THE INCIDENCE OF NON-DOMESTIC PROPERTY TAXES

by

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SUMMARY

The thesis endeavours to infer the effective incidence of the non-domestic property tax in the UK.

Chapter 1 briefly describes the history of the property tax and the existing rating system. In addition, the chapter examines the formal incidence of the tax and its purported merits and deficiencies.

Chapter 2 investigates the neoclassical theory of property tax incidence and focuses on the development of general equilibrium incidence analysis.

In contrast, Chapter 3 describes the Post-Keynesian theory of tax incidence and suggests an amendment to a model which is found to yield theoretically inconsistent results.

Chapter 4 reviews the existing empirical work on the impact of the non-domestic property tax in the UK. It is argued that most of these studies are based on theoretically inconsistent models, and hence do little to dispel doubts about the incidence of the tax.

In an attempt to remedy this deficiency, Chapter 5 develops a theoretical general equilibrium model, which is used to infer the incidence of the non-domestic property tax. The results suggest that much of the non-domestic property tax burden is borne by firms.

However, general equilibrium incidence estimates are based on a plethora of stringent assumptions which are merely imposed on the data rather than statistically tested. It would therefore seem useful to use an alternative procedure to estimate the impact of the non-domestic property tax. Chapter 6 thus examines the various quantitative techniques employed in public finance to infer the incidence of taxes. It is suggested that econometric procedures, while not perfect, provide a method for discriminating between competing theories and deriving data coherent estimates of tax incidence.

Chapter 7 develops an econometric model which is used to infer the degree of short run property tax shifting. The investigation is based on a theoretically derived model of mark-up pricing. The chapter further examines the process by which agents form expectations of output and costs, and the impact of demand factors on prices and the mark-up. The results suggest that much of the non-domestic property tax burden is borne by firms. The chapter ends with a discussion of the theoretical implications of the empirical exercise.

Finally, Chapter 8 summarises the main results of the study and emphasises the contribution of incidence theory. The thesis concludes with suggestions for future empirical and theoretical research.

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CHAPTER ONE

INTRODUCTION

Rates or property taxes are of considerable antiquity and have their origins in the Poor Relief Act of 1601. However, the history of the rating system has been one of recurring controversy and arguments, with no apparent solution. The property tax system has been reviewed by Government Commissions in 1901, 1914, 1969, 1971 and 1977[1], to cite but a few occasions, and proposals for its reform or abolition abound in the literature. Despite this sustained record of criticism, little attention has been paid to the critical issue of the incidence of the property tax. Much of the discussion of the rating system is based on the unsubstantiated assumption that the actual burden of the property tax falls on those who are legally obliged to pay the tax. These studies therefore ignore the crucial distinction between the formal incidence of a tax (i.e. the burden on those who are legally liable to pay the tax) and the effective incidence (i.e. the actual burden of the tax after the economy has adjusted to it). The present study endeavours to remedy this deficiency and seeks to infer the effective incidence of the non-domestic property tax in the UK.

More specifically, the analysis focuses on three particular areas in the voluminous literature on tax incidence which appear to have been particularly productive and illuminating. Perhaps the most significant theoretical development in public finance has been the application of the

Walrasian general equilibrium framework to the analysis of tax incidence. Thus the contribution of the general equilibrium approach to property tax incidence is explored in some detail. However, general equilibrium analysis is based on a plethora of restrictive assumptions which have been vigorously attacked by proponents of the Post-Keynesian paradigm. The Post-Keynesian view of the non-domestic property tax constitutes the second major topic of discussion. Finally, in an attempt to discriminate between alternative theories, and empirically infer the incidence of the non-domestic property tax, econometric techniques have been employed to measure the degree of tax shifting. The analysis is based on the methodological approach pioneered by Kryzyaniak and Musgrave (1963) in their study of the incidence of corporation taxes.

ORGANISATION OF THE THESIS

The thesis is divided into seven chapters of which the first four describe the institutional features of the rating system and theoretical and empirical work on the incidence of the non-domestic property tax, while the final three chapters seek to extend and develop the existing literature, and provide theory based measures of the incidence of non-domestic property taxes in the UK.

Chapter 1 provides an introduction to the rating system and discusses its historical development and quantitative significance. The chapter further examines the purported advantages and disadvantages of the property tax.

It is suggested that these arguments rely on implicit and untested assumptions regarding the effective incidence of the non-domestic property tax. Hence in the absence of a full investigation into the actual burden of the tax, it appears difficult, if not impossible, to evaluate the rating system.

Chapters 2 and 3 review the neoclassical and Post-Keynesian theories of property tax incidence. Chapter 2 traces the development of general equilibrium incidence analysis and explores the incidence of property taxes in neoclassical growth models and under imperfect competition. In contrast, Chapter 3 discusses the Post-Keynesian view of property tax incidence which derives its motivation from recent dissatisfaction with neoclassical incidence theory.

Having examined the theoretical aspects of property tax incidence, Chapter 4 reviews the existing empirical studies on the impact of the non-domestic property tax in the UK. It is argued that much of this work is based on theoretically misspecified and econometrically deficient models, and hence these studies do little to dispel doubts about the effective incidence of non-domestic property taxes.

In an attempt to partly remedy this deficiency, Chapter 5 derives a hierarchical general equilibrium model of property tax incidence which is used to measure the distortionary impact of the tax. General equilibrium analysis is, however, based on a plethora of stringent assumptions and hence these results may be criticised as misleading.

Thus Chapter 6 examines the various quantitative techniques which are used in public finance to measure the incidence of taxes. The chapter discusses the income distribution approach, general equilibrium analysis and the econometric approach. It is suggested that both the income distribution and general equilibrium approaches rely on highly restrictive assumptions which are imposed on the data rather than empirically tested and these therefore appear to be of questionable value. In contrast, the econometric approach, while not perfect, provides a framework for testing theories and generating data consistent estimates of tax shifting.

Hence, Chapter 7 endeavours to econometrically infer the extent to which the non-domestic property tax is shifted onto other agents in the economy. The analysis is based on a general model of mark-up pricing and employs the statistical procedures pioneered by Hendry (1980) et al. The chapter ends with a brief discussion of the theoretical implications of the results.

Finally, Chapter 8 summarises the main conclusions of the study. It emphasises the contribution of incidence theory and the implications of the empirical analysis.

1.1 HISTORY OF THE RATING SYSTEM

The property tax or rates are one of the oldest taxes in Britain and, as noted earlier, have their origins in the Poor Relief Act of 1601. In earlier centuries, relief of the poor was a matter for charity, much of which was administered by the church. It was thus natural that the Act of 1601 made the parish the administrative unit for rating and confered on church-wardens the power to tax the inhabitants of the parish whatever sums were deemed to be necessary. Since rates were levied primarily for redistributive purposes, the principle of *juxta facultates* dictated that poor relief should be paid for by greater contributions by the rich than the poor. Few people in the seventeenth century earned salaries and property was the primary source of income, hence a tax on property approximated to a local income tax levied according to ability to pay.

At first, poor relief was the only purpose for which rates could be levied, but as other local government services developed, new charges were added to the poor rate. For such beneficial local expenditure, it was viewed as desirable to relate tax payments to benefits received. It was customary to assume that the benefits of local government services were proportional to the value of property, hence a tax on property could also be treated as a benefit tax. Thus for instance, Cannan (1896) argued that: "in practice, the nearest approximation to ability and the benefit are one and the same thing, namely the rating of persons in respect of fixed property". In recent years, the emphasis has changed and few commentators are now willing to justify a property tax either in terms of ability to pay or the benefit principle, for property is no longer the main source of income and there is no necessary relationship between the quantity of services received and the value of property.

Over the next three centuries, particular aspects of the rating system figured prominently in several enactments and were the subject of numerous official reports. Eventually the position became so confused that the poor rate was abolished and a general rate was introduced by the Rating and Valuation Act, 1925. The general rate was calculated as an amount in the pound on the assessed net annual rental value of property. The Act substituted boroughs, urban districts and rural districts for the parish as the unit for rating, and attempted to simplify the entire system. The underlying principles of the Act are still operative, and form the basis of the rating system today.

GENERAL FEATURES OF THE RATING SYSTEM

THE TAXABLE ENTITY:

The Poor Relief Act of 1601 placed the liability to pay rates upon the *INHABITANTS* of a parish and all personal property (fixed and movable) was taxable. However, it soon became impossible to assess the value of all movable assets and hence an Act of 1840 restricted the tax to fixed property and introduced the principle, still in operation, of taxing the *OCCUPIERS* of property.

However, there is no statutory definition of 'occupation'. The meaning of this term for rating purposes has therefore evolved by case law and entails four conditions (see Cross [1981].) First, occupation must be beneficial in the sense of confering some convenience or pecuniary advantages. Second, the person who is legally liable to pay rates must have exclusive possession and control over the property. It follows that a lodger has neither exclusive possession nor control and hence cannot be taxed. Third, occupation of a property must be permanent and this implies that the structure cannot be temporary. The principle of permanence was introduced to determine physical possession of a property rather than the actual duration of occupation. Finally, there must be de-facto possession of the property embracing use or enjoyment.

On the basis of these principles, certain categories are excluded from rate liability. Common examples being vacant properties which do not confer any benefits, and temporary structures which do not entail permanent physical possession. In addition to these, special exemptions have been granted to Crown properties, agricultural land and buildings, places of worship, charitable organisations, sewers, waterways, and more recently, business properties in Enterprise Zones.

VALUATION AND ASSESSMENT:

Properties liable to be rated are referred to as hereditaments and are entered in a valuation list which constitutes the official record of the value of land and property in each rating authority. The assessed value of the property (termed the rateable value) defines the tax base to which is applied the rate poundage. The rateable value is based on the 'net annual value' of property which is defined as the ". . . amount equal to the rent at which it is estimated the hereditament might reasonably be expected to let from year to year if the tenant undertook to pay the usual tenants rates and taxes and to bear the cost of the repairs and insurance and other expenses, if any, necessary to maintain the hereditament in a state to command that rent". (General Rate Act, 1967).

In essence, the valuation is based on the rent which would obtain in a free market if there were no legal restrictions. There are no prescribed methods or systems for valuing property, but certain procedures have been established by courts in litigation. Four methods are typically used to value non-domestic properties:

(a) The Rental Method

(b) The Profits or Accounts Basis

(c) The Contractors Basis

(d) Statutory Provisions

(a) The Rental Method: This is the most frequently used procedure and is typically considered as the best approach in litigation. Assessment under the rental method is either based on the rent of a similar hereditament located in a comparable economic site, or the 'rack rent' of the premises under consideration. The 'rack rent' is defined by case law as ". . . the figure at which the hypothetical landlord and tenant, would. . ., come to terms as a result of bargaining for that hereditament, in the light of competition or its absence in both demand and supply as a result of 'the higgling of the market'. " (Robinson Brothers (Brewers) Ltd v Houghton and Chester le-Street Assessment Committee [1937]). The rack rent like the hypothetical bargain is purely a creation of law and need have no connection with either the actual tenant or landlord. In the hypothetical bargain, the hereditament is assumed to be:

1. Vacant, but complete with all plant attached to the property
2. Available for use in its present condition
3. Exclusive of all other plant and machinery
4. Available for one year at a time, with security of tenure.

This method is used principally for the valuation of shops, banks and small industrial premises.

(b) The Profits or Accounts Basis: Where there is no acceptable rental evidence, rents are ascertained from the accounts of a firm as the amount that would be left after meeting all expenses and allowing the tenant:

(i) interest on capital invested

(ii) a return for risk

(iii) a reasonable profit for trading

The balance is regarded as being available for rent and rates, after deducting a suitable amount for insurance and maintenance. Since the assessed rent is based on estimated profits, this approach implicitly assumes that the rent which an occupier will pay is related to the profits that can be earned by occupying the hereditament.

(c) The Contractors Basis: This method is employed when the other two approaches cannot be used. The procedure is based on the notion that the rent on a building can be infered from the capital invested in its construction. The contractors test therefore consists of an estimate of the capital value of the site and building, a fraction of which is assumed to represent the interest on capital (i.e. the rent) that the owner could reasonably expect. This procedure is mainly used for valuing local authority premises, libraries, and universities.

(d) Statutory Provisions: Where the above three methods of valuation have been found to be inappropriate, a series of formulae have been developed to assess rateable values. These apply to the following traditional nationalised industries:

(i) Assets of the Electricity Board

(ii) Assets of the Gas Board

(iii) Assets of British Rail

(iv) National Coal Board property

(v) Assets of the water authorities

(vi) Docks and harbours

(vii) Post Office property

The formulae used to determine rate payments reflect the peculiarities of each industry, and they are fixed by statutory instrument following negotiations between representatives of the nationalised industries and local authorities under the Chairmanship of the Department of Environment.

Rateable values, however defined, are entered in a valuation list. The list reflects assessed open market rates of hereditaments in an area on a particular date. The Local Government Act (1948) stipulated that all properties in England Wales were to be revalued every five years. However, since the Second World War there have been only three revaluations in 1956, 1963, and 1973. In contrast, in Scotland revaluations have been undertaken at seven year intervals.

Properties are improved and new structures built between revaluations. Hence the valuation lists are updated regularly. Changes in the list are based on the rental values at the time of the last valuation, so as to maintain comparability between old and new structures. However, the value of a property depends partly on its location. In the parlance of the General Rate Act (1967), differences in property values resulting from locational factors are referred to as the 'tone of the list'.

The tax rate applied to the assessed rateable value is termed the rate poundage, and is largely determined by local authorities. Until 1985, local authorities enjoyed considerable autonomy in setting rate poundages. Their independence has, however, been eroded by the introduction of the 'rate cap' which sets a maximum limit beyond which rates cannot be raised. The upper limit varies between authorities depending upon 'needs' as assessed for central grant purposes. In 1985-1986, the 'rate cap' was applied to thirteen authorities[2].

However, not all local authorities are legally empowered to levy rates directly. In England and Wales, local authorities are divided into the metropolitan and non-metropolitan councils and districts. The districts are responsible for administering and levying rates, while the counties impose a precept upon the districts. In contrast, the local authorities in Scotland consist of regions and districts and both are entitled to levy rates, though it is only the regional councils that collect rates. There were 523 local authorities in the UK in 1985 as shown in Table 1.1 below. In 1986, the number was reduced to 511, with the abolition of the Greater London Council and the Metropolitan counties.

TABLE 1.1

TYPE OF LOCAL AUTHORITY		Number
ENGLAND AND WALES		
Upper Tier Authorities		
Metropolitan Counties		6
Non-Metropolitan Counties		47
GLC		1
Lower Tier Authorities		
Metropolitan Districts		47
Non-Metropolitan Districts		333
London Boroughs		33
Special Authorities:	ILEA	1
	Metropolitan Police	1
SCOTLAND		
Upper Tier Authorities		
Regions		9
Lower Tier Authorities		
Districts		53
Island Councils		3
	TOTAL:	523

1.2 ADVANTAGES AND DISADVANTAGES OF THE PROPERTY TAX

Having described the central features of the non-domestic property tax in the UK, we now examine the purported merits and failures of the rating system. The general nature of the debate is well documented in text books (see Hepworth (1984), King (1984), Prest (1978)), and official reports (see Layfield Report (1977), Allen Report (1965)) and will consequently be described briefly in this section. In what follows, it will be suggested that the arguments typically rely on implicit and unsubstantiated assumptions about the effective incidence of business rates.

Heading the litany of complaints against the non-domestic property tax is its alleged regressivity. Property tax payments depend on the assessed rateable value of a structure, rather than the profits or earnings of the occupier. Hence it is argued that rates are intrinsically unfair since tax payments are not related to ability to pay. It is clear that the argument implicity assumes that the formal and effective incidence of the property tax are identical. If, however, firms profitably shift all or part of the tax burden onto other agents in the economy, the distributional impact of the tax can only be properly inferred by measuring its effective incidence. The actual incidence of the non-domestic property tax is a complex question on which there is little empirical evidence. The issue is thus dealt with in considerable detail in subsequent chapters.

It is frequently argued that firms owning the same value of taxable property are exposed to different tax bills because of inadequacies in assessment practices. The Layfield Committee compared the rateable values of properties which are similar in all relevant respects in different areas. As shown in Table 1.2, the figures reveal that the rateable value of a property is twice as high in London as in Wales and the non-metropolitan areas. Thus a firm with a given income, occupying a certain type of structure with given physical characteristics will be paying higher rates in certain areas than elsewhere, assuming a uniform rate poundage. Non-domestic property taxes have therefore been criticised as inequitable, since they are neither related to ability to pay or the physical characteristics of a structure. However, the argument appears to ignore the role of locational factors in the property market. The property market is spatially differentiated, hence identical structures located in different areas represent heterogeneous products which command different rents. Thus, considerations of horizontal equity would seem to require rateable values to vary in a manner which reflects differences in rental values. It follows, that the distribution of rateable values can only be regarded as unfair if they are unrelated to rents.

It is further argued, that a 'good' tax should have a base that is uniformly and widely distributed throughout the country. An even distribution is seen to be desirable since government grants are paid to compensate for variations in the tax base to equalise the burden of taxes. A greater reliance on grants, it is argued, undermines local government autonomy and accountability. In

TABLE 1.2

INDEX OF RATEABLE VALUES OF IDENTICAL PROPERTIES BY REGION

Wales	100
North	115
York and Humberside	124
East Midlands	129
South West	134
North West	136
West Midlands	164
Greater London	225

Source: Layfield (1977) pp.158

the UK, the resource and needs elements of grants seek to equalise rate poundages, so implicitly the rate poundage is assumed to be an accurate measure of the tax burden, and the rateable value an accurate measure of taxable capacity. Equalisation grants thus redistribute resources from high to low rateable value areas. However, since rateable values depend on assessed rents rather than incomes, this will not necessarily mean that transfers are made from high to low income areas. The distribution of rateable values is highly uneven in the UK, hence local authorities are heavily reliant on grants which are used to equalise rate poundages. In so far as grant payments are hypothecated, or have conditions attached to them, local authority autonomy will be undermined.

