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INTRODUCTION AND SUMMARY OF STUDY

1. Introduction

In the UK, as in other countries, there has been substantial discussion in recent years of tax reform. Many of the problems and difficulties encountered by the UK economy have, at times, been attributed to the structure of the tax system, and over the years both politicians and academic economists have produced a number of alternative proposals for tax reform. The Report of the Royal Commission on Taxation (1966), and more recently the Meade Report (1978), are evidence of this continuing interest. In spite of pressure for change, however, quantitative analysis of the effects which taxes and subsidies produce (especially those on resource allocation) remains surprisingly sparse, both in the UK and elsewhere.

In this study we use a conceptual approach, widely explored in theoretical literature in public finance, to analyze the impacts of the UK tax/subsidy system on the allocation of resources and the distribution of income using 1973 data. We explore general equilibrium efficiency and incidence effects of taxes and subsidies, emphasizing a numerical, empirically oriented version of this well-known approach. In Part I of the study we describe the structure of the model we use. Part II reports our empirical results.

The approach used is to build a general equilibrium model using explicit demand and production functions. In the model all markets clear in equilibrium. Demands equal supplies for both goods and factors, and no industry does any better than break even in terms of profitability. Equilibrium conditions hold both in the data which we use for the benchmark solution for the model, and in the counterfactual equilibria which we simulate for alternative policy regimes. We assume full employment of all factors, an absence of any monetary non-neutralities and complete information, all of the assumptions characteristic of classical general equilibrium analysis. The use of the model is based on the belief that the essence of the behaviour of the economic system is captured through a sequence of market interactions which are distorted through government intervention. Though highly stylized and excluding many features of actual economies, this approach is widely used in the analytical literature in public finance. On that basis it provides the framework for our analysis, even though we abstract from many important phenomena (such as unemployment).

The model incorporates production functions for UK industries and demand patterns for households and incorporates the distorting effects of the major taxes and subsidies which operate. We work with a basic variant model into which we incorporate a number of extensions as model alternatives. Counterfactual equilibria generated by alternative policies to those which charaterize the assumed base year of 1973 are compared to a base period equilibrium. We emphasize welfare and distributional comparisons between equilibria, and summarize the implications of our results for tax/subsidy policy in the UK.[1]

2. The Basic Structure of General Equilibrium Tax Models

The central idea underlying general equilibrium analysis of tax policy is that in order to evaluate the effects of changing a major tax, important economy-wide effects must be taken into account. Taxes distort the allocation of resources in the marketplace by causing resources to be used where productivity is lower than elsewhere and commodities to be offered to consumers at tax distorted prices adversely affecting consumer choice.

The basic analytics of general equilibrium tax models can be illustrated with the aid of diagrams depicting a two-factor, two-product, perfectly competitive economy, with fixed aggregate factor supplies, and, for convenience, consumers with identical, homothetic preference functions. In the absence of externalities and government interventions, such an economy will, in equilibrium, satisfy all the marginal conditions required for a Pareto optimal allocation. With distorting taxes this will no longer be true.

Figure I.1 depicts the simple case of a consumption tax on product X in a two-commodity economy. We consider a single consumer who selects from alternative combinations of the two goods X and Y represented by the economy's production possibilities frontier. The revenues from the tax are returned in lump sum form to the single consumer. Productive efficiency is not affected since the economy remains on the production possibility frontier AB, but the product mix is altered by the tax. The tax produces a distortion between the marginal rate of transformation (MRT) (the net of tax price ratio facing producers) and the marginal rate of substitution (MRS) (the gross of tax price ratio facing consumers). In an equilibrium in the presence of the tax (point F), consumers adjust their purchases so that their marginal rate of substitution equals the gross of tax commodity price ratio. The consumer price ratio exceeds the ratio of prices received by producers since these are net of taxes. The distorted equilibrium at point F corresponds to a lower indifference curve than that associated with the undistorted equilibrium at point E. Because MRS ' MRT the allocation of resources corresponding to point F cannot be Pareto optimal.

