.

Of course, these results depend critically on the underlying assumptions — in particular the distributions associated with the elasticities of supply and demand, and the assumption that the unknown elasticities used by the policy maker are drawn from these distributions. Bullock draws his conclusions from a completely different PPF model which might be less susceptible to the uncertainly discussed here. Refining this analysis would be an interesting area for further research.

CONCLUSIONS

The main conclusions that must be drawn from the discussion above seem quite discouraging. We do not know very much about the PPF itself beyond a few revealed points and some basic assumptions about its shape. The prospects for finding out more about the PPF from observations alone are not very encouraging. Hence, our ability to make predictions and detect changes in policy preferences on the basis of empirical PPF work remains limited.

At the same time, the construction of PPF models seems to be caught between often contradictory mathematical and practical considerations. The relationship between the numbers of interest groups and policy tools has important implications for the tractability of PPF models and more careful consideration must be given to reasonable criteria for determining both. In particular, if we define the number of policy tools broadly to include any tool that might reasonably have been used, we may find ourselves consistently concluding that observed policy is not efficient and, hence, that the PPF approach is not valid.

Finally, preliminary results suggest that the confidence intervals associated with estimated PPF weights might be fairly large. These results are based on several very contestable assumptions, but the simulation method used could be refined and generalized. More information on issues such as these is needed if PPF analysis is to become a useful practical tool.

NOTES

1 See Swinnen and van der Zee (1993) for a brief summary of the literature.

2 Bullock (1993, pp.7–10) is the first to make this point clearly and demonstrate that a number of researchers have failed to appreciate it. For example, von Cramon-Taubadel (1992, p.389) claims that a PPF he estimates is not concave in the policy tools he considers. However, his tests actually indicate that the STC is not concave. Hence, his results cannot be interpreted as a failure of the PPF method. Love *et al.* (p.17) also claim erroneously that second order conditions on the PPF must be checked to ascertain that the PPF has been maximized.

3 Specifically, the PPF contours must be at least more convex than the STC in the case of a (locally) convex STC. Beghin and Foster (1992, p.789) recognize that any second order tests which are carried out will pertain to the STC and not the PPF, but do not explicitly acknowledge the possibility of an optimum at a point where the STC is convex.

4 I thank David Bullock for pointing out that this is especially true if the STC is not linear, in other

words if the marginal rate of substitution is not constant as it is in the case of linear constraints in Varian's tests.

[5] For example, in the mid-1980s when the EU adopted a more conservative price policy and enlarged to include Spain and Portugal.

[6] With only three groups, the simple second order quadratic form discussed by Love *et al.* (1990, p.13), for example, involves 9 parameters.

[7] For example, we might consider the EU's direct income transfers to grain producers as feasible but rejected prior to 1992 — in other words, a non-decision. However, perhaps these transfers were never seriously considered prior to 1992 and, hence, cannot be considered a non-decision.

[8] See Bullock (1993, p.16ff) and Beghin and Foster (pp.788–789).

[9] For simplicity these estimates are assumed to have a covariance of 0.

[10] Simulations were performed using the random number generator in GAUSS.

[11] Bullock (1993, p.17), transformed to make them comparable with the results in Figure 1.

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