Another major complaint about the property tax concerns the low elasticity of tax yields with respect to money incomes (i.e. the buoyancy of the tax). In part, the lack of buoyancy appears to stem from the infrequent revaluations in England and Wales. The Layfield Committee found that property values increased by 10% per annum between the revaluations of 1963 and 1973. Thus much of the alleged money income inelasticity of yields stems from the infrequency of revaluations rather than any inherent deficiency of the property tax. More generally, the property tax will lack buoyancy only if the increase in nominal rents is less than that of the price of other goods and services.

Furthermore, critics of the property tax have argued that it is distortionary in its impact, and has significant disincentive effects on investment. Thus it has been suggested that high property taxes have accelerated the decline of the depressed regions by inducing firms to relocate in lower taxed areas. It is clear that the argument once more relies on the assumption that the property tax cannot be profitably shifted by firms. This issue is investigated in greater detail in later chapters.

It is frequently suggested that local taxes should be levied in a way which promotes government accountability. The Layfield Committee asserted that: "The first requirements of a financial system for local government is accountability: whoever is responsible for incurring expenditure should also be responsible for raising the revenue." In so far as increases in local expenditure are financed from local rates, the property tax is seen to promote accountability. However, firms and businesses do not have votes, hence there is no direct accountability between non-domestic ratepayers and local authorities. Thus critics of the rating system have argued that non-domestic property taxes weaken the link between voters, taxpayers and expenditure, thereby eroding local government accountability. However, the argument assumes that firms cannot pass the burden of property taxes on to consumers or other agents. Clearly, in the extreme case where the tax is fully shifted to households who form part of the electorate, the link between voters and taxpayers will once again be restablished.[3]

In contrast, supporters of the rating system have argued that the property tax is particularly well suited to provide revenues for local government since its base (property) is immobile, and hence the tax cannot be easily evaded. It is clear that this argument is valid only in the short run, since although existing property is spatially immobile, additions may well respond to tax differentials between areas. Thus, differentially higher tax rates may in the long run erode the tax base of an area.

A second reason why property taxes are favoured at the local level is that the tax base is properly recorded so that in a formal sense yields are completely predictable and stable. However, as noted earlier, this has also been regarded as a drawback, for unlike other taxes, there is no automatic increase in yields in response to changes in money incomes. Where revaluations are infrequent, rate poundages must be explicitly increased to meet increasing expenditure requirements. It has been suggested that increases in tax rates are more easily perceived than automatic tax increases resulting from inflation, and hence the lack of buoyancy of the property tax serves to promote accountability.

A further advantage of rates as a local tax is seen to stem from the ease with which tax yields can be allocated to particular authorities. Since property taxes depends on the location of property, the yield is payable to the authority where the property is situated.

Finally, supporters of the rating system have suggested that the cost of administering the property tax system is low relative to yields. The collection costs are estimated at approximately 2% of yields, which is considerably less than for other taxes such as the wealth tax (Prest [1978]).

Having reviewed the purported merits and disadvantages of the rating system, it is apparent that in the absence of a full investigation of the effective incidence of the property tax, it is impossible to evaluate the system. This, as noted earlier, is the main objective of the current endeavour. However, before proceeding with the analysis of the effective incidence, it would seem useful to begin with a brief description of the quantitative significance of the non-domestic property tax, and its formal incidence.

1.3 THE FORMAL INCIDENCE

"The Art of Taxation consists in so plucking the goose as to obtain the largest amount of feathers with the smallest amount of hissing".

Jean Baptiste Colbert

From 1963 to 1983 the estimated income from non-domestic rates has risen from £422.2 million to £6,069.3 million in nominal terms. Thus, as shown in Table 1.3, the rate burden on commerce and industry is high and has been constantly rising.[4] If we compare non-domestic rates to other taxes as in Table 1.4, it can be seen that rate yields constitute approximately 10% of

TABLE 1.3

POTENTIAL RATE INCOME 1963-1985

Year	Commerce	Industry	Utilities	Total
1963	235.5	159.2	47.5	442.2
1964	248.6	167.4	51.1	467.1
1965	279.6	186.0	57.7	523.3
1966	323.5	207.2	64.5	595.2
1967	344.0	217.6	68.1	629.7
1968	368.7	230.3	72.0	671.0
1969	406.0	252.3	78.2	736.5
1970	450.9	275.8	97.8	824.5
1971	519.1	315.8	112.4	947.3
1972	588.1	353.2	124.9	1066.2
1973	748.7	361.0	140.8	1250.5
1974	952.4	459.8	184.3	1596.5
1975	1250.6	599.3	246.1	2096.0
1976	1346.5	636.1	264.9	2247.5
1977	1497.5	697.2	329.2	2523.9
1978	1640.1	745.8	360.0	2745.9
1979	1913.4	847.7	410.6	3171.7
1980	2517.3	1049.2	515.2	4081.7
1981	3147.6	1280.2	639.7	5067.5
1982	3547.0	1434.6	719.9	5701.5
1983	3784.5	1525.3	759.5	6069.3

(Note: Potential Rate Income = Rateable Value x Average Rate Poundage. This may be greater than rate yields, since some rates are not collected.)

Source: Birdseye and Webb (1984)

TABLE 1.4

Major Taxes : Percentage Contribution

TAX	1974	1978	1980	1982	1984
Income Tax	31.3	31.3	27.5	26.5	25.0
Corporation Tax	9.0	6.0	5.5	4.6	5.2
VAT	8.9	8.7	13.4	12.4	13.7
National Insurance	15.9	19.7	19.9	18.4	17.9
Rates:	9.8	9.4	9.4	10.4	9.9
of which Non-domestic	5.0	4.8	4.8	5.3	5.1
Other Taxes	25.3	24.1	20.9	21.9	21.2
Petroleum Revenue	-	0.8	3.4	5.8	7.1

Source : National Income and Expenditure Blue Books the total tax bill in the UK, and the non-domestic component around 5% of total taxes. Hence, rates are a major tax with a yield which is second only to the income tax and national insurance charges. It is instructive to compare the yield of rates with property tax yields in other OECD countries. Table 1.5 reveals that property taxes tend to be most important in English speaking countries, where tax yields as a fraction of GDP are on average higher. Furthermore, it can be seen that the UK and Ireland are the only two countries where property taxes are the sole source of local tax revenue. These figures therefore suggest that rates are a major tax in Britain, with yields which have been rising over the years.

However, aggregate figures conceal much of the variation in non-domestic rate burdens across both sectors and regions of the economy. Differences in property tax burdens may derive either from variations in rateable values (i.e. the tax base), the amount of exempted property, or the rate poundage (i.e. the tax rate). Tables 1.6 and 1.7 show the average rateable value per hereditament in England and Wales, and Scotland respectively. In England and Wales, non-domestic rateable values vary over a range of 1:2.25, and in Scotland 1:1.9. Not surprisingly, the figures reveal that higher rateable values are concentrated in London, the metropolitan areas, and the major cities of Scotland (shown in parantheses in Table 1.7).

Tables 1.8 and 1.9 disaggregate rateable values by broad industrial sectors for the major classes of local authorities in England and Wales, and the

TABLE 1.5
YIELD OF PROPERTY TAXES IN OECD COUNTRIES
1979

COUNTRY	TAX	Yield as % of GDP	Yield as % of total tax revenues	Yield as % of tax revenue local government
Australia	Land	0.27	0.80	6
	Rates	1.19	3.99	97
Denmark	Land	1.24	2.82	n.a.
	Service	0.18	0.42	n.a.
France	Building	0.15	0.94	0.96
	Land	0.39	0.36	0.34
	Property	0.60	1.45	1.47
Germany	Property	0.37	1.00	12.6
Ireland	Rates	1.16	3.47	100.0
Japan	Fixed Assets	1.15	4.58	33.9
	City Planning	0.19	0.77	5.7
	Land Holding	0.03	0.12	0.9
Netherlands	Municipal	0.61	1.28	92.0
	Polder Contributions	0.13	0.27	43.0
New Zealand	Land	0.05	0.16	0.01
	Rates	2.22	7.12	92.7
Spain	Rural Land	0.02	0.08	1.48
	Urban Land	0.11	0.45	7.89
Sweden	Municipal	0.40	0.80	n.a.
Switzerland	Recurrent	0.25	1.20	n.a.
UK	Rates	3.30	9.51	100
USA	Property	3.60	9.29	35.46

Source: OECD (1983)

TABLE 1.6

RATEABLE VALUE PER HEREDITAMENT BY CLASS OF LOCAL AUTHORITY IN ENGLAND AND WALES IN 1982

	Inner London	Outer London	Metropolitan District and Counties	Non-Metropolitan Districts and Counties	Wales
Domestic	302.6	273.9	165.4	193.9	123.2
Non-Domestic	1.02		0.95	0.84	0.01

Source: Bennett (1986a);
CIPFA Financial General and Rating Statistics

TABLE 1.7

RATEABLE VALUE PER HEREDITAMENT BY REGIONS IN SCOTLAND IN 1982

	Domestic	Non-Domestic
Borders	202.8	336.8
Central	238.3 (Stirling) (263.2)	670.4 (Stirling) (583.2)
Dumfries	222.9	398.4
Fife	250.7	523.6
Grampian	221.1 (Aberdeen) (229.0)	540.01 (Aberdeen) (690.7)
Highland	196.1	451.3
Lothian	270.9 (Edinburgh) (272.9)	620.2 (Edinburgh) (700.5)
Strathclyde	244.8 (Glasgow) (204.8)	560.11 (Glasgow) (601.8)
Tayside	221.8 (Dundee) (225.1)	480.2 (Dundee) (563.9)

Source: CIPFA SCOTLAND; Rating Review

regions in Scotland. The figures reveal that the variability over both sectors and local authorities increases with the level of disaggregation. Once again, the figures show that the more urbanised areas of England and Wales have the highest proportion of non-domestic rateable values.

However, non-domestic rate burdens may vary across sectors and regions not only as a result of difference in rateable values, but also because of variations in rate poundages. Tables 1.10 and 1.11 show the average rate poundages in England and Wales, and Scotland respectively. A distinct pattern appears to have emerged over this period; namely higher rate poundages in the more urbanised areas of Scotland, Inner London, and the metropolitan districts. In Scotland the divergence is most marked in Lothian and Strathclyde. Overall, these figures suggest that high rate poundages and rateable values are concentrated in the older industrial centres in metropolitan England and the cities of Scotland. Thus, critics of the rating system have argued that property taxes are highly distortionary in their impact, inducing firms to migrate to lower taxed regions, and thereby accelerating the decline of the depressed urban areas.

In response it has been suggested that the disincentive effects of the property tax are negligible since rate burdens are quantitatively insignificant when compared with total costs. Table 1.12 presents data on the major costs in UK manufacturing industry. Non-domestic rates constitute a mere 5% of total costs in the aggregate. However, simple comparisons based on observed

TABLE 1.8

PROPORTION OF RATEABLE VALUE BY CLASS OF PROPERTY AND LOCAL AUTHORITY IN ENGLAND AND WALES 1982

Hereditament	London	Metropolitan Districts & Counties	Non-Metropolitan Districts & Counties	Wales
Domestic	0.38	0.49	0.53	0.47
Commercial	0.79	0.46	0.32	0.44
Industrial	0.11	0.28	0.22	0.21
Utilities	0.38	0.05	0.09	0.05
Entertainment	0.008	0.01	0.015	0.01
Education	0.02	0.04	0.04	0.03
Other	0.08	0.04	0.05	0.06

(Note: Totals may not sum to unity because of rounding errors)

Source: Inland Revenue Statistics

TABLE 1.9

PROPORTION OF RATEABLE VALUE BY CLASS OF PROPERTY AND REGION IN SCOTLAND 1982

	Domestic	Commercial	Industrial	Utilities	Other
Borders	0.48	0.18	0.09	0.05	0.19
Central	0.31	0.19	0.30	0.05	0.16
Dumfries & Galloway	0.47	0.19	0.07	0.04	0.22
Fife	0.39	0.20	0.12	0.08	0.19
Grampian	0.35	0.29	0.11	0.03	0.22
Highland	0.35	0.26	0.15	0.05	0.18
Lothian	0.37	0.31	0.07	0.03	0.21
Strathclyde	0.38	0.29	0.09	0.04	0.18
Tayside	0.39	0.25	0.08	0.04	0.22

Source: CIPFA SCOTLAND; Rating Review

TABLE 1.10

RATE POUNDAGES (i.e. pence per pound)
BY CLASS OF LOCAL AUTHORITY IN ENGLAND AND WALES
1978 - 1985

	Inner London	Outer London	Metropolitan Districts and Counties	Non-Metropolitan Districts and Counties	Wales
1978	78.30	78.69	89.88	86.00	100.39
1979	85.27	90.97	103.12	98.15	116.93
1980	108.24	110.91	128.10	118.19	140.88
1981	144.87	139.97	162.66	132.64	162.11
1982	159.32	154.71	185.25	151.75	167.11
1983	177.32	167.32	193.64	159.23	169.65
1984	187.15	174.28	203.22	168.88	178.92
1985	190.97	189.53	226.81	180.53	196.15

Source: Bennett (1986a)

TABLE 1.11

RATE POUNDAGES BY REGION IN SCOTLAND 1978 - 1983

REGION	1978	1979	1980	1981	1982	1983
Border	48.65	55.48	71.8	86.2	99.5	103.25
Central	54.0 (Stirling) (54.0)	62.33 (Stirling) (62.0)	73.33 (Stirling) (72.0)	98.0 (Stirling) (93.0)	118.3 (Stirling) (112.9)	123.6 (Stirling) (130.0)
Dumfries	44.25	51.5	64.0	77.75	102.6	101.25
Fife	42.0	51.6	69.5	87.0	105.0	121.16
Grampian	53.4 (Aberdeen) (55.0)	62.5 (Aberdeen) (66.5)	72.75 (Aberdeen) (80.25)	79.9 (Aberdeen) (96.5)	95.4 (Aberdeen) (116.0)	100.9 (Aberdeen) (119.5)
Highlands	50.5	59.8	77.5	95.0	116.13	116.13
Lothian	57.63 (Edinburgh) (58.0)	68.37 (Edinburgh) (68.5)	94.25 (Edinburgh) (94.5)	134.25 (Edinburgh) (134.8)	139.9 (Edinburgh) (140.0)	124.75 (Edinburgh) (125.0)
Strathclyde	54.21 (Glasgow) (63.5)	78.5 (Glasgow) (68.0)	80.52 (Glasgow) (93.0)	110.2 (Glasgow) (128.0)	126.84 (Glasgow) (150.0)	136.56 (Glasgow) (156.0)
Tayside	48.3	54.6	66.8	95	110.33	119.0

(Note: Rate Poundages in the major cities of Scotland shown in parantheses)

Source: CIPFA SCOTLAND; Rating Review

TABLE 1.12

COSTS IN MANUFACTURING 1980

Costs	% of gross output in Manufacturing	
Purchases: energy	3.6	
non-energy	53.6	
TOTAL:		57.2
Reduction in stocks	0.3	
Labour Costs	23.0	
Industrial Service	2.7	
Rent	0.3	
Rates	0.6	
Transport	1.3	
Hire of Vehicles	0.5	
Insurance	0.04	
Bank Charges	0.4	
Other	3.24	
TOTAL:		6.4
All Other Costs	10.5	
Gross Output	100.0	

Source: Bennett (1986a)

costs appear to be of questionable value, if not totally misleading: First, the figures conceal much of the variability in costs and rate burdens across different sectors and areas. Furthermore, they take no account of the possible response of firms to the tax. For example, if differentially higher tax burdens in one area induce firms to migrate to lower taxed regions, a comparison based on aggregate *ex post* cost data will considerably understate the importance of the tax. Finally, for the figures to provide an indication of the actual burden of rates, it must be implicitly assumed that the tax is neither shifted forward into prices, or back into costs. Thus, in order to measure the actual burden of the property tax, it becomes necessary to analyse its effective incidence.

Notwithstanding these criticisms, the local authorities have argued that rates do not constitute a serious problem for business since the increase in rate burdens has been less than that of inflation (A.M.A. 1983). In contrast, representatives of commerce and industry claim that the ". . .rates paid by industry rose around 1.6 to 1.9 times more than other costs and prices". (BirdsEye and Webb [1984]). However, as noted by Bennett (1986a), these conflicting conclusions derive from the use of different base years in calculating property tax and cost increases. As shown in Table 1.13, setting 1979 as the base year validates the claims of the businessmen, and with 1975 as the base year, rate increases approximately equal the rise in other costs and inflation.

TABLE 1.13

RATE, COST AND PRICE INCREASES

	Rates	Costs of Materials and Fuels	Retail Price Index
1975	100	100	100
1976	110	127	117
1977	113	146	135
1978	123	145	146
1979	141	168	166
1980	176	201	196
1981	214	228	219
1982	248	244	238
1979	100	100	100
1980	125	120	118
1981	152	136	132
1982	176	145	143

Source: AMA (1983); Birdseye and Webb (1984)

Having reviewed the main features of the non-domestic property tax, it seems not unreasonable to suggest that it is impossible to discern its distributional impact by focusing on the formal incidence alone. Thus subsequent chapters seek to provide theory based measures and empirical estimates of the effective incidence of the non-domestic property tax. However, in view of the wide variations in property tax burdens, it is difficult, if not hazardous, to make generalisations about its effective incidence. Despite this diversity, the analysis in subsequent chapters proceeds at a high level of aggregation. In part, this reflects the paucity of spatially disaggregated data on costs, prices and profits, and in part the fact that the central features of the rating system exhibit several common characteristics.

NOTES TO CHAPTER ONE

1. Royal Commission on Local Taxation (1901) CMND 638

   Final Report on the Departmental Committee on Local Taxation (1914) CMND 7316

   Report of the Royal Commission on Local Government in England (1969) CMND 4741
   The Future Shape of Local Government Finance (1971) CMND 4741
   Local Government Finance (1977) CMND 6813

2. These were Camden. Greenwich. Hackney. Islington. Lambeth. Lewisham. Southwark. Brent. Haringay. Basildon. Leicester. Sheffield. Tamesdown.

3. The argument clearly assumes that voters are well informed. and aware that non-domestic property taxes are shifted into prices.

4. These figures may partly exaggerate the importance of the non-domestic property tax. since they are treated as a deductable expense from corporation taxes.