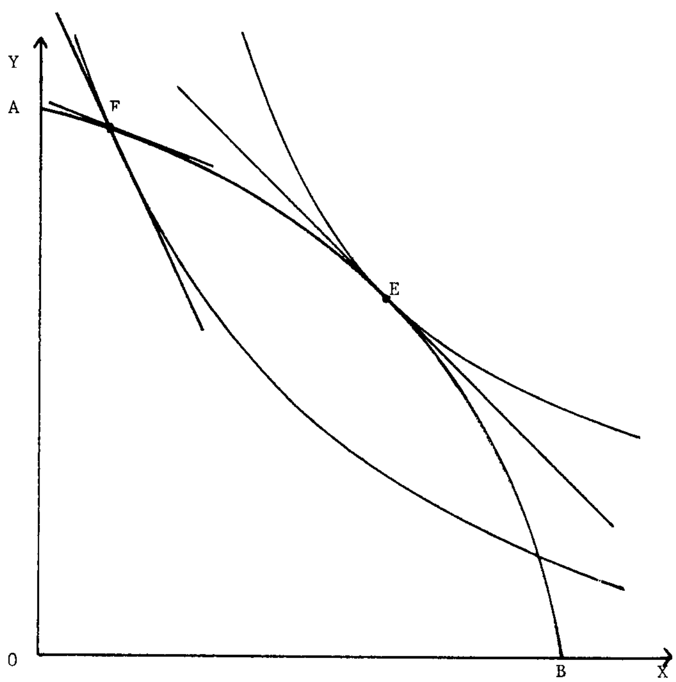
A consumer tax which induces a move along the production possibility frontier from E to F may also have other effects beyond those represented in the diagram. One issue frequently analyzed is the incidence of such a tax. In the two-sector framework, this usually involves functional incidence analysis; the impact on the income return to the two factors, capital and labour. The functional incidence of the tax in Figure 1 will depend upon the relative factor intensities of the two industries and cannot be analyzed simply by the same diagram. A proposition from the literature on the Harberger model (see Mieszkowski [1969]) is that the factor which is relatively intensively used in the taxed industry will bear some of the burden of the tax; whether it will fully bear the tax burden, however, depends on the parameters of demand and production functions.

The two sector framework represented in Figure I.1 is not confined to analyzing tax distortions of choices by consum-

FIGURE I-1

Simple Analysis of a Distorting

Consumer Tax on Good X



ers among commodities, as one ordinarily thinks of them. Any household decision distorted through the tax system can be fitted into this framework. Distortions of household choices between labour and leisure, and between present and future consumption can be analyzed analogously.

A similar framework can also be used to analyze tax distortions of production decisions. Figure I.2 contains an Edgeworth box diagram showing the effects of a tax distortion on the production side of the economy induced by a tax on the use of one factor in one industry. We consider a tax on the use of capital in industry X. Because of the tax, the marginal rate of substitution between factors will differ between industries. In Figure I.2, A is a point on the contract curve where the marginal rates of substitution between factors are equalized, while B is a point where, because of the tax on capital use in X, the marginal rates of substitution differ across industries. In this case the economy will not operate on its production possibility frontier in the presence of the tax, and Pareto optimality is not attained. Either labour or capital can bear the burden of the tax, depending on the factor intensities and substitution possibilities in the two industries.

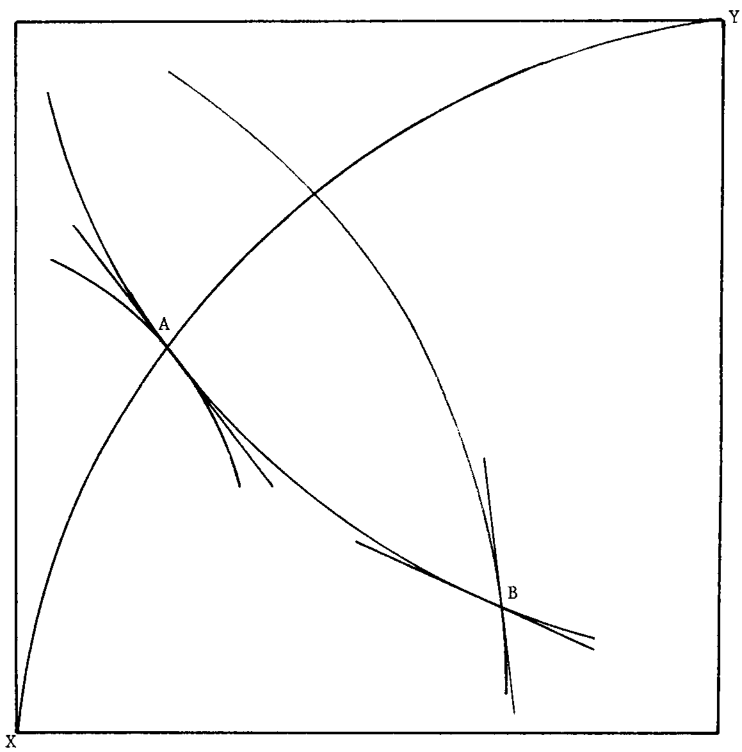
3. Quantitative Assessment of General Equilibrium Tax Effects

In our modelling, we attempt to go beyond the diagrammatic framework outlined above by using a numerical higher dimensional approach. The need to quantify, however imperfectly, we see as an integral element of the process through which policy decisions are made.

There are two active strands of research activity which address this problem of quantification of general equilibrium impacts of taxes. The first begins with the pioneering efforts of Harberger (1959, 1962, 1966, 1974); the second is the algorithmic approach which builds on the work of Scarf (1973). To place our study in the context of these developments we briefly review each.

FIGURE I-2

Simple Analysis of a Factor Tax Distortion



a. The Harberger General Equilibrium Tax Model

In the general equilibrium tax literature, Harberger's contributions (1959, 1962, 1966, 1974) have been of landmark proportions. Earlier contributors such as Rolph (1952) and Musgrave (1959) had pointed out both the general equilibrium nature of tax incidence, and the need for a general equilibrium approach. But it was Harberger who provided public finance with the explicit general equilibrium model that met this need. While our formulation goes further than Harberger in many ways, the dependence of our work on these developments will be obvious to anyone familiar with the literature.

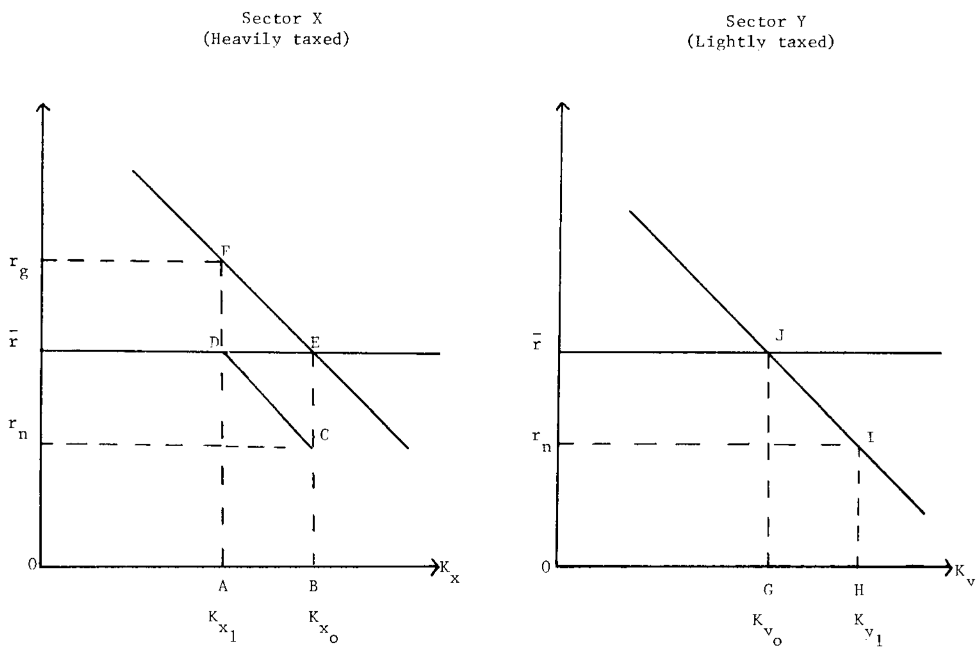
The Harberger model is based on standard neo-classical assumptions. He assumes fixed aggregate factor supplies; perfect factor mobility between industries; two factors and two products; perfect competition in factor and product markets; a closed economy (no foreign trade); linear homogeneous production functions; and a one-distortion economy.[2]

This model, with particular values of elasticities of substitution in production and demand, is able to generate estimates of the incidence and efficiency effects of particular taxes. The model is represented by a reduced form of three equations, and changes in tax rates are evaluated through the model. Strictly speaking, only infinitesimally small changes in taxes and their comparative static impacts upon other variables can be considered, and for discrete changes the analysis provides only approximate results. Perhaps the most famous numerical finding from this model is that the US corporate tax is borne by all capital owners, whether or not their capital is used in incorporated enterprises.

Harberger also develops a procedure for estimating the size of the welfare cost of a distortionary factor tax. In the case of capital taxation distortions, he considers the economy to be represented by two sectors, "heavily taxed" and "lightly taxed". These are labelled sectors X and Y in Figure I.3. Each sector uses capital in production, and marginal revenue product schedules are assumed to be linear

FIGURE I-3

Harberger's Two-Sector Analysis of Efficiency Impacts of Distortionary Capital Taxation



(a local approximation). The economy has a fixed capital endowment. In the absence of any taxes, market forces will ensure that capital is allocated between the two sectors such that the rate of return $\bar{r}$ in each is equalised, and the capital endowment is fully employed. If, instead, a tax on capital income in sector X operates, the gross rate of return r_g in that sector must be such that the net rate of return r_n is equalized across the sectors, and capital is again fully employed. The difference between r_g and r_n is the tax on each unit of capital utilized in sector X.

In Figure I.3, the tax and no tax situations are characterized by the capital allocations K_{x_1}, K_{y_1}, and K_{x_0} and K_{y_0} respectively. The area ABEF represents the loss in output in sector X when K_x decreases from K_{x_0} to K_{x_1} as the tax is imposed. GHIJ represents the increase in output of sector Y. Full employment guarantees that $K_{x_0} - K_{x_1} = K_{y_1} - K_{y_0}$. The area FECD (= ABEF-GHIJ) represents the efficiency cost of the tax, L, and is given by:

$$L = \frac{1}{2} T \Delta K_x$$

where T represents the tax distortion $r_g - r_n$, and ΔK_x is the change in capital use in sector X from the removal of the tax. Harberger finds a solution for ΔK_x by solving a system of three reduced form equations describing the local behaviour of the two sector general equilibrium model. This form of calculation has been generalized by Harberger (1964) into an extension of the famous welfare loss formula due to Hotelling (1938). In spite of the simplicity of the procedure, a number of difficulties are immediately apparent, not the least of which is the reliance on local approximations when the large changes often associated with tax distortions are being analyzed. In addition, it is unclear how the Harberger procedure can be applied where several distortions simultaneously operate and change together. The approach used in this monograph extends the Harberger literature in both of these directions.

b. The Algorithmic Approach

In a series of papers beginning in 1972, Shoven and Whalley have presented an alternative approach to general equilibrium analysis of taxation which does not rely on local approximations nor limit analysis to single distortions. Their work builds on an algorithm due to Scarf (1967, 1973) which makes possible the computation of general economic equilibria using fixed point techniques. In applying these methods to general equilibrium with taxes Shoven and Whalley (1973) present both a computational procedure and an existence proof. In subsequent papers, Shoven and Whalley (1974, 1977) have extended the approach to capture international trade distortions and equal yield tax alternatives. In essence, these techniques permit full general equilibria associated with alternative tax regimes to be computed and compared. Policy regimes may involve the simultaneous operation of many different taxes and subsidies. Since 'true' general equilibria are computed, localization approximations are not required, and large changes may be analyzed with somewhat more confidence than under Harberger procedures.

The empirical implementation of this approach in the present study embodies a higher dimensional version of traditional two sector general equilibrium models. This yields a number of advantages over earlier attempts to deal with incidence and efficiency questions associated with tax policy.

Firstly, considerable disaggregation of commodities and consuming groups is possible. This allows incidence analysis to focus on the size distribution of personal income, rather than solely on factor incomes. It also permits a more general representation of tax distortions, which treats alternative agents, factors and commodities differently. Taxes and subsidies can be introduced on all transactions, so that multiple tax instruments can be represented and changed simultaneously.

Secondly, the extension of this approach to include equal yield alternatives makes possible differential incidence calculations. These are easier to interpret than the incidence experiments associated with the Harberger approach, or