CHAPTER TWO

NEOCLASSICAL THEORY OF PROPERTY TAX INCIDENCE

One of the most valuable insights that economic analysis has provided in public finance is that the person who bears the ultimate burden of a tax is not necessarily the person upon whom the tax is levied. Associated with a tax are a milieu of secondary interrelated effects, as market agents adjust their behaviour to the introduction of a tax, and these influence the distribution of income and hence the eventual impact of the tax. Thus, in a survey of tax incidence theory Mieszkowski (1969) asserted that: "The analysis of tax incidence is the investigation of the distributive effects of taxes. In a general way incidence theory is applied distribution theory".

Given the widespread distributional and allocative impacts of taxes, it would seem natural to expect incidence theory to take a fairly policy oriented shape. This, however, has not happened and much of the incidence literature is enunciated within abstract models which are concerned with rather esoteric issues. Nevertheless, even in these studies, the analysis has yielded insights that are of more than theoretical interest. In part, the abstract nature of the models reflect the innate complexities of the problem being analysed. As noted earlier, the incidence of a tax is the result of a profusion of interacting effects. It is clearly impossible to investigate each and every effect and hence theoretical analysis necessitates the use of simplifying assumptions. At one extreme lie the traditional partial equilibrium models which focus primarily on the allocative and distributive effects of a tax on one market in isolation. The most pervasive deficiency of this approach is its failure to take account of the interdependence of markets, and the changes in factor and product markets that occur simultaneously when a tax is levied. At the other extreme lie the comprehensive general equilibrium models pioneered by Meade (1955) and Harberger (1962). In principle, these models attempt to incorporate all the complex linkages between markets. However, in practice, the analysis is more restricted in scope and considerations of analytical tractability necessitate the use of a formidable array of stringent assumptions. These assumptions are based on the conventional marginal productivity theory of distribution, and appear to bear little relation to the 'real world'. In general, there is little disagreement on the fact that the assumptions are unrealistic; what is at issue is whether they serve as useful simplifications which make analysis tractable, without grossly misleading.

This chapter attempts to survey the voluminous literature on the incidence of the non-domestic property tax. The models described in this survey have been chosen to clarify the main analytical issues encountered in the analysis of property tax incidence. Thus section 2.1 reviews the traditional theory of property tax incidence, and traces the development of the general equilibrium approach. Section 2.2 deals with the 'dynamic incidence' of the property tax in a growing economy, and section 2.3 discusses the implications of introducing monopolistic competition and oligopoly in the standard general equilibrium framework.

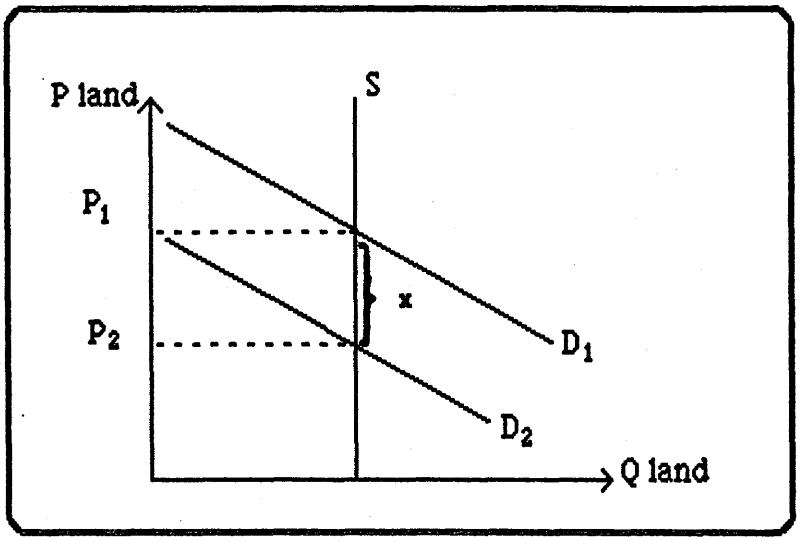
2.1 The 'Traditional View' versus the 'New View' of Tax Incidence:

The most significant features of the property tax which confound incidence theory derive from the fact that the property tax is a levy on both the value of structures, and the land on which they are erected. While land is spatially fixed in location, capital is in the long run mobile, both spatially and between sectors of the economy. In much of the incidence literature, recognition of these 'stylised' facts plays an important role in analysing tax burdens.

THE 'TRADITIONAL VIEW' OF THE PROPERTY TAX

The 'traditional view' of the property tax is based on conclusions deduced from the Marshallian partial equilibrium framework. Accepting the dichotomy between the land and capital components of the property tax, the 'traditional view' asserts that since land is location specific and inelastic in supply, that proportion of the property tax falling on land is borne entirely by its owners. This simple result derives entirely from the inelasticity of the supply of land. In Diagram 2.1 below, prior to the imposition of the tax the price of land is P_1. A tax of 'x' per unit of land, *ceteris paribus* lowers the demand curve so that the net-of-tax price received by land-owners is P_2.

DIAGRAM 2.1



However, by far the greater part of property-tax revenue arises from the levy on structures (and hence capital). Since capital is assumed to be mobile in the long run, its supply is perfectly elastic. It follows that this portion of the tax will be shifted forward to users of property or their customers. This conclusion stems from the fact that a tax on a perfectly elastic factor (commodity) is borne entirely by those who demand the factor (commodity). Thus, combining the two components of the tax, it is argued by proponents of the 'traditional view' that consumers bear the levy on structures in proportion to their expenditures, while the tax on land is borne by land-owners.

This conclusion is perfectly valid under certain stringent assumptions, which appear to rule out important behavioural responses to the tax. In general, the response of the taxed sector will affect the relative price of other commodities and factors of production, as firms attempt to substitute cheaper untaxed inputs for the taxed factor. These equilibriating adjustments will in turn have secondary impacts in all sectors of the economy. Thus, unless it is implicitly assumed that the tax applies to a jurisdiction or sector that is 'small' in relation to the economy, the analysis is incomplete. Second, and allied to this omission, 'income effects' that alter labour supplies are ignored. If land owners provided labour services, the incentive effects of the land tax might induce them to work harder thereby raising gross land rents. Even if this effect were ignored, input prices will change if the tax revenue is redistributed as lump sum payments to other factors of production. For example, labourers who receive lump sum transfers are likely to reduce their labour supply, causing a fall in pre-tax land rents.

Finally, the conclusions which are arrived at from the analysis of one market, cannot be generalised to the case of the economy at large. If only one 'small' jurisdiction levies a property tax, the long run return to capital (the mobile and perfectly elastic factor) will be unaffected. However, if the tax is national in its application, capital cannot escape the tax burden by migrating out of the high taxed region. Thus the overall return to capital will decline. Hence, generalising the incidence effects from the case of a single region to the economy as a whole is seen to be an example of the 'fallacy of composition'.

THE 'NEW VIEW' OF THE PROPERTY TAX

The analytical inadequacies of the partial-equilibrium model were partly overcome in the general equilibrium analysis of Mieszkowski (1971). The origins of the general equilibrium theory of property tax incidence, lie in Harberger's (1962) model of coporation taxes which provided the theoretical constructs necessary to analyse property tax incidence in an economy-wide context.[1] The conclusions of the general equilibrium approach have now become accepted doctrine, embodying what is termed the 'new-view' of the property tax.[2]

The 'new view' models are based on marginal productivity theory and hence employ the familiar stringent assumptions of neoclassical distribution theory. Thus the models typically assume that:

1. All factor and product markets are perfectly competitive
2. Factor supplies are homogenous and fixed
3. Technology is described by linearly homogenous and quasi-concave production functions
4. The models abstract from the demand effects of taxes and government expenditures. It therefore becomes necessary to neutralise any policy induced changes in income distribution which may affect the pattern of demand. Hence it is implicitly assumed that all consumers have identical marginal and average propensities to consume. Consequently, a redistribution of income between

consumers will have no effect on either the level or the pattern of demand in the economy. If, however, tax revenues are expended on goods which increase consumer utility, the distortionary impact of a tax may be offset by the corresponding benefits of government expenditure. More specifically, if property tax burdens are distributed so that the incremental tax costs equal the marginal benefits of government expenditure on goods and services, the tax would approximate to a user charge for government services with no distortionary impact.[3] Thus, in order to analyse the incidence of property taxes, it is typically assumed that government expenditure is on 'onerous' or 'useless' goods which have no effect on consumer utility.

Finally, Mieszkowski's analysis is based on two further special assumptions:

5. The property-tax is viewed as a tax levied on reproducible, malleable, capital. The model therefore ignores the levy on the value of land.

6. There are three factors of production; malleable capital which is perfectly mobile between sectors and regions, labour which is imperfectly mobile and land which is completely immobile.

Given this formidable list of assumptions, it follows that when all jurisdictions in the nation levy a uniform tax on the stock of capital, the tax burden falls entirely on capital owners. This crucially important result cannot be questioned given the stringent assumptions of marginal productivity theory. Since factor supplies are fixed, and all markets perfectly competitive, full employment is reached through price adjustments. Furthermore, the demand effects of government spending are neutralised in the model. Consequently, a tax can only be shifted in this framework by reducing the supply of the taxed factor (activity). Clearly, if the level of the taxed factor (activity) does not change, the original configuration of relative prices continue to define the solution to the general equilibrium system, and hence the tax is borne passively by the factor owners. In this case, since the supply of capital is fixed by assumption, a uniform property tax levied on reproducible capital will fall on its legal base (i.e. property).

However, in general, property tax rates are not uniform and vary between sectors and regions. Thus, given perfect capital mobility, a differentially higher tax rate will induce an outward flight of capital to the lower taxed regions. The increased supply of capital in these regions serves to lower after-tax returns, while the reduced supply of capital in the higher-taxed areas raises net-returns. Equilibrium is eventually reached when sufficient capital has migrated from the taxed regions to equalise the net-of-tax returns to capital. Compared with the original equilibrium; the net- returns of the immobile and imperfectly mobile factors (land and labour) will be lower in the taxed jurisdictions, while the price of 'non-traded' goods (i.e. locally produced and sold goods) will be higher. The analysis and conclusions relating to differential tax burdens in the general equilibrium framework are thus broadly analogous to those of the 'traditional view'. However, the important result that distinguishes the 'new view' from partial equilibrium analysis, is the insight that while a uniform property tax across all jurisdictions lowers the after-tax returns to capital throughout the economy; tax rate differentials lead to differences in the net-returns to immobile factors and non-traded commodities. The precise distribution of burdens remains one of the most important unresolved issues in the 'new view' literature.

While Mieszkowski's view has generated a considerable amount of disagreement over the issue of differential property tax shifting, the important conclusion relating to a uniform tax remains unassailable, regardless of assumptions about factor mobility, the number of traded goods, etc. A uniform property tax as specified in the model is merely a tax on a fixed factor, and is consequently borne by capital owners. The remainder of this section attempts to survey what appear to be the more important and illuminating theoretical extensions of the basic Mieskowski model. In particular, attention is focused on the consequences of amending the plethora of stringent assumptions. It is argued that dissenting views on differential tax shifting arise from differences in the formal structures of models, as well as different definitions of the commodity to be taxed.

Variable Tax Rates and Mobile Land:

In an interesting development of the Mieszkowski model, Sonstellie (1979) investigates the consequences of varying the tax rate levied on different classes of property within a given jurisdiction. This assumption clearly brings the analysis more in line with actual practice, for in most developed economies, certain sectors are exempted from property taxes, while others (such as industry and housing) are taxed at different rates. This, however, implies that land can no longer be viewed as an immobile factor, for in the long run land, like other factor inputs, is clearly mobile between sectors and classes of property. This feature serves to distinguish the Sonstellie model from much of the existing literature.

More specifically, the analysis is based on the standard two-sector general equilibrium model and focuses on the impact of varying tax rates in a single 'small' jurisdiction. All markets are perfectly competitive and it is assumed that the supply of property in the two sectors (denoted X and Y) are described by the constant returns production function:

(1) $$Zi = fi\ (Ki, Ni)$$

$$i = X, Y,$$

where: Ki = capital input in sector i (i = X, Y,)

Ni = land input in sector i (i = X, Y,)

Supplies of both land and capital are assumed to be perfectly mobile between sectors. Thus, in equilibrium net factor returns will be equal in the two sectors:

(2a) $$P_i \left(\frac{\partial f_i}{\partial K_i} \right) = P_K \qquad [i = X, Y,)$$

(2b) $$P_i \left(\frac{\partial f_i}{\partial N_i} \right) = P_N \qquad [i = X, Y,]$$

where: P_i = price of property in sector i [i = X, Y,]

$[\partial f_i/\partial K]$ = marginal product of capital in sector i [i = X, Y,)

$[\partial f_i/\partial N]$ = marginal product of labour in sector i [i = X, Y,]

P_K = price of capital

P_N = price of land

Furthermore, in equilibrium the demand for structures (denoted Di) will equal its supply as determined by the production function:

(3) $$D_i = f_i\,[K_i, N_i] \quad [i = X, Y,]$$

where: D_i = demand for property in sector i [i = X, Y,]

Finally, a tax is levied at rates t_X and t_Y on the value of property in sectors X and Y respectively. It is, however, well established that a tax on the value of output of a constant returns industry is equivalent in its effects to a tax at equal rates on the value of all factor inputs. Thus, in the present model, the property tax is in essence a tax at equal rates on the value of land and capital employed by each sector. This definition contrasts with that of the Mieszkowski model where the tax levy on the value of land is ignored. With the introduction of the tax, the gross rental on land and capital may be defined as:

(4) $G_i^K = [1 + t_i]\ P_K$, and $G_i^N = [1 + t_i]\ P_N$

These equations are assumed to describe the main features of the economy. There are, however, a number of assumptions implicit in this framework which seem worth noting. First, the model focuses solely on the property market, to the neglect of other products. Second, and allied to this, the model ignores the existence of other factors of production - chief among these is labour. Thus, despite its claim to 'generality', the model is in fact highly restrictive and incomplete. Following Grieson (1974) the framework may thus be termed 'partial general equilibrium'.

The solution to the above system of equations is obtained by using one input or product as the numeraire and solving for the relative factor returns. This procedure is well documented in Harberger (1962) and much of the general equilibrium literature. Consequently, we ignore the formal results of the model, and provide an intuitive explanation of the tax induced allocative distortions.

It will be recalled that the property tax is levied at the rates t_x and t_y on the value of property in sectors X and Y respectively. In addition, the two factors of production (i.e. land and capital) are assumed to be perfectly mobile between sectors. Thus, in equilibrium, the net after-tax returns to both land and capital must be equal.

Consider first a tax increase in one sector (say X). The tax will initially discourage investment in property in X, and hence decrease the demand for land. The reduced supply of property in X therefore raises property prices, while the lower demand for land depresses the net rent of land in X. However, land is assumed to be mobile between sectors; consequently as land rents decline in X, some land will flow into sector Y. The migration of land from sector X to Y therefore lowers gross land rents in Y, and raises gross rents in X. This process will continue until net land rents are equalised in both sectors.

It will be recalled that the tax initially discourages investment in property in sector X. Hence, capital flows from X to Y, and investment in property in Y increases and hence property prices fall in Y (and rise in X). Thus, in the new equilibrium, the gross rent of land will be higher in X and lower in Y, while net rents are equal across both sectors. At the same time, property prices are higher in X and lower in sector Y, and net after-tax returns to capital are equalised.

In contrast, a uniform tax on all property within the jurisdiction, will discourage investment and lead to an outmigration of capital to lower taxed regions. As a consequence, the supply of property in the jurisdiction falls, and land rents decrease. Thus, the tax burden is shared between consumers of property who pay higher prices for structures, and land owners who receive lower rents. This conclusion is thus analogous to that of the Mieszkowski model.

The Public Sector:

A striking feature in much of the general equilibrium literature lies in its neglect of the public sector. This omission is, arguably, not wholly unreasonable for the models describe perfectly competitive auction markets, while much of the allocative decision making in the public sector is guided by political fiat rather than market forces.

In a recent development of the basic Harberger framework, Henderson (1985) explicitly introduces the public sector into the standard two sector general equilibrium model.

This innovation complicates property tax incidence analysis in two related ways. First, in the model, the public sector is assumed to be tax free. Thus, the public sector provides a 'shelter' into which taxed capital can escape.[4] In addition, the public sector grows directly with the level of taxation[5], and this feature complicates the formal analysis considerably. Thus, in discussing this model we ignore the more technical issues and instead provide an informal description, focusing on the mechanisms of tax shifting.

The model assumes that there are three goods: housing (H), public goods (G), and private goods (X). It is assumed that a tax is levied on the housing sector. Each good is produced under constant returns, and perfect competition prevails in sectors X and H. In addition, it is assumed that public sector decision making is guided by cost minimising considerations[6], and consequently the opportunity cost of capital is the net rental for all sectors in the economy. There are two mobile factors; capital (K) and labour (L) whose total supplies are fixed. Sectors X and G employ both capital and labour, while sector H employs only capital. These production relations can therefore be described as follows :

(1) $$H = f_H [K_H]$$

(2) $$G = f_G [K_G, L_G]$$

(3) $$X = f_X [K_X, L_X]$$

Full employment of factors implies that:

(4) $$L_G + L_X = L$$

(5) $$K_G + K_X + K_H = K$$

Perfect competition implies that prices reflect marginal costs:

(6) $$P_H = a_{KH} [P_K + t]$$

(7) $$P_G = a_{KG} P_K + a_{LG} P_L$$

(8) $$P_X = a_{KX} P_K + a_{LX} P_L$$

where: P_H, P_G, P_X = price of final goods H, G, and X respectively

a_{ij} = amount of input i required to produce a unit of output J

P_K = price of capital

P_L = price of labour

The model is solved by the well established procedure of differentiating the above system of equations and solving for the relative price of capital P_K. The typically complex and "unwieldy" solution for P_K reveals that the tax induced change in the price of capital depends on the interaction of a number of key technological parameters. Particularly critical among these are the relative factor intensities in the public sector (i.e. $\frac{L_G}{L} - \frac{K_G}{K}$).

Intuitively, this result can be explained as follows: It will be recalled that the public sector (G) is tax exempt and hence provides a 'tax-shelter' into which taxed capital can escape. Thus, an increase in taxes serves in the first instance to lower the demand for capital and hence its price. In Mieszkowski's parlance, this is termed the 'substitution effect'. However, there are two additional forces at work which may either reinforce or offset this effect. It will be noted from equation (6), that increased taxation raises marginal costs and hence the price of goods in the taxed housing sector, thus demand for housing decreases, while demand for the untaxed and relatively cheaper public goods increase. Now, if the public sector is capital intensive, the increased demand for public goods will lead to a proportionately greater increase in the demand for capital relative to labour. Hence, the price of capital will rise, i.e. tax increases are shifted to labour.

However, it will be recalled that the public sector grows directly with the level of taxes. Hence, at low tax rates the proportion of capital and labour employed in the public sector will be small relative to the other sectors and consequently the increased demand for capital in the public sector may not be sufficient to outweigh the reduced private sector demand for capital. Thus, it is possible that at low levels of taxation capital bears the entire tax burden, but as tax rates increase and public sector demand for capital grows, the burden is shifted to labour. Hence, tax incidence in this model depends not only on technical parameters such as capital intensity, but in addition the level of taxation and the size of the public sector. These conflicting forces have the troubling consequence of precluding any qualitative predictions regarding tax shifting.

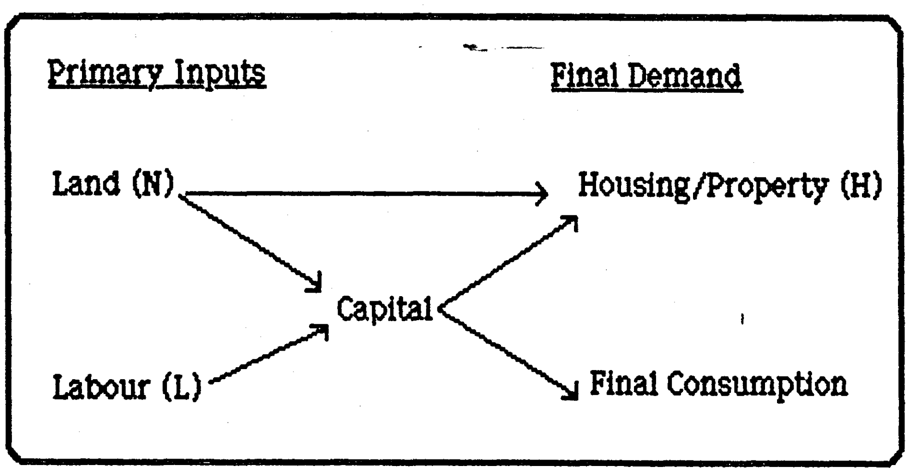
Despite this obvious weakness, the model does appear to represent an interesting development of the two-sector general equilibrium framework. The major innovation lies not so much in the inclusion of a tax free public sector, but the assumption that tax revenues monotonically increase the size of the untaxed sector. Hence, ceteris paribus, the opportunities to escape the tax burden increases directly with taxation.

Endogenous 'Capital':

The models discussed thus far have assumed that the stock of capital is fixed, and its supply exogenously determined. In contrast to these studies, Breuckner (1981) has developed a model in which capital is endogenously determined as an intermediate good in the production process. This assumption serves to complicate the structure of the conventional general equilibrium framework, and represents a departure from previous work.

Specifically, it is assumed that there are two communities (denoted X and Y) with 'primary' factors of production, land (N) and labour (L), and an 'impure-intermediate' good, capital (K). The supply of land in each community is fixed while labour is perfectly mobile between communities. Capital - the intermediate good, is produced using land and labour under constant returns. There are two consumption goods produced by each community; the first is capital, and the second housing or property. Housing services are produced using land and capital in a constant returns production function. This stylised economic structure is illustrated in Diagram 2.3 below:

DIAGRAM 2.3



Finally, it is assumed that a property tax is levied on the value of housing/property.

Before discussing incidence effects in this framework, it would seem important to note that capital in this model represents a pure flow of services derived from the primary inputs land and labour, rather than a flow emanating from a fixed durable stock. Consequently, the question of the incidence of the tax on the owners of a durable capital stock, does not arise in the analysis. Stated differently, capital owners, as conventionally defined, do not exist in this framework. Thus, despite the advantages of endogenising the capital stock, the model ignores an issue which is crucial to incidence analysis.

Consider first the impact of a uniform property tax on the stock of housing in both communities. An increase in the tax levy on housing will, in the first instance, induce firms to transfer production from housing to the untaxed consumption good - capital. Thus, the supply of capital in the economy increases, while the supply of housing decreases. However, this shift in production can only be achieved by transfering primary factor inputs to the capital sector. Thus, the supply of land used in capital production rises and hence the marginal product of land and net rents decline while the marginal product of labour, and hence wages, rise.[7] Compared with the old equilibrium, housing prices and wages are higher, while net land rents are lower. Clearly, while higher house prices decrease workers' utility, higher wages, in contrast, raise real incomes. Thus the net change in workers' utility remains ambiguous. In contrast, the lower rents lead to an unambiguous decline in land-owners' utility.[8]

We now consider the impact of a tax on one community (say X) in isolation. A tax on housing in community X serves initially to raise house prices, and hence worker utility in X declines. Since labour is mobile between communities, workers will migrate to the untaxed community Y, and hence the supply of housing and capital increase in Y, and their prices decrease. The increased supply of labour in Y lowers the marginal productivity of labour and wages, while the marginal product of land, and hence rents, increase.

At the same time, in sector X, land will be transferred from the production of (taxed) housing to capital. Hence the marginal product of land and net rents decline in X, while the decreased supply of labour in X raises wage rates.

Compared with the original pre-tax equilibrium, wage rates and house prices are higher while land rents are lower in community X. Thus, land-owner utility in X declines. In contrast, wages and house prices are all lower in Y, hence the change in workers' utility levels is ambiguous.

It is evident that the introduction of an endogenous capital stock represents a useful development of the basic two-sector model. However, the incidence of the property tax on capital owners cannot be discerned from the model. Furthermore, it would appear that 'capital' in this model is merely an intermediate good, rather than the durable, malleable asset of the conventional general equilibrium models.

Finally, it would seem worth noting that the conclusions of the model are inextricably tied to the assumed structure of the economy. Thus, a uniform property tax lowers land rents, as in the 'new-view', but the consequent increase in wages results from the 'escape hatches' created by the assumed production hierarchy. Hence, incidence depends crucially on the structure of the economy, and it seems difficult to justify the ad-hoc assumptions regarding production flows, and the nature of capital.[10]

Risk and Factor Variability:

The fundamental conclusion of the Harberger-Mieszkowski framework, that a uniform factor tax is borne by the factor owners, has endured despite the numerous theoretical developments and modifications to the basic model. This is not surprising, for given the entourage of assumptions in the model, a tax can only be shifted by reducing the supply of the taxed activity. A general tax on a fixed factor such as land or capital is a clear case where the taxed activity cannot be varied, and hence the entire burden of the tax is borne by the factor owners. None of the models discussed above permit primary factor supplies to vary, and hence shifting of a general factor tax is precluded by definition. In an innovative and illuminating paper, Feldstein (1977) analyses the conditions under which this conclusion holds. It is shown that even if factor supplies are fixed, considerations of risk and uncertainty may lead to partial shifting of a general factor tax.

The formal analysis is based on the more restrictive one-sector neoclassical model. Thus, all markets are assumed to be perfect, and there are three factors of production: land (N), labour (L) and capital (K). A uniform national tax is levied on land. In addition, it is assumed that factor supplies are fixed in the short-run. Factor inputs are used to produce a composite commodity (X) described by a constant returns aggregate production function:

(1) $$X = F\,[K, L, N,]$$

As there is only one good in the economy, the community's stock of capital (K) takes the form of an accumulation of the composite commodity. The price of this commodity (and hence the price of capital) is assumed to be the numeraire. Following Samuelson (1958), it is assumed that workers live for two periods: in the first period they work and save. Savings are held in the form of assets K and N. In the second period individuals retire and sell their assets.

Under the assumptions of marginal productivity theory, the wage rate earned in the first period is:

(2) $$W = F_L$$

where: $F_L = \partial F/\partial L$ = marginal product of labour

The fraction of wage income saved is assumed to depend on the rate of interest:

(3) $$s = \alpha\,[F_K]$$

where: s = saving rate = average propensity to save

$$F_K = \partial F/\partial K = \text{rate of interest} = \text{marginal product of capital}$$

Since all savings are held in the form of assets (i.e. K and N), we have by definition:

(4) $$s\,W\,L \equiv K + P_N\,N$$

where: P_N = price of land

In a non-stochastic deterministic world the returns to land and capital will be known with certainty, and hence both assets will be held by savers if and only if net returns are equal, i.e.

(5) $$\frac{F_K}{1} = \frac{F_N}{P_N}$$

However, in a non-deterministic world, asset yields canot be known with certainty and hence derived portfolio holdings will depend partly on the risks associated with each asset. Since asset supplies are assumed to be fixed, relative yields must reflect the risk differentials in order to induce investors to hold the available quantities.

Within this framework, a uniform tax on land will initially lower net yields by the full amount of the tax:

$$[1 - t]\ F_N$$

where: t = tax rate

The tax will thus be capitalised into lower land values, and investors' wealth declines. Now, the riskiness of land is determined by the standard deviation of net rental income relative to the price of land. Given lower land values, tax capitalisation clearly serves to reduce the riskiness of land vis-a-vis capital.[11] Thus, ceteris paribus, the demand for land relative to capital rises, and since asset supplies are fixed, the price of land is bid up. That is part of the uniform tax is shifted. Hence the analysis reveals that a uniform land tax will only be borne fully by land owners in a riskless, deterministic world in which assets are perfect substitutes.

The analysis thus far has been restricted to the short run where asset supplies were fixed. This assumption is now relaxed, and the capital stock is allowed to vary while supplies of land and labour are held constant. However, the long-run analysis abstracts from considerations of risk.

A uniform tax on land lowers the net rent and hence equation (5) can be expressed as:

$$(6) \qquad \frac{F_K}{1} = \frac{[1-t]F_N}{P_N}$$

Using equations (4), (2) and (3) to eliminate P_N in (6) and rearranging we obtain the fundamental equilibrium savings relationship:

$$(7) \qquad K = D_K = \partial[F_K]F_L L - \frac{[1-t]F_N.N}{F_K}$$

where: D_K = demand for capital

Equation (7) states that in equilibrium the demand for capital (D_K) must equal savings (∂ $[F_K]$ F_L L) minus the net value of land ($([1-t] F_N N/F_K)$. Clearly (7) is stable only if an increase in savings or reduction in land values does not induce a proportionately greater increase in the demand for capital i.e. $\partial D_K/\partial K < 1$.

Differentiating (7) with respect to taxes (t):

(8)
$$\frac{dK}{dt} = \frac{-N F_N/F_K}{\left[\frac{\partial D_K}{\partial K} - 1\right]} > 0$$

Thus, an increase in land taxes induces an increase in the equilibrium stock of capital. This result is clearly not implausible, for a tax on land lowers its net yield and consequently increases the desirability of capital vis-a-vis land. Thus, the equilibrium ratio of capital to land rises. Changes in gross factor yields follow directly from this basic result. Since supplies of land and labour are fixed, an increase in the stock of capital raises the marginal product of land and labour, and hence rents and wages rise. At the same time, the marginal product of capital and hence returns to capital fall. Part of the tax on land is therefore shifted in the form of a lower net yield on capital - the increase in wage rates is a by-product of these tax induced changes.

The analysis therefore suggests that the long run incidence of the tax will reflect a combination of; risk induced portfolio changes, and the long period marginal productivity changes resulting from the increases in the stock of capital. Clearly a major shortcoming of the model lies in its failure to incorporate risk into the long run analysis. However, this is unlikely to alter the fundamental result that a uniform factor tax can be shifted in the long run.

Despite this apparent weakness, the analysis demonstrates the sensitivity of the 'new-view' results to plausible and minor changes in the assumptions. Thus, the general equilibrium conclusions have been shown to depend crucially on the assumption of fixed factor supplies and certainty. Solow's (1956) views on model evaluation seem apposite in this respect: "when the results of a theory seem to flow specifically from a special assumption that is dubious, the results are suspect".

In so far as the "new-view" conclusions rely primarily on the ad-hoc assumptions of fixed factor supplies and a riskless world, it is perhaps not unreasonable to suggest that the results are "suspect". This conclusion clearly emphasises the importance of analysing incidence in the context of a growing economy, with variable factor supplies. The following section attempts to survey the literature in this field.

2.2 Tax Incidence in a Growing Economy:

The analysis of the growth affects of a tax or 'dynamic incidence', is primarily an investigation of the effects of a tax on the level of savings and the growth rate in the economy. While there is no single well-defined approach to 'dynamic incidence', much of the literature is based on conventional neoclassical growth models.[12] Thus, in contrast to the static general equilibrium framework, factor supplies are allowed to vary, and the models emphasise the interdependence between changes in the supply of labour and of capital. Hence, labour is typically treated as a primary factor of production, while the stock of capital is assumed to depend on savings out of labour and capital income. The current stock of capital is therefore influenced by labour in two distinct ways: directly through savings out of labour income, and indirectly through the effect of changes in the supply of labour on capital income and hence savings out of capital income. The dependence of capital accumulation on past labour supply and savings implies that taxes affect the growth path of the economy through their impact on the supply of labour and aggregate savings.

Following Atkinson and Stiglitz (1980, Chapter 8) this section analyses the 'dynamic incidence' of property taxes within the Solow (1956) one-sector neoclassical growth model. Thus, it is assumed that there is only one 'composite commodity' (denoted Y), which is produced using malleable capital and homogenous labour. Technology is described by a linearly-homogenous aggregate production function of the form:

(1) $$Y = F[K, L,]$$

where: K = capital

L = labour

Y = composite commodity

Since the production function embodies the assumption of constant returns, it can be written in intensive form as follows:

(2a) $$Y = L \quad f\ [k]$$

or

(2b) $$y = f[k]$$

where: $k = \frac{K}{L}$ = capital-labour ratio

$y = \frac{Y}{L}$ = output-labour ratio

It is assumed that equilibrium prevails and hence equation (2) satisfies the following Inada conditions:

$$f'[0] = \infty; \qquad f'[\infty] = 0$$

The assumption of a single composite commodity implies that ex-ante savings and investment are always equal. Clearly, in a one good economy, that fraction of the good that is not consumed is saved, and what is saved forms part of the capital stock. Hence, the assumption obviates the need to distinguish between *ex-ante* savings and investment.

Savings are assumed to depend on income, and the capital-labour ratio since workers and capitalists are assumed to save at different rates:

(3) $$S = s[k]\ Y$$

where: s = the average propensity to save

Since savings necessarily equal investment, we have:

(4) $$\dot{K} = s[k]\,Y$$

where: $[\dot{}]$ = rate of change (i.e. derivative of K with respect to time.)

Eliminating Y using [2]:

$$\frac{\dot{K}}{K} = \frac{s[k]\ f[k]}{k}$$

(5) or:

$$g_K = \frac{s[k]\,f[k]}{k}$$

where: $g_K = \frac{\dot{K}}{K}$ = rate of growth of the capital stock K.

In addition, it is assumed that the labour force grows at the constant exogenously determined rate n:

(6) $$g_L = \frac{\dot{L}}{L} = n$$

In perfect competition factors receive the value of their marginal products:

(7) $w = \partial Y/\partial L = f[k] - k f'[k]$

(8) $r = \partial Y/\partial K = f'[k]$

where: w = wage rate

r = rate of return on capital

By definition, in steady-state growth capital and labour grow at equal rates:

(9) $g_K = g_L = n$

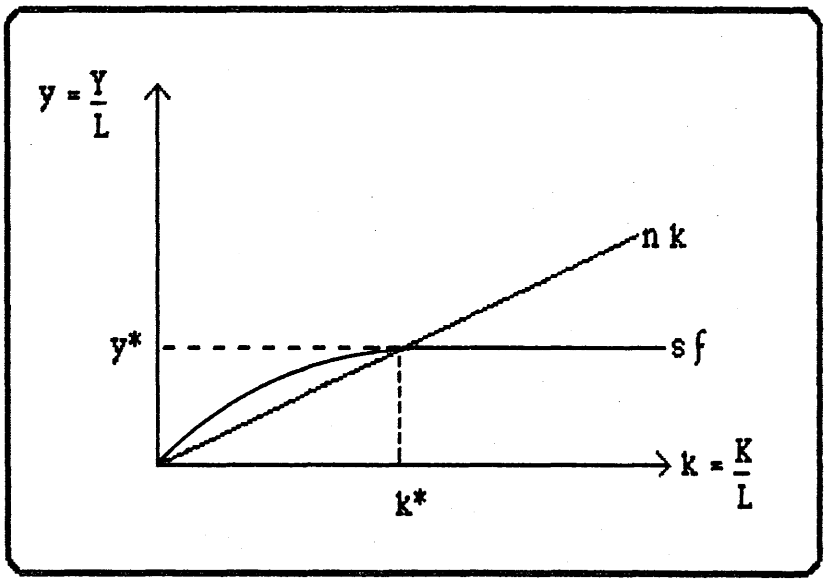
Hence, by implication the capital-labour ratio (k) remains constant in the steady-state (i.e. $\dot{k} = 0$).

Substituting for g_K and g_L in (9) and rearranging:

(10) $\dot{k} = s[k] f[k] - n k = 0$

Equation (10) describes the "fundamental growth equation" which reveals that the rate of change of the capital-labour ratio [k] is determined by the difference between saving per worker (s [k] f [k]) and the amount required to keep the capital-labour ratio [k] constant as the labour force grows at rate n (this is termed 'capital-widening'). This equilibrium relationship is portrayed in Diagram 2.4 below. The s f curve depicts the level of savings per worker for given levels of the capital-labour ratio [k]. The n.k. curve reflects the constant rate of increase in the labour force (i.e. "capital-widening"). Equilibrium is determined by the intersection of these two curves. In equilibrium, the quantity of saving (and investment) per person is just sufficient to keep the growing labour force equipped at a constant capital-labour ratio [k*].

DIAGRAM 2.4



This basic model has been extended in a variety of ways to include depreciation , technical progress and money. However, we ignore these developments and focus instead on the consequences of introducing a property tax.

Within this simplified framework, a property tax is equivalent to a tax on the stock of capital. Since all assets earn the same rate of return, a tax on capital, and a levy on capital income are also equivalent. Furthermore, since there is only one commodity in the model, there can be no partial factor taxes (such as a differential property tax).

Consider a tax on capital at the rate t per unit. In the first instance, the tax lowers the net returns to capital:

(8') $$r_n = f'[k] - t$$

where: r_n = net returns to capital

t = property tax

The decline in net income from capital implies that savings per person will be lower. Thus, the savings function in equation (3) may be expressed as :

(3') $$S = s\,[k, t]\,Y$$

Substituting equation (3') into the 'fundamental equation' (10) we obtain:

(11) $$\dot{k} = s\,[k,t]\,f\,[k] - n\,k$$

Equation (11) reveals that the tax affects the growth path of the economy through its influence on the savings function. Thus differentiating (11) with respect to t yields:

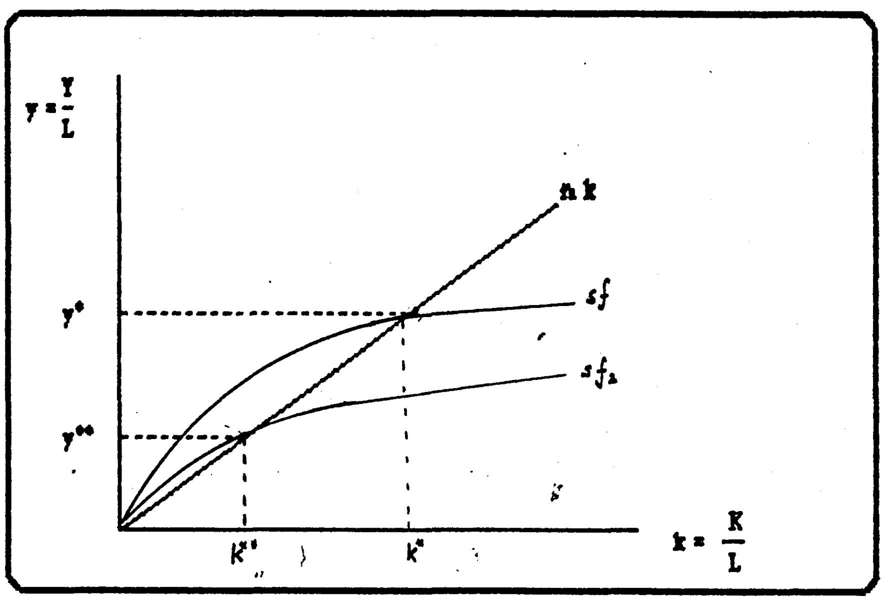
(12) $$\frac{d\dot{k}}{dt} = \frac{-s_t f}{s\,[k, t]\,f' + s_k\,f\,[k] - n}$$

where: $s_t = \frac{\partial s}{\partial t}$

$s_k = \frac{\partial s}{\partial k}$

The steady-state is dynamically stable if the denominator of (12) is negative (see Gandolfo [1979, Ch.3]). Thus, the sign of (12) depends crucially on that of s_t. Consider the case where an increase in taxes lowers the propensity to save (i.e. $s_t = \frac{\partial s}{\partial t} < 0$). In this case (12) is negative, and the equilibrium capital-labour ratio (k) falls. Thus, the marginal product of capital increases and hence the returns to capital rise, while the marginal product of labour and wages fall. This is portrayed in Diagram 2.5. The tax lowers the sf curve to sf_2, and the steady-state capital labour ratio falls to k^{**}, and income per worker to y^{**}.

DIAGRAM 2.5



Clearly, the tax will be fully shifted to labour if gross returns to capital rise by the full amount of the tax. This depends primarily on the response of savings to the tax. In terms of Diagram 2.5, *ceteris paribus* the greater the decline in the sf curve (i.e. the fall in savings), the lower will be the equilibrium level of income per worker. Thus, to obtain more definitive results, it becomes necessary to explicitly specify the form of the savings function.

Like much else in growth theory, the savings function has been at the centre of considerable controversy (see Meade and Hahn [1965], Kaldor [1966], Pasinetti [1962], Samuelson and Modigliani [1966]). Thus, "Keynesian" growth theorists such as Kaldor [1966] distinguish between the propensity to save out of labour and capital income i.e.

(13) $$S = S_w \,(f[k] - k f'[k])\, L + S_r [1 - t] f'[k] K$$

where: S_w = propensity to save out of labour income (i.e. wages)

S_r = propensity to save out of capital income

Consider the extreme case where there are no savings out of wages. The savings function (13) therefore simplifies to :

(14) $$S = S_r [1 - t] f'[k] . K$$

substituting into (11) we obtain

(15a) $$S = S_r [1 - t] f'[k] .k - n k = 0$$

or

(15b) $$S_r [1 - t] f'[k] .k = nk$$

It will be noted that $\frac{\partial s}{\partial t} < 0$, and hence the tax reduces savings per person and capital accumulation.

Rearranging (15b):

(16) $$r_n = f'[k] [1 - t] = \frac{n}{S_r}$$

Equation (16) reveals that the net returns to capital ($f'[k][1-t]$) are unaffected by the tax and depend only on the rate of population growth (n), and the propensity to save (S_r). Thus, the tax is fully shifted to labour.

In the more general savings function, with $S_w > 0$ and $S_r > S_w$ solving for r_n yields:

$$(17) \qquad r_n = \frac{n}{S_r + S_w \left[\frac{\alpha}{1-\alpha}\right]\left[\frac{1}{1-t}\right]}$$

where: α = labour's share of output.

In this case, the degree of shifting depends on the relative propensities to save (S_r and S_w), and the shares of capital and labour in income (α, $1-\alpha$). In particular, the greater the propensity to save out of wages, the lower will be the degree of shifting.

In contrast, critics of this approach regard the distinction underlying the "class savings hypothesis" to be both unnecessary and misleading (see Samuelson and Modigliani [1966]). Instead, savings are regarded as the outcome of a lifetime utility maximising exercise. In terms of the "class savings function", this may be represented in terms of the propensities to save, by assuming that the dominant source of saving is through wage earners making provision for retirement. Then $S_w > S_r$, and the second term in the denominator of (17) dominates the expression, and there is little tax shifting.

Thus, despite the stringent assumptions which underlie the model, the conclusions remain highly sensitive to the assumed form of the savings function.

More generally, it has been argued that by confining attention to steady-state growth, the analysis abstracts from important features of the economy, such as the role of uncertainty, "animal spirits", disequilibrium, etc. To incorporate these features, it becomes necessary to introduce an investment function into the model, and as noted by Sen [1970], this in turn gives rise to the familiar "Harrod instability problem". Moreover, the time required to approach the steady-state has been shown to be excessively long. (See Atkinson [1971]). Thus key parameters may change in the transition thereby precluding convergence to steady-state equilibrium. In a sense, these criticisms reflect more fundamental objections to the neoclassical paradigm, and will be discussed in greater detail in the following section.

2.3 Property Tax, Incidence under Monopolistic Competition and Oligopoly:

Central to the standard two-sector general equilibrium model is the assumption that product markets are perfectly competitive. While this abstraction has the undoubted merit of simplifying the analysis, the need to eschew this questionable assumption is apparent. There are, however, a number of theoretical difficulties in analysing the incidence of taxes under non-competitive conditions. In particular, the absence of a well-defined general equilibrium model of imperfect competition has meant that there is no obvious alternative analytical paradigm. Hence, much of the non-competitive incidence literature is based on minor extensions and modifications of the standard neoclassical general equilibrium model.

In the appendix to his seminal article, Harberger [1962] introduced into his model a monopolistic corporate sector, and concluded that tax incidence under alternative forms of competition "differs only in minute detail" from the competitive case. It has since been noted that Harbergers analysis of monopoly was technically flawed and misleading,[13] and there have been a number of attempts to extend and modify the basic two-sector model to allow for imperfect competition and oligopoly. Most notable among these studies are the models propounded by Anderson and Ballentine [1976], Atkinson and Stiglitz [1980, Ch.7], and Davidson and Martin [1985].

These papers provide considerable insight into the effects of taxation in the presence of substantial levels of imperfect competition. Following Harberger [Op cit.], it has frequently been suggested that tax incidence, like the conduct and performance of a firm, can be arrayed along a spectrum between the polar cases of monopoly and perfect competition. However, these recent papers revealed that this assertion is highly misleading. For example, in the Davidson-Martin model, for non-pathological cases, a general factor tax under oligopolistic competition raises after-tax profits - a result that can never arise under the polar extremes of either monopoly or perfect competition.

This conclusion is clearly of considerable importance and the remainder of this section attempts to review this literature. However, much of the work is concerned mainly with monopoly profits and corporation tax incidence. In what follows, we focus on the models of Atkinson and Stiglitz (Op cit.) and Davidson and Martin (Op cit.), where a tax is levied on the value of capital rather than capital income.

Monopolistic Competition:

Atkinson and Stiglitz [1980, Ch.7] analyse the incidence of a capital tax in a model where one sector of the economy is assumed to be monopolistically competitive. In essence, the authors seek to model an economy where there are a large number of firms in each industry, and where: "... although there are strong competitive elements ..., virtually every firm ...... has some degree of monopoly power." (Atkinson and Stiglitz, [Op cit.])

Specifically, firms in the monopolistic sector are assumed to produce differentiated products, and hence demand curves are relatively inelastic. The existence of a "large" number of firms further implies that group interdependence can be ignored, and consequently strategic behaviour is assumed to be Cournot-Nash.

This model of monopolistic competition is imbedded into the standard general equilibrium framework. Thus it is assumed that there are two sectors (denoted X and Y). While perfect competition prevails in sector Y, sector X is assumed to be imperfectly competitive. Both sectors employ homogenous malleable capital (K), and labour (L). Factors are assumed to be fixed in supply, and perfectly mobile between sectors.

Following Dixit and Stiglitz [1977], market imperfections in sector X are assumed to stem from consumers' desire for differentiated products (denoted Xi). For computational ease, the sub-utility function $\Gamma(X_i)$ is assumed to have the constant elasticity form:

(1a) $$\Gamma^{\rho} = \sum_{i} X_i^{\rho}$$

Where $\rho = 1$, products are perfect substitutes, and competition in X will be perfect. In what follows, we therefore assume that $0 < \rho < 1$.

In addition, the aggregate utility function is assumed to be Cobb Douglas:

(1b) $$U = (1 - \delta) \log Y + \delta \log \Gamma(X_i)$$

Consumers therefore maximise (1b) subject to the budget constraint:

(2) $$M = P_Y Y + \sum_{i} P_i X_i$$

where:

M = income

P_Y = price of good Y

P_i = price of differentiated product X_i.

The first-order maximising conditions are given by:

(3a) $$\frac{\partial U}{\partial Y} = \frac{1-\delta}{Y} - \alpha P_Y = 0$$

(3b) $$\frac{\partial U}{\partial Y} = \delta X_i^{\rho-1} - \alpha P_i = 0$$

(3c) $$\frac{\partial U}{\partial \alpha} = M - P_Y Y - \sum_i P_i X_i = 0$$

where: α = the Lagrangean Multiplier.

Rearranging (3), we obtain the demand functions:

(4a) $$Y = \frac{(1-\delta)M}{P_Y}$$

(4b) $$X_i = \left[\frac{(\delta M)}{(P_i \Gamma^{\rho})}\right]^{\frac{1}{1-\rho}}$$

In Chamberlinian parlance, the parameter $\left(\frac{1}{1-\rho}\right)$ in equation (4b) represents the elasticity of the dd curve - i.e. the "firm" demand curve which relates each differentiated product to its own price, assuming that all other firms hold their prices constant. In addition, it is assumed that firms have identical fixed and marginal costs, and that there are no barriers to entry. Thus, in equilibrium marginal costs and revenues are equalised, and entry occurs until the marginal firm earns zero profits. Diagramatically, equilibrium is therefore described by the familiar case of Chamberlinian monopolistic competition, where the dd curve is tangential to a downward sloping average-cost curve. Furthermore, the equal cost condition implies that all firms produce the same level of output, and we can define the number of firms as: $n = \frac{\bar{X}}{X}$, where: $\bar{X}$ is firm output and X is total industry output.

More formally equilibrium in sector X is described by the following conditions:

From equation (4) we obtain marginal revenue and hence:

(5) $$\rho P_x = C_x$$

where: $C_x = C_{LX}.W + C_{KX}.\ r$ = marginal costs in X.

C_{LX} = amount of labour required to produce a unit of X

C_{KX} = amount of capital required to produce a unit of X

W = wage rate

r = rate of return to capital

The zero profit condition can be expressed as:

(6) $$P_X \bar{X} - C_X \bar{X} - Co = 0$$

where: C_X = marginal costs in X

C_o = fixed costs in X

X = firm output

From the demand equation (4) we have:

(7) $$\bar{X} = \frac{\delta M}{P_x . n}$$

substituting (5) and (6) into (7), the scale of each firm is given by:

(8) $$\bar{X} = \frac{\rho}{1-\rho}\,\frac{C_0}{C_X}$$

From (8), it can be seen that output per firm is larger, the higher are fixed costs (C_0), the lower the elasticity $\frac{1}{1-\rho}$, and the lower are marginal costs (C_X).

Turning now to sector Y, perfect competition implies that prices reflect marginal costs:

(9) $$P_Y = C_Y$$

where: $C_Y = C_{LY}.W + C_{KY}.r$ = marginal costs in Y.

C_{LY} = amount of labour required to produce a unit of Y

C_{KY} = amount of capital required to produce a unit of Y.

Since both capital and labour are fully employed:

(10a) $$C_{LX}.X + n.C_{LO} + C_{LY}.Y = L$$

(10b) $$C_{KY}X + n.C_{KO} + C_{KY}.Y = K$$

where: C_{LO} = fixed labour inputs in sector X

C_{KO} = fixed capital inputs in sector X

Having outlined the basic model, Atkinson and Stiglitz examine the effects of a tax on capital employed in the monopolistic sector (X). In what follows, we formally extend the model to explore the effects of a uniform tax on both sectors. To facilitate comparison with the original model, we adopt the notation and analytical procedures employed by Atkinson and Stiglitz, and present the formal results in somewhat greater detail.

A Uniform Property Tax:

Consider first a uniform tax (denoted t_K) on the value of capital employed in both sectors of the economy. Thus, total tax revenue is given by:

$$T = t_K \, (C_{KX}.X + C_{KY}.Y + n\, C_{KO})$$

The tax raises costs in both sectors and hence the price equations (5) and (9) are amended to:

(5')
$$\rho P_X = C_{LX}.W + C_{KX}(r + t_K)$$

where: t_K = uniform property tax.

and

(9')
$$P_Y = C_{LY}.W + C_{KY}(r + t_K)$$

With this modification, the above system can now be solved as follows:

Totally differentiating the demand equations (4a and b) and subtracting we obtain the familiar result:

(11)
$$\hat{X} - \hat{Y} = -\sigma_D \, (\hat{P}_X - \hat{P}_Y)$$
$$= -(\hat{P}_X - \hat{P}_Y)$$

(∵ $\sigma_D = 1$ for the utility function is Cobb-Douglas).

where: (^) denotes proportionate changes e.g. $\hat{X} = \frac{dX}{X}$

$\sigma_D = 1$ = income compensated elasticity of demand

Totally differentiating the price equations (5') and (9'), and subtracting:

(12) $$\hat{P}_X - \hat{P}_Y = (\theta_{LX} - \theta_{LY})(\hat{w} - \hat{r} - \hat{t}_K)$$

where: $\theta_{LX} = \frac{C_{LX}.W}{P_X}$ = labour's share in the cost of producing X

$\theta_{LY} = \frac{C_{LY}.W}{P_Y}$ = labour's share in the cost of producing Y

Substituting (12) into (11) we obtain the demand side expression for the tax induced relative shifts in the demand for X and Y.

(13) $$\hat{X} - \hat{Y} = -\theta^* (\hat{w} - \hat{r} - \hat{t}_K)$$

where: $\theta^* = (\theta_{LX} - \theta_{LY})$

Equation (13) is frequently referred to as the "output effects" of a tax.

Totally differentiating the full employment condition (10) yields:

(14a) $$\lambda_{KY}.\hat{Y} + \lambda_{KX}.\hat{X} + \lambda_{KY}.\hat{C}_{KY} + \lambda_{KX}.\hat{C}_{KX} + \lambda_{KO}\hat{n} + \lambda_{KO}.\ \hat{C}_{KO} = \hat{K} = 0$$

(14b) $$\lambda_{LY}.\hat{Y} + \lambda_{LX}.\hat{X} + \lambda_{LY}.\hat{C}_{LY} + \lambda_{LX}.\hat{C}_{KX} + \lambda_{LO}.\hat{n} + \lambda_{LO}.\hat{C}_{LO} = \hat{L} = 0$$

where:

$\lambda_{ij} = \frac{C_{ij}.J}{i}$ (i = K, L) = Fraction of input i used in the production of J.

Solving for the C_{ij} terms in (14) we obtain:[14]

(15a) $$C_{LX} = -\theta_{KX}\ \sigma_X\ (\hat{w} - \hat{r} - \hat{t}_K)$$

(15b) $$C_{KX} = \theta_{LX}\ \sigma_X\ (\hat{w} - \hat{r} - \hat{t}_K)$$

(15c) $\hat{C}_{LY} = -\theta_{KY}\,\sigma_Y\,(\hat{w} - \hat{r} - \hat{t}_K)$

(15d) $\hat{C}_{KY} = \theta_{LY}\,\sigma_Y\,(\hat{w} - \hat{r} - \hat{t}_K)$

where σ_i = partial elasticity of substitution as defined in footnote(14).

Substituting into equation (14) and subtracting:

(16) $\lambda^{**}\,(\hat{X} - \hat{Y}) = (\hat{w} - \hat{r} - \hat{t}_K)\,(a_X\sigma_X + a_Y\sigma_Y + a_O\sigma_O) + \hat{n}\,(\lambda_{LO} - \lambda_{KO})$

where:

$\lambda^{**} = (\lambda_{KY} - \lambda_{LY})$ = relative capital intensity of sector Y

$a_X\sigma_X = \lambda_{KX}\,\theta_{LX}\,\sigma_X + \lambda_{LX}\,\theta_{KX}\,\sigma_X$

$a_Y\sigma_Y = \lambda_{KY}\,\theta_{LY}\,\sigma_Y + \lambda_{LY}\,\theta_{KY}\,\sigma_Y$

$a_O\sigma_O = \lambda_{KO}\,\theta_{LO}\,\sigma_O + \lambda_{LO}\,\theta_{KO}\,\sigma_O$

Solving for $\hat{n}$ from (16) and using the fact that $n = \frac{X}{\bar{X}}$:

(17) $\hat{\bar{X}} = (\theta_{LO} - \theta_{LX})\,(\hat{w} - \hat{r} - \hat{t}_K)$

Finally substituting (16) into (17), and using the wage rate as the numeraire (i.e. w = 0), we obtain:

(18) $\lambda^{**}\,(\hat{X} - \hat{Y}) = (-\hat{r} - \hat{t}_K)\,(a_X\sigma_X + a_Y\sigma_Y + a_O\sigma_O)$

$+ (\theta_{LO} - \theta_{LX})\,(\lambda_{LO} - \lambda_{KO})\,(-\hat{r} - \hat{t}_K)$

Equation (18) embodies what might be termed the "substitution" and "scale effects" of the tax. The first term on the right hand side of (18) describes the "substitution effects". The tax induces firms to substitute cheaper labour for capital, and as a result the demand for capital and gross returns decline across all sectors of the economy. The second term in (18) describes the tax induced changes in the structure of the economy i.e. the "scale effects". An increase in taxes on fixed capital, initially raises fixed costs and firms suffer losses. This leads to exit from the industry, and the equilibrium level of output produced by each firm increases. Thus concentration levels and entry barriers are raised by the tax. At the same time, firms attempt to substitute fixed labour inputs for taxed capital, and the demand for fixed capital declines. Since the tax applies uniformly to all sectors of the economy this serves only to lower gross returns.

More formally, we solve the system by equating the demand side "output effects" in (13) with the supply side expression (18):

$$(19) \qquad \Theta* \left(\hat{r} + \hat{t}_K\right) = \left(a_x\sigma_x + a_y\sigma_y + a_o\sigma_o\right)\left(-\hat{r} - \hat{t}_K\right) + \left(\Theta_{LO} - \Theta_{LX}\right)\left(\lambda_{LO} - \lambda_{KO}\right)\left(-\hat{r} - \hat{t}_K\right)$$

Rearranging (19) we obtain :

$$(20) \qquad \hat{r} = -\hat{t}_K$$

Thus, capital bears the full burden of a uniform property tax in an imperfectly competitive economy. In a sense, this result is not surprising for the introduction of a monopolistic sector does little to alter the basic shifting mechanism of the standard neoclassical model. A tax in this framework can only be shifted by varying the supply of the taxed product/factor. Given the assumption that the supply of capital is fixed and fully employed, a uniform tax on capital is necessarily borne by its owners. However, the model does reveal that taxation increases the level of concentration in imperfectly competitive sectors of the economy.

A Differential Property Tax :

We consider next the effect of a tax (denoted t_{KX}) on the value of capital employed in the imperfectly competitive sector (X). The tax applies at equal rates to both fixed and variable capital in X. Thus tax revenue is given by :

$$T = t_{KX} \, (C_{KX} \, X + n . C_{KO})$$

Since the tax raises marginal costs, price equation (5) is modified to:

$$(5'') \qquad \rho \, P_X = C_{LX} . w + C_{KX} \, (r + t_{KX})$$

With this amendment, the above system can now be solved in a manner analogous to that described above. The solution has been derived in detail by Atkinson and Stiglitz (Op. cit., p. 209-16), and hence we merely present the final result:

$$(21) \qquad \hat{r} = \frac{-[a_X\sigma_X + a_O\sigma_O) + (\Theta_{LO} - \Theta_{LX}) (\lambda_{LO} - \lambda_{KO}) - \Theta_{KX} \, \lambda^{**}] \, \hat{t}_{KX}}{[\lambda^{**} \, \theta^{*} + a_X\sigma_X + a_Y\sigma_Y + a_O\sigma_O]}$$

The first term describes the "substitution effects", while the second and third terms embody the "scale" and "output" effects respectively. Consider first the "substitution" effects. It is clear that these are unambiguously negative and hence serve to lower $\hat{r}$. In contrast, the sign of the "scale" and "output" effects" depend on relative factor intensities. Consider first the "scale effects". These will be negative if fixed costs are capital intensive relative to

(a) variable costs (i.e. $(\Theta_{LO} - \Theta_{LX}) < 0$), and (b) the rest of the economy (i.e. $(\lambda_{LO} - \lambda_{KO}) < 0$). Turning to the "output effects", these will be positive if the taxed sector is labour intensive (i.e. $\lambda^{**} = (\lambda_{KY} - \lambda_{LY}) > 0$). If in addition, the "output effects" are greater in absolute value than the negative "scale" and "substitution effects", then $\hat{r}$ rises and hence part of the tax is shifted to labour. Compared with the pre-tax equilibrium; the relative returns to capital will be higher, the number of firms lower, and hence fewer differentiated products will be produced. Since the utility function (see equation (1b)) embodies the assumption that consumers demand a variety of products, overall consumer welfare falls. Hence, part of the tax burden is shifted to labour (through lower wages) and a part to consumers (via lower utility levels). Furthermore, the overall level of concentration in sector X has increased.

Thus, the distinguishing feature of the postulated model lies in the introduction of "scale effects", and the conclusion that property taxes may increase the level of industrial concentration on the one hand, and decrease consumer welfare on the other. However, as noted by Dixit and Stiglitz (Op. cit.) these results depend crucially on the assumed form of the utility function. Thus, little generality can be claimed for the conclusions. Furthermore, the assumption of Cournot-Nash behaviour is clearly restrictive, and serves to detract attention from problems of group interdependence and the concomitant collusive strategies which may arise. We turn now to these issues within the context of an oligopolistic market.

Oligopolistic Competition

The quintessential feature of an oligopoly is interdependence : the actions of individual firms in an industry are affected by the actions of their rivals. It is this interdependence which gives rise to the problems in modelling oligopolistic behaviour, and hence discerning the incidence of taxes in these markets. In a general sense, the solution to an oligopoly problem depends crucially on the assumed behavioural strategies. Thus, there is no definite "model of oligopoly", and perhaps as a result there has been a tendency to ignore tax incidence in oligopolistic markets.[15] However, recent work by Katz and Rosen (1985) and Davidson and Martin (1985) has revealed that the mechanisms of tax shifting in oligopolistic markets, differ fundamentally from those under either monopoly or perfect competition. In what follows, we attempt to review this work focusing on the Davidson-Martin model, rather than the Katz-Rosen study which is concerned with corporation tax incidence.

In the Davidson-Martin model, there are assumed to be two sectors in the economy; one perfectly competitive and the other oligopolistic. It is further assumed that firm behaviour in the oligopolistic sector is governed by non-Cournot tacit collusion[16] in the form of output quotas.

However, it has long been recognised (see Stigler [1964], Osborne [1976]) that the fundamental problem in colluding to raise profits stems from the fact that when all <u>other</u> firms observe the agreement, it pays any one of them to cheat by making secret price cuts. In essence, the problem is that of the familiar prisoners' dilemma in which the pay offs are such that for each player cheating is the "dominant strategy". Thus, the collusive agreement collapses and firm behaviour once more reverts back to Cournot-Nash strategies. Stigler (Op. cit.) argued that an agreement can only be enforced if (a) breaches can be detected, and (b) firms can retaliate by imposing losses on the "cheat" which outweigh the higher profits from cheating.[17] The problem of detection has been debated at considerable length (see inter alia Stigler (Op. cit.), Friedman (1977), Spence (1978), Rees (1985)). In the Davidson-Martin model, however, it is assumed that cheating can be detected costlessly. Thus, the study focuses on the second problem - that of formulating an effective retaliatory strategy which deters cheating.

In general, retaliation is only theoretically feasible and effective if the oligopoly problem is defined in terms of an infinite period game - termed a "supergame" (see Waterson (1984)). Thus, consider a two-period cartel agreement (or game) involving three firms (or players). Let one firm (player) cheat in both periods. Given that one player cheats, and that the game ends in the second period, no retaliation is possible in subsequent periods. Hence, the best move for non-cheaters in period 2 is the non-cooperative Cournot-Nash strategy. However, since the play in period 2 has been decided, there can be no retaliation if cheating occurs in period 1. Hence the best strategy for non-cheaters is once more the Cournot-Nash move. The argument can be extended to any finite number of periods. To obtain non-Cournot strategies, it becomes necessary to consider an infinite period game (i.e. a "supergame") in which retaliation next period is possible.

Thus the Davidson-Martin model is based upon an infinite period "supergame" in which the retaliatory actions of non-cheaters are of the Friedman (1977) "Grim Trigger" form. Specifically, it is assumed that all firms adhere to the cartel only if, there is no cheating. If any firm cheats, the cartel dissolves and each firm reverts back to the output level it produces in a non-cooperative Nash equilibrium.[18]

Hence, a potential cheat must compare the current higher profits of cheating, with the discounted future lower profits resulting from the dissolution of the cartel. Formally, we express the gains/losses from cheating (denoted Z) as follows:

(1a) $$Z = (\Pi^{ch} - \Pi^{c}) - \frac{1}{r}(\Pi^{c} - \Pi^{n})$$

where:

Π^{ch} - cheating profits

Π^{c} - cartel profits

Π^{n} - Nash-equilibrium profits

r - discount rate

The first term in (1a) defines the immediate increase in profits from cheating. The second term is the present value of future lower profits resulting from the collapse of the cartel. It follows that collusion is feasible if, for a given discount rate (r), output is at a level such that the present value of the future loss of profits $[\frac{1}{r}(\Pi^c - \Pi^n)]$ exceeds the immediate gains from cheating $(\Pi^{ch} - \Pi^c)$, - (i.e. no cheating occurs if $Z \leq 0$).[19] Thus, setting $Z = 0$ and rearranging (1a), we can define a discount rate r_0:

(1b) $$r_0 = \frac{\Pi^c - \Pi^n}{\Pi^{ch} - \Pi^c}$$

and define a set :

(1c) $$\bar{R} = \{ r \in R \mid r \leq r_0 \}$$

Cheating is thus unprofitable if the discount rate $r \in \bar{R}$ (Rees [1985],). This is termed a "balanced temptation equilibrium" and defines a situation where, although each firm may be tempted to defect, it pays none to do so. Hence, price/output may settle down at its collusive level even though firms are NOT explicitly colluding.

We can now define a set of feasible sustainable output levels in a cartel (denoted Ω) as follows:

(2) $$\Omega = (Q^c \mid Z \leq 0, Q^c \geq 0)$$

where: Q^c = cartel output

Thus, cartel prices and profits will be given by the solution to the optimising problem:

(3) Maximise Π^c

subject to $Q^c \in \Omega$

Solving (3) yields price as a function of the basic parameters of the model (i.e. unit costs (c) and the discount rate (r)). Thus:

(4) $$Px = fx(c, r)$$

where: c = unit costs, r = discount rate = net returns to capital.

Now, for a cost minimising firm, the rate at which future profits (losses) are discounted is given by the net returns to capital. Consequently, the returns to capital affects price through two channels: First through its influence on the sustainable cartel output (Q^c), and in addition, as a component of unit costs (c). Hence, differentiating (4) with respect to r, we obtain:

(5) $$\frac{dPx}{dr} = \frac{\partial Px}{\partial c} \cdot \frac{\partial c}{\partial r} + \frac{\partial Px}{\partial r}$$

Thus, an increase in r raises costs and hence prices (i.e. $\frac{\partial Px}{\partial c} \frac{\partial c}{\partial r} > 0$). At same time, increases in r lower the present value of future losses from defection. Hence, cartel output must be increased towards its Nash equilibrium level to deter cheating, and prices tend to decline (i.e. $\frac{\partial Px}{\partial r} < 0$). The net effect is therefore ambiguous.

At this point an important caveat is in order. The model assumes that cheating is detected costlessly. Thus it must be implicitly assumed that firms know either the output of each player or the total output of the industry. In addition, information on the game and associated pay offs should be "complete" in the sense that forecasts of future profits are compatible.

We now consider the effects of both uniform and differential property taxes. More specifically, the oligopolistic sector is embedded into the Atkinson - Stiglitz model described in the preceeding subsection. It is assumed that sector Y is perfectly competitive, while sector X is oligopolistic in the sense defined above. Once more the utility function is given by :

(6) $$U = (1 - \delta) \log Y + \delta \log X$$

and the budget constraint :

(7) $$M = P_X . X + P_Y . Y$$

The full employment condition expressed as :

(8a) $$C_{LX} X + C_{LY} Y = \bar{L}$$

(8b) $$C_{KX} X + C_{KY} Y = \bar{K}$$

From equations (6) and (7) we obtain the demand functions and hence :

(9a) $$P_Y = \frac{(1 - \delta) M}{Y}$$

(9b) $$P_X = \frac{\delta M}{X}$$

Output in sector X is obtained from the cartel maximisation problem (equation (3)), and substituting for X in (9b) yields (see Davidson-Martin (Op cit.) p.1218):

(10) $$P_x = \frac{n(rn+1)^2}{(n-1)(rn-1)^2}$$

where: n = number of firms

A Uniform Property Tax :

Consider first a uniform tax on all capital. In the standard neoclassical model a tax can only be shifted by reducing the supply of the taxed factor. Since factor supplies are fixed and fully employed by assumption, a uniform capital tax is borne entirely by its owners. This result was shown to endure the introduction of monopolistic competition. However, in the present model, the returns to capital provide an additional tax shifting mechanism. Thus, a uniform capital tax which lowers net returns also serves to reduce the inducement to cheat (by raising the present value of future losses from retaliation.) This permits the cartel to further restrict its output, and hence profits and prices rise.

More formally solving the above system in the manner described earlier we obtain:

(11) $$r = -\frac{[\theta^* \lambda^{**} + a_x\sigma_x + a_y\sigma_y)}{[a_x\sigma_x + a_x\sigma_y + \lambda^{**}(\theta^* + \Psi]}$$

where: $\theta^* = (\theta_{LX} - \theta_{KX})$

$\lambda^{**} = (\lambda_{KY} - \lambda_{LY})$

$a_i\sigma_i$ are as defined earlier

$$\Psi = \frac{4rn}{([rn]^2 - 1)} = \text{the "discount rate effect"}$$

It is assumed that the system is dynamically stable, and hence the denominator is positive. Consider the case where X is labour intensive (i.e. $\lambda^{**} = \lambda_{KY} - \lambda_{LY} > 0$). This implies that the numerator is unambiguously negative and the tax initially lowers r. However, the reduction in r reduces the incentive to cheat thereby permitting the cartel to further restrict its output. Hence, the demand for both capital and labour declines in sector X. Since X is assumed to be labour intensive, the demand for labour falls relative to that of capital. Hence, the wage rate falls relative to the returns to capital (i.e. $\hat{r} > 0$), and part of the burden is shifted to labour. It is worth noting that this result depends crucially on the assumption that the oligopoly is labour intensive (i.e. $\lambda^{**} > 0$).

A. Differential Property Tax :

Consider now a partial tax on capital employed in the oligopolistic sector (X). The solution is given by :

$$r = \frac{-[\theta_{KX}\lambda^{**} - a_X\sigma_X]\,\hat{t}_{KX}}{a_X\sigma_X + a_Y\sigma_Y + \lambda^{**}\ (\theta^* + \Psi]}$$

Once again consider the case where X is labour intensive (i.e. $\lambda^{**} < 0$). The first term is therefore positive. If in addition it is greater in absolute value than the second term, then r will tend to increase. However, an increase r, raises the incentive to cheat and hence cartel output must be increased to deter cheating. Thus, the demand for labour rises relative to that of capital and this serves to mitigate the increase in r and the degree of tax shifting.

More generally, the returns to capital play a dual role in this model. While the gross returns affect the costs of production, the net returns influence the ability of the cartel to restrict output below the Nash equilibrium. This permits firms to shift part of the burden of a general property tax - a result that can never arise under either monopolistic competition or monopoly. However, the model does appear to be incomplete in several important respects. Thus the conclusions depend upon the assumed form of the supergame, and the model ignores important informational problems in detecting cheating. Despite these inadequacies, the results suggest that group interdependence plays a crucial role in determining the degree of shifting in highly concentrated markets. Hence, the fact that there is no unique solution to the oligopoly problem would appear to provide a reason for further research, rather than an excuse for ignoring tax incidence under oligopoly on the grounds that " it is difficult to arrive at any decisive result" (Break 1974).

Objections to General Equilibrium Theory :

While the introduction of market imperfections represents a useful extension of the standard general equilibrium framework, the models described so far are characteristic of the neoclassical paradigm. Thus, it is assumed that resources are fully employed, factor markets are perfect, production functions are linearly homogenous and there is instantaneous price adjustment. It is evident that these assumptions are not intended to mirror reality; rather their role is that of rendering the analysis tractable. From the neoclassical perspective, theories are not be judged by the relevance of their assumptions, but the sensitivity of the conclusions to changes in the structure and assumptions of the model. In this and earlier sections it has been shown that considerations of risk, variable factor supplies, growth and firm interdependence all serve to invalidate the basic neoclassical result that a uniform factor tax is borne by its owners. It may therefore be argued that the general equilibrium models are highly sensitive to minor, and not unreasonable modifications, and that the results are consequently misleading.

At a more fundamental level, it has been suggested that the neoclassical conception of "capital" as a malleable asset is invalid, thereby vitiating any conclusions based on these models. Proponents of this view include a number of the more resourceful and eminent theoreticians such as Kaldor (1972), Robinson (1953) and Sraffa (1960). Stated briefly and at the cost of considerable simplification their objections may be stated as follows: The assumption that capital is "malleable" implies that it can be transferred costlessly from one form to another. Hence two crucial features of capital, its specificity and heterogeneity are ignored. In the present context, the central question that must be confronted is whether the existence of historically determined heterogeneous capital goods invalidates the conclusions of the general equilibrium models. In part, the answer depends on whether any unit or scalar value can be found for aggregating and measuring heterogeneous capital goods. Critics of the neoclassical paradigm deny the possibility of deriving such a measure. Thus, for example, Robinson (Op cit.) points to a logical inconsistency in the conventional present value measure of capital: " . . . we have to begin by taking the rate of interest as given, whereas the main purpose of the production function is to show how wages and the rate of interest . . . . are determined". Clearly, if capital cannot be aggregated into a single unit then a uniform marginal product of capital: " . . . would not merely be hard to find - it would not be there to be found". (Sraffa (Op cit.) It then follows, that if the marginal product of capital cannot be defined, the notion of a uniform return to capital is meaningless and hence the conclusions of neoclassical incidence theory would appear to be highly misleading if not completely invalid.

A further implication of "malleable" capital is that expectations can never be disappointed. Thus, typically, "Keynesian difficulties" associated with long run expectations and the discrepancy between *ex-ante* savings and investment cannot arise in the standard general equilibrium models. The models appear to implicitly assume perfect foresight and, as a result, there is no role for money, liquidity preference, "animal spirits" and other imperfections which mar the real world. Markets operate to ensure that prices and marginal products are equalised, even if the latter cannot be shown to exist. Clearly, once an independent investment function is introduced into the model, long run expectations may be disappointed, thus driving a wedge between demand and full employment output. Tax incidence will then depend not merely on policy induced supply-side shifts (i.e. "output" and "substitution effects"), but also on changes in aggregate demand.

More generally, eschewing any one of the plethora of assumptions underlying the standard general equilibrium model is sufficient to preclude the existence, and uniqueness, of general equilibrium. Among these, the assumption of constant returns has recently been accorded considerable attention (see Worswick and Trevithick (1983)). In the general equilibrium paradigm, the assumption of linearly homogenous production functions plays the crucial role of ensuring that the assumptions of perfect competition and profit maximisation remain consistent with one another (Kaldor (1974)). However, once increasing returns are introduced into the system the mere existence of competition will not in itself ensure the full utilisation of resources. Hence, the aggregate demand effects of a tax will once again play a critical role in determining tax incidence. Furthermore, exogenous shocks are liable to lead to "cumulative changes" (Kaldor Op cit.), rather than convergence on a static equilibrium.

These criticisms would appear to suggest that an alternative theoretical paradigm may be required in order to capture the combined impact of tax induced supply-side shifts, together with the income-expenditure effects. A useful, though much neglected, body of theory which partly meets these criticisms has been developed by Asmikopulos and Burbidge (1974) in the Post-Keynesian - Kaleckian tradition. The following chapter thus discusses property tax incidence within this framework.

NOTES TO CHAPTER TWO

1. It has seldom been recognised that in Harberger's model, the corporation tax is equivalent to a property tax levied on one sector in the economy.

2. While Mieszkowski's analysis is largely non-technical, the issues are more rigorously investigated in a later study by Courant (1977).

3. In this case, property tax burdens are analgous to prices set in efficient perfectly competitive markets where resources are allocated in a Pareto optimal manner. It follows that tax burdens, like prices in perfect markets, can have no distortionary effects.

4. Thus the tax induced shifts in factor supplies will be similar to those described in the Sonstellie (1979) model.

5. Since tax revenues are used directly to fund expenditures on state provision of goods and services.

6. Cost minimisation in the public sector implies that the government consider as their price the PRIVATE cost of capital, rather than some shadow price based on (say) social criteria.

7. Assuming positive cross partial derivatives.

8. However, the change in the price of capital is ambiguous since the demand for capital as an intermediate input rises, while the supply of capital as a final good also increases.

9. This issue is dealt with in the following sections where the nature of "capital" in neoclassical theory is discussed briefly.

10. This is discussed in Chapter 5, where a model is developed in which the hierarchical structure of production closely accords with empirical magnitudes.

11. It is implicitly assumed here that the standard deviation of rental income is negatively related to land values.

12. For alternative approaches, see Kryzaniak (1968), Diamond (1970), Feldstein (1974a, b,).

13. Ballentine and Erise (1975) showed that Harberger's calculations were incorect since he did not allow for income effects in his demand equation. In addition, Anderson and Ballentine (1976) argue that Harberger's analysis was incomplete since he failed to take account of that part of a corporation tax that falls on pure monopoly profits.

14. We can define factor demand curves as follows :

(i) $C_{LX} = f\,(w, r + t_K)$

(ii) $\therefore \; d\,C_{LX} = \dfrac{\partial C_{LX}}{\partial w}\, d\,w + \dfrac{\partial C_{LX}}{\partial (r + t_K)}\, d\,(r + t_K)$

(iii) $\hat{C}_{LX} = \dfrac{d\,C_{LX}}{C_{LX}} = \dfrac{w}{C_{LX}} \dfrac{\partial C_{LX}}{\partial w} \dfrac{dw}{w} + \dfrac{(r + t_K)}{C_{LX}} \dfrac{\partial C_{LX}}{\partial (r + t_K)} \dfrac{d\,(r + t_K)}{(r + t_K)}$

or

$$\hat{C}_{LX} = \frac{w}{C_{LX}} \frac{\partial C_{LX}}{\partial w}\, \hat{w} + \frac{(r + t_K)}{C_{LX}} \frac{\partial C_{LX}}{\partial (r + t_K)}\, d\, \frac{(\hat{r} + \hat{t}_K)}{(r + t_K)}$$

Define the weighted partial elasticities of substitution as follows:

$$\theta_{LX}\sigma_X = \frac{\theta_{LX} w}{C_{LX}} \frac{\partial C_{LX}}{\partial w} \quad \text{and} \quad \theta_{KX}\sigma_X = \frac{\theta_{KX}\, r}{C_{LX}} \frac{\partial C_{LX}}{\partial r}$$

Substituting in (iii)

(iv) $\hat{C}_{LX} = \theta_{LX}\sigma_X\, \hat{w} + \theta_{KX}\sigma_X\, (\hat{r} + \hat{t}_K)$

Allen (1959) has shown that :

(v) $\theta_{LX}\sigma_X = - \; \theta_{KX}\sigma_X$

Substituting into (v) yields :

(15a) $\hat{C}_{LX} = - \theta_{KX}\sigma_X\, (\hat{w} - \hat{r} - \hat{t}_K)$

By similar reasoning, we obtain (15b) - (15c) in the text.

15. A notable exception, however, is Musgrave who has consistently stressed the importance of rivalry and interdependence (see his theoretical work Musgrave (1959), and pioneering econometric study Kyrzaniak & Musgrave (1963)).

16. In what follows, it will be evident that the results of the model rely crucially on the assumed form of collusive behaviour.

17. It seems not unreasonable to suggest that in addition to these two conditions an enforcible agreement requires that such retaliation be considered *credible* by potential cheats.

18. It may be argued that the model is somewhat restrictive since the form of output retaliation is assumed, rather than derived from the model. Thus, for example, firms may respond to the "cheat" by pushing output beyond the Nash level, thereby imposing negative profits on the cheat. (This appears to have been the response of the established national airlines to Laker Airways' cheap flights to the USA).

19. In essence, this is a dynamic problem cast in static terms, for not only do we define whether $Z > 0$ (i.e. whether cheating is profitable), but also the time period over which $Z > 0$ is at a maximum (assuming appropriate values for r which ensure that $Z > 0$ for some finite period).

20. The standard public finance text books make no reference to this literature (see for instance Musgrave and Musgrave (1978), Brown and Jackson (1980). In Atkinson and Stiglitz (1980) Post-Keynesian incidence analysis is relegated to a mere footnote on Page 222.

CHAPTER THREE

POST-KEYNESIAN TAX INCIDENCE THEORY

The Post-Keynesian approach to tax incidence is based on a theoretical paradigm which difers fundamentally from its neoclassical counterpart. While there is no formal unified "Post-Keynesian Theory", exponents of this school share certain common propositions developed from the work of Keynes and Kalecki. In a sense, the distinguishing feature of Post-Keynesian analysis lies in the emphasis given to particular aspects of the General Theory and the rejection of certain features of the prevailing neoclassical orthodoxy.

Perhaps central to the Post-Keynesian vision, is the notion that the General Theory represents a radical departure from the neoclassical paradigm. Accordingly, the "neoclassical synthesis" of Keynes is viewed as a reassertion of the Walrasian general equilibrium framework, with the addition of some "Keynesian" macro variables. For Post-Keynesians, the "neoclassical synthesis", eschews the essential logic of the General Theory, while retaining some of its specific policy recommendations. The framework is thus inextricably linked to Keynes, and its origins lie in the controversies surrounding the interpretation of the General Theory. Hence, this chapter begins with a brief discussion of the various elements of the General Theory which distinguish the Post-Keynesian approach from the "neoclassical synthesis". To begin with Keynes, however, is not symptomatic of the ritualistic genuflexion to the General Theory. It is instead, a reflection of the Post-Keynesian view that

Keynes' ideas remain poignant and relevant today, even if not universally accepted.

3.1 "Chapter 12 Keynesians"

Economic activities are, as a rule, directed towards the future. This is obviously true for durable goods and financial instruments of long maturity. It is equally important for perishable goods, for production and consumption may be differed from one period to the next. It therefore follows that it is impossible to describe or explain the state of the economy today, unless we can do so for all future time. Within the confines of Walrasian general equilibrium, this difficulty is circumvented by assuming that there exists intertemporal and contingent future markets for all commodities. Thus, for example, goods to be produced for future delivery will be sold in contingent future markets, and inputs purchased from the proceeds of the sale. Similarly, savers sell their claims for the purchase of commodities to be delivered in the future. The existence of future markets therefore serves to collapse the future into the present, and as a result expectational errors are ruled out by assumption. This scenario may be attacked on grounds of realism and relevance (see Walsh and Gram [1979]). However, as noted by Arrow [1981], there are more fundamental theoretical reasons which preclude the existence of future markets. First, it has been shown that if information is imperfect, Arrow-Debreu future markets cannot exist. Second, if exchange is costly, it will no longer be profitable to operate such markets.

Accordingly, Post-Keynesians forcefully reject the Arrow-Debreu general equilibrium system, and attempt to meet the problem by analysing the future in irreversible "historical time"[1] The essential feature of an economy that functions in historical time is that the past is given and cannot be changed, while the future remains unknown and uncertain. Post-Keynesians insist that "historical time" and uncertainty are central to both the real world, and the General Theory. Though doctrinal matters are not the concern of this chapter, we note that exponents of the "neoclassical synthesis" have regarded them as peripheral.

If the future is unknown and uncertain, it follows that agents must form expectations. Post-Keynesians emphasise the essential heterogeneity of long run expectations. In both Chapter 12 of the General Theory, and his 1937 article, Keynes argued that long-term expectations are formed not merely in the context of risk to which a probability can be assigned, but also in uncertain circumstances for which there is " . . . no scientific basis on which to form any calculable probability whatever". (Keynes 1937).

Post-Keynesians have extended and developed Keynes' views on uncertainty (see Shackle [1968]). Thus in Davidson's [1978] parlance, uncertainty stems from the fact that economic decisions are "crucial" in nature. A "crucial decision" is defined as one where the very choice of a course of action may alter the existing circumstances in a manner which makes it impossible to restore the <u>original</u> situation. Thus, each decision is in a sense unique, since repetition is by definition impossible. This implies that frequency ratios of possible outcomes cannot be defined, and numerical probability statements assigned to future events are essentially meaningless.

Since uncertainties cannot be reduced to probability statements, agents must resort to alternative sources of guidance. Keynes argued that past experience,[2] the state of confidence, and general opinion, play an important role in determining expectations:

"We assume that the present is a much more servicable guide to the future . . . (and) we endeavour to fall back on the judgement of the rest of the world which is perhaps better informed". (Keynes [1937]). Expectations based on such fickle foundations will clearly be subject to sudden and violent fluctuations.

It is perhaps worth emphasising that expectations thus formed are not necessarily irrational, in the sense of being based on a subset of all available information. For Keynes, "rational" calculating action is severely limited by uncertainty, i.e. the information required to form probability statements *simply do not exist* [3]

Time and uncertainty introduce further complications in the Post-Keynesian paradigm. In a world of historical uncertainty, transactions neither occur instantaneously nor simultaneously; individuals who sell goods hold money for some period of time before purchasing other commodities. Thus, both uncertainty, and the lack of synchronisation between receipts and payments give rise to a demand for liquidity and money. Consider, for example, the production process in historical time. The time consuming nature of production implies that factor inputs must be hired and paid before the sale of the finished product. Firms therefore require liquidity in order to discharge their contractual obligations and hence they hold money which serves as a "link between the present and the future". (Keynes [1936]).

In contrast, a neoclassical world of perfect certainty with Arrow-Debreu future markets, means that all future prices are known. A decision to sell involves a concomitant purchase, and hence all goods are in a sense perfectly liquid. Money therefore loses its special status as a stored of value and "temporary abode for purchasing power".

Time and liquidity further permit Keynes to define an "underemployment equilibrium" - a seemingly contradictory concept in the classical paradigm. Consider a reduction in investment resulting from an exogenous shift in expectations. The lower level of investment implies that agents postpone current expenditure and move into liquid assets. The reduction in the demand for investment goods lowers output and employment, while the increased demand for liquid assets raises their price. However, since liquid assets such as money are not "produced" by labour (i.e. they have a zero elasticity of production), unemployed workers cannot be re-employed in the production of liquidity. Keynes further assumed that the elasticity of substitution between liquid assets and real producable goods is zero. Consequently, an increase in the price of liquid assets does not divert demand back to the real sector, and unemployment persists. Hence, we observe that :

"Unemployment develops, that is to say, because people want the moon; - men cannot be employed when the object of desire (i.e. money) is something which cannot be produced and the demand for which cannot be readily choked off". (Keynes [1936]).

Finally, it is perhaps worth noting that equilibrium as defined by Keynes and the Post-Keynesians merely denotes a state in which the prevailing price is such that agents neither have the incentive nor the power to alter their market offers. In contrast, neoclassical theory adopts a rather more restrictive definition of equilibrium - i.e. that markets clear and hence demand and supply are equalised at the prevailing price. Clearly, the Post-Keynesian definition is more general in the sense that market clearing is a sufficient but not necessary condition for Post-Keynesian equilibrium. Thus conceptualised, disequilibrium in the Post-Keynesian framework occurs if agents' expectations are falsified, and there is a desire to alter market offers together with the power to effect such change.[4]

3.2 Post-Keynesian Tax Incidence Theory

The Post-Keynesian Theory of tax incidence has its genesis in Kalecki's [1937], much neglected, pioneering study on the impact of commodity, profit and capital taxes. Kalecki's analysis has recently been extended and restated in contemporary Keynesian nomenclature by Eatwell [1971] and Asimakopulos and Burbridge [1974] (A-B hereafter). The A-B model was applied to a study of property tax incidence by Mair [1985], and in what follows, we describe the A-B model and Mair's extension in some detail. It is shown that Mair's conclusions are either erroneous or incompatible with the fundamental tenets of Keynesian economics. In the following section we therefore propose an amendment to the model, and provide a test of its "Kaleckian" nature by comparing the results to Kalecki's (Op cit.) conclusions.

Post-Keynesian incidence analysis is based on a theory of distribution that combines both microeconomic and macroeconomic aspects of the economy. Income shares are determined partly by the level of effective demand, and in part by the degree of monopoly enjoyed by firms. Moreover, the analysis focuses on the short run equilibrium distribution of income, for it is argued that the "long run is but a slowly changing component of a chain of short period situations : it has no independent entity". (Kalecki [1971]). Investment in any short period is thus assumed to be exogenously fixed, being determined by decisions taken in earlier time periods. Income distribution and tax incidence are therefore determined by the Keynesian equilibrium condition that desired savings be equal to the exogenously given level of investment.

More specifically, the A-B model distinguishes three groups in the economy on the basis of the source of their incomes, and their savings behaviour. There are assumed to be a category of agents termed "workers" who receive only earned wage income and undertake no net saving. In addition, production is undertaken by "firms" who earn profits and retain a proportion of the net profits $(1 - \beta)$ as savings. Finally a group of "rentiers" receive a fraction (β) of firms net profits by virtue of their share holdings, and save a proportion (s_r) of their net-income. The assumed form of saving behaviour thus reflects the organisation of capitalist production, where control and ownership of the means of production is vested in fewer hands than those who engage in production. The critical assumption is not the absence of workers saving, but the difference in saving propensities out of wages and profit income.[5]

Output and Production :

For expository convenience, A-B assume that output consists of a single multi-purpose good which can either be consumed, invested, or used by the government. The output is produced in plants in which labour is the only variable factor input. Moreover, costs are assumed to be constant over a substantial range of output, and then to rise sharply beyond a certain 'normal' level of capacity. With these assumptions average output per man will be constant up to normal capacity utilisation, and hence total output may be expressed as -

(1) $$O = aL \quad ; \quad L \leq \bar{L}$$

where: O = Total Output

a = Average output per man

L = Level of employment

$\bar{L}$ = Level of employment at "normal capacity".

Pricing and Market Structure:

A-B develop two versions of their model. In the first, markets are assumed to be perfectly competitive, and hence the mark-up over unit costs is determined by the market price which equates demand to capacity output. Thus, by implication, under perfect competition, price flexibility ensures that resources are fully employed.

In the second version, markets are assumed to be oligopolistic, and price is set by leaders who adopt some <u>fixed</u> mark-up over their costs. The mark-up chosen by price leaders is assumed to cover both overhead costs and profits. Its precise value would thus be dependent on the standard or "normal" rate of capacity utilisation used to calculate costs, as well as the rate of return which is considered "normal" in the particular sector of the economy. The "normal" rate of return in Kalecki's approach is "rooted in past economic, social and technological developments". (Kalecki [1968]). Thus, industries which enjoy a high degree of monopoly will, on average, earn higher "normal" rates of profit.

More formally the price equation is given by:

(2) $$P = (1 + \lambda) \frac{w}{a}$$

where: P = Factor-cost price of output

λ = Mark-up

w = Money wage rate

There are thus three elements in the determination of the price level, the mark-up (λ), average output per man (a), and the money wage rate (w). In what follows, the money wage is assumed to be fixed, being determined by contracts negotiated at the beginning of the period under consideration. In the competitive version of the model, the mark-up, prices and hence real wages are assumed to be variable, while output and employment are fixed at their full employment levels. In contrast, under oligopoly, prices and the mark-up are fixed by price leaders, and output is permited to vary.

A-B's attempt to allow for the interdependence of firms' pricing decisions is commendable, and represents a useful development over the neoclassical flex price approach. At a technical level, the assumption that prices are fixed by leaders, merely serves as a device for introducing into the model quantity rather than price adjustments. Theoretically, however, it may be argued that this is much too simplified a presentation of the forces determining prices in oligopolistic markets. Price leadership, it will be recalled, is one of several possible solutions to the oligopoly problem. In the absence of explicit collusion, rigid prices may be generated for a variety of reasons. Theoretically, price leadership thus appears to be a somewhat restrictive and limiting assumption which may, in addition, be criticised on grounds of its empirical relevance.

Firm interdependence raises further problems of aggregation. The A-B theory of distribution is concerned with aggregates i.e. total output, savings, etc. The analysis thus proceeds at a high level of aggregation which is far removed from the actions of individual firms. Aggregation, though a powerful simplifying device, is only valid if members within an aggregate display more similarity than differences. (see Chick [1983]), and Weintraub [1979]). In the present model, problems arise from potential rivalry between firms, for clearly the behaviour of the aggregate will depend on the manner in which the conflicts are resolved. In order to aggregate across firms, it therefore becomes necessary to assume that differences between sectors (such as investment and consumer goods producers) are minor, and that all firms have similar objectives and respond in a similar way to the same stimulus. By implication, the central features of oligopoly such as product variations, advertising costs, price differences, etc. must therefore be ignored.

Aggregate Equilibrium Relations :

The market price of the multipurpose good can be obtained from its factor-cost price (i.e. equation 2) by adjusting for the tax on consumption :

(3) $$P^1 = (1 + tc)P$$

where: P^1 = market price of the mult purpose good

tc = tax on output used for consumption

From the expenditure side of the national accounts, output (or real income) may be defined as :

(4) $$O = C + \bar{I} + G + U$$

where: C = consumption in real terms

$\bar{I}$ = investment in real terms (assumed fixed)

G = government expenditure in real terms

U = unintended inventory accumulation/decumulation

Expressed in nominal values, we have:

(5) $$Y = P^1C + P\bar{I} + PG + PU$$

where: Y = nominal income

From the income side, nominal output (income) is given by:

(6) $$Y = wL + \Pi + tcPC + P\bar{D}$$

where: Π = gross profits in nominal terms

D = depreciation in real terms

Combining equations (1) - (6), we obtain an equation relating the mark-up to employment and profits:

$$(7) \qquad \frac{\lambda}{1+\lambda} \, a.L = \frac{\Pi}{P} + \bar{D}$$

Rearranging equation (7) and differentiating partially, we find that $\delta P/\delta\Pi > 0$ and $\delta L/\delta\Pi > 0$. Thus we note that an increase in profits is either accompanied by an increase in prices (in the competitive version), or an increase in employment (in the oligopolistic version).

Finally, there is assumed to be a wage tax, a profits tax, a consumption tax, and a property tax in the system. The property tax is levied at a uniform rate on the value of domestic property owned by workers and rentiers (denoted V_w and V_r, respectively), and the value of all fixed assets owned by firms (denoted K). Thus, total tax revenue is given by :

$$(8) \qquad T = t_w.wL + t_j.\Pi + t_r(1 - t_j)\beta\Pi + t_c PC + t_p(K + V_r + V_w)$$

where:

t_w = Tax on wage incomes

t_j = Tax on profits

t_r = Tax on rentiers incomes

β = Proportion of after-tax profits paid to rentiers

t_p = Property Tax

K = Value of fixed assets owned by firms

V_r = Value of property owned by rentiers

V_w = Value of property owned by workers

To simplify the analysis, it is assumed that the budget is balanced :

(9) $$T = PG$$

By definition, gross private saving must be equal to the value of investment and the government deficit:

(10) $$S = P\bar{I} + PG + PU - P\bar{D} - T$$

The analysis focuses on situations of short run equilibrium in which ex-ante savings and investment are equal. Thus P U: (i.e. unintended inventory accumulation) is zero, and from equation (9) we know that the budget is balanced. Hence in short-period equilibrium, desired savings equal net investment:

(11) $$S = P\bar{I} - P\bar{D}$$

Both the distribution of income and its level are determined by this equilibrium condition. Consider, for example, an increase in property taxes; disposable income initially falls, and this alters spending flows and hence savings. The equilibrium level of savings in equation (11) may either be restored by (a) an increase in output, the distributive composition of income being constant, or (b) a redistribution of income between differential saving groups, such that the required equilibrium volume of saving is attained. In practice, the tax will induce a combination of the two effects - the relative emphasis of each being dependent on the level of capacity utilisation. Clearly, where resources are fully employed (as in the competitive case) the redistributive effects dominate the adjustment process.

However, we have assumed that the government budget is balanced. Hence, in the absence of compensating reductions in other taxes, a property tax increase will be accompanied by an increase in government expenditure. It will be recalled, that in Keynesian income-expenditure analysis, balanced tax and government expenditure increases, raise aggregate demand, and hence employment and output, or prices. The fiscal expansion derives from the transfer of income from net savers in the private sector (who pay taxes partly out of savings), to the government which spends all the revenue raised through taxes. The increase in government expenditure therefore exceeds the reduction in private consumption and aggregate demand rises.

In striking contrast, Mair (Op cit.) in his extension of the A-B model argues that balanced property tax and government expenditure increases have no effect on either employment, output or profits. This peculiar conclusion seems difficult to explain in a Keynesian model of an employment equilibrium. Hence, in what follows, we attempt to locate the source of this anomalous result. There are, however, a number of difficulties in identifying the error in Mair's analysis. The formal structure of the extended A-B model receives scant attention and there is no discussion of either the property tax shifting mechanisms or the economic implications of this aberrant conclusion. Much of the discussion is concerned with institutional features, and the article merely presents three equations which appear to be based on a number of unsubstantiated assumptions. The paucity of formal anlysis is somewhat regrettable since it obscures the contradictions implicit in the postulated equations. Hence in the remainder of this section, we explicate the model and results in some detail, emphasising the theoretical inconsistencies implicit in the analysis

The short-period distribution of income is determined by the equilibrium condition that desired saving be equal to the exogenously fixed level of net investment. Hence, the tax induced changes in income distribution depend crucially on the variation in consumption and saving necessary to restore this equilibrium condition. Mair (Op cit.) defines, without explanation, rentiers consumption as follows:

$$C_r = (1 - S_r)(1 - t_r)(1 - t_j)\frac{\beta \Pi}{P(1 + t_c)} - t_p V_r \quad (12)$$

where: S_r = rentiers propensity to save

β = proportion of after-tax profits paid to rentiers

From equation (12) we can infer rentiers after-tax income:

$$Y_r = (1 - t_r)(1 - t_j)\frac{\beta \Pi}{P(1 + t_c)} - t_p V_r \quad (13)$$

subtracting (12) from (13), rentiers net savings are given by :

$$S_r(1 - t_r)(1 - t_j)\frac{\beta \Pi}{P(1 + t_c)} \quad (14)$$

There are, however, two unsubstantiated assumptions implicit in the consumption function which appear to contradict the fundamental postulates of Keynesian and Kaleckian theory. First, it will be noted from equation (12) that the tax on rentiers property (i.e. $t_p V_r$) is treated as a (negative) component of autonomous consumption. The property tax burden is thus met entirely out of consumption expenditures, leaving net rentier savings (equation [14]) unaffected. This contrasts with the conventional treatment of taxation in income-expenditure models where taxes are paid out of income prior to its distribution between consumption expenditures and savings. Hence, the tax burden is apportioned between consumption and savings in proportion to the propensities to consume and save. Consequently, balanced tax and government expenditure increases, augment aggregate demand, raising employment and output. In contrast, Mair's peculiar formulation of the consumption function implies that the reduction in rentiers' expenditure is exactly counterbalanced by higher government spending, and hence aggregate demand and output are unaffected.

Furthermore, the consumption function embodies two mutually contradictory behavioural assumptions. Thus, while taxes on rentiers' incomes are partially absorbed by savings, property taxes are paid wholly out of consumption expenditures. Hence, income taxes in Mair's model induce Keynesian behaviour in the sense that taxes are apportioned between consumption expenditures and savings, while property taxes induce neoclassical behaviour based on a simple two-period consumption-saving model (see Samuelson [1958]) where individuals save a given amount for future consumption.[6] It therefore appears reasonable to suggest that Mair's consumption function is theoretically inconsistent embodying two diametrically opposed theories of consumer behaviour.

It will be recalled that firms in the model pay both profits and property taxes. However, equations (12) and (13) reveal that while profit taxes are apportioned between retained and distributed profits (i.e. rentiers incomes), firms property tax payments have *no effect on distributed profits.* By default, this therefore implies that non-domestic property taxes are either (a) paid entirely out of retained profits, or (b) that taxable distributed profits (i.e. Π/P) in equations (12) and (13) are implicitly defined net of of firms' property tax payments and that the marginal rate of profits tax is unity (i.e. $t_j = 1$).

If non-domestic property taxes are paid entirely out of retained profits, it follows that the property tax is equivalent in its impact to a tax on retentions, and net retained profits may then be defined as :

(15a) $$\left([1 - \beta]\,[1 - t_j]\,\frac{\Pi}{P} \right) - t_p K$$

where: $[1 - \beta]$ = proportion of profits retained.

On the other hand, if profits in equation (12) are implicitly defined to include firms property tax payments and the marginal rate of profits tax is unity, it follows that increases in non-domestic property taxes lower taxable gross profits and hence the profits tax liability, by an amount equal to the property tax levy. Thus, non-domestic property taxes are fully integrated into the profits tax schedule. More formally, let $\frac{\Pi^1}{P}$ denote real gross profits PRIOR to property tax payments (i.e. as conventionally defined), and let $\frac{\Pi}{P}$ be "gross" taxable profits AFTER property tax payments. Then, it follows that:

$$\frac{\Pi}{P} = \left(\frac{\Pi^1}{P} - t_p K \right)$$

and hence firms total tax liability is given by:

$$t_j \left(\frac{\Pi}{P} \right) = t_j \left(\frac{\Pi^1}{P} - t_p K \right)$$

That is, non-domestic property taxes are fully integrated into the profits tax schedule. If we further assume that the marginal profits tax rate is unity, it follows that an increase in non-domestic property taxes will lead to a corresponding and equivalent decrease in the profits tax liability. Net retained profits may then be defined as :

$$(1 - \beta)\ (1 - t_j)\ \left(\frac{\Pi^1}{P} - t_p K \right)$$

or equivalently

(15b) $$(1 - \beta)\ (1 - t_j)\ \frac{\Pi}{P}$$

It is perhaps worth noting that this peculiar definition of "gross" taxable profits contradicts both accounting practice and economic convention.[7] However, the consumption function reveals that non-domestic property taxes have no effect on distributed profits, and this necessarily implies that property taxes are either paid out of retained profits, or directly lowers firms profit tax payments.[8]

Where property taxes are paid wholly out of retained profits, total private savings may be obtained by combining equations (14) and (15a):

(16a) $$S_1 = \left([1-\beta]\,[1-t_j]\,\frac{\Pi}{P} - t_p K \right) + \left(S_r [1-t_r]\,[1-t_j]\,\frac{\beta\Pi}{P} \right)$$

$$= [1-t_j]\,\frac{\Pi}{P}\left([1-\beta] + S_r [1-t_r]\,\beta \right) - t_p K$$

Alternatively, with full integration combining equations (14) and (15b), total private savings are given by :

(16b) $$S_2 = \left([1-\beta]\left[\frac{\Pi^1}{P} - t_p K\right][1-t_j] \right) + \left(\beta S_r [1-t_r]\,[1-t_j]\left[\frac{\Pi^1}{P} - t_p K\right] \right)$$

$$= [1-t_j]\left[\frac{\Pi^1}{P} - t_p K\right]\left([1-\beta] + \beta S_r [1-t_r] \right)$$

In equilibrium, savings and investment are equal, hence substituting equations (16a and b) respectively for S in equilibrium relation (11), we obtain:

(17a) $$S = [1-t_j]\,\frac{\Pi}{P}\left([1-\beta] + S_r [1-t_r]\,\beta \right) - t_p K = \bar{I} - \bar{D}$$

and

(17b) $$S = [1-t_j]\left[\frac{\Pi^1}{P} - t_p K\right]\left([1-\beta] + S_r [1-t_r]\,\beta \right) = \bar{I} - \bar{D}$$

The equilibrium tax induced changes in income distribution can be inferred from equation (17). Thus, if a tax initially lowers either retained profits or rentier savings, gross profits must increase to restore the equilibrium level of savings. From equation (7), this implies that either output and employment, or prices rise. In the competitive version of the model, prices are flexible and employment is fixed, hence prices rise. In the oligopolistic version, on the other hand, the mark-up is constant, and hence employment increases.

Consider the case where an increase in any one tax is accompanied by higher government expenditure, the other taxes being held constant. Following A-B, we assume for computational ease that the distributional impact of government spending can be ignored. We consider first the case where non-domestic property taxes are paid out of retained profits.

Rearranging equation (17a) we define <u>equilibrium</u> gross profits (i.e. $\frac{\Pi}{P}$) as follows :

$$(18) \qquad \frac{\Pi}{P} = \frac{\bar{I} - \bar{D} + t_p K}{[1 - t_j]\left([1 - \beta] + S_r [1 - t_r] \beta \right)}$$

The impact of various taxes on equilibrium gross profits can be inferred from the sign of the partial derivative of $\frac{\Pi}{P}$ with respect to the tax under consideration. Thus it can be seen that:

$$(18a) \qquad \frac{\partial (\Pi/P)}{\partial t_j} > 0$$

(18b) $$\frac{\partial(\Pi/P)}{\partial t_r} > 0$$

(18c) $$\frac{\partial(\Pi/P)}{\partial t_p} > 0$$

(18d) $$\frac{\partial(\Pi/P)}{\partial t_c} = 0$$

(18e) $$\frac{\partial(\Pi/P)}{\partial t_w} = 0$$

Furthermore, from equation (7) we observe that an increase in gross profits raises prices in the competitive version, and employment in the oligopolistic model. Table 3.1 overleaf presents Mair's results for the non-competitive version. It will be noted that an increase in property taxes (row 5) has no effect on either gross real profits, or employment. In contrast, the partial derivative in equation (18c) is positive, implying that gross profits are higher, and hence either employment or prices increase. We therefore conclude that Mair's saving function does not embody the assumption that non-domestic property taxes are paid entirely out of retained profits. It would seem worth noting that it is algebraically impossible to derive equilibrium net profits from equation (17a) (i.e. $[1 - t_j] \frac{\Pi}{P} - t_p K$). This therefore further reinforces our conclusion that non-domestic property taxes in Mair's model cannot be paid wholly out of retained profits.

TABLE 3.1

NON COMPETITIVE VERSION

Change In

	After Tax Profits	Profits	Rentiers Consumption	Post Tax Wage Rate	Employment and Output
1. $\Delta t_j > 0$ $\Delta t_w = \Delta t_r = \Delta t_c = 0$	0	+	0	0	+
2. $\Delta t_j > 0$ $\Delta t_j = \Delta t_r = 0$	0	0	0	-	0
3. $\Delta t_r > 0$ $\Delta t_j = \Delta t_c = \Delta t_w = 0$	+	+	-	0	+
4. $\Delta t_c > 0$ $\Delta t_j = \Delta t_r = \Delta t_w = 0$	0	0	-	-	0
5. $\Delta t_p > 0$ $\Delta t_j = \Delta t_r = \Delta t_w$ $= \Delta t_c = 0$	0	0	-	-	0

Source : Mair (Op. cit. pg.126)

Rows 1-4 calculated by A-B, Row 5 calculated by Mair

We consider next the equilibrium saving function in equation (17b) which assumes that non-domestic property taxes are fully integrated into the profits tax schedule and the marginal profits tax rate is unity. Equilibrium taxable "gross" profits (i.e. $\frac{\Pi}{P} = [\frac{\Pi^1}{P} - t_pK]$) can be obtained by rearranging equation (18b) as follows:

(20) $$\frac{\Pi}{P} = [\frac{\Pi^1}{P} - t_pK] = \frac{\bar{I} - \bar{D}}{[1 - t_j]\ ([1 - \beta] + \beta\, S_r [1 - t_r]\ )}$$

From equation (20) we obtain the following partial derivatives:

(20a) $$\frac{\partial (\Pi^1/P - t_pK)}{\partial t_j} > 0$$

(20b) $$\frac{\partial (\Pi^1/P - t_pK)}{\partial t_r} > 0$$

(20c) $$\frac{\partial (\Pi^1/P - t_pK)}{\partial t_p} = 0$$

(20d) $$\frac{\partial (\Pi^1/P - t_pK)}{\partial t_c} = 0$$

(20e) $$\frac{\partial (\Pi^1/P - t_pK)}{\partial t_w} = 0$$

From equation (20c) it will be observed that balanced property tax and government expenditure increases have no impact on "gross" taxable profits and hence our results accord with Mair's conclusions. (see Table 3.1, row 5).

Rearranging equation (17b) we further define equilibrium net profits

(i.e. $[1 - t_j] \; [\frac{\Pi^1}{P} - t_p K]$) as follows:

$$(21) \qquad Z_N\Pi = [1 - t_j] \; [\frac{\Pi^1}{P} - t_p K] \;) = \frac{\bar{I} - \bar{D}}{([1 - \beta] + \beta \; [1 - t_r] S_r \;)}$$

Hence it can be seen that:

$$(21a) \qquad \frac{\partial Z_N\Pi}{\partial t_j} = 0$$

$$(21b) \qquad \frac{\partial Z_N\Pi}{\partial t_r} > 0$$

$$(21c) \qquad \frac{\partial Z_N\Pi}{\partial t_p} = 0$$

$$(21d) \qquad \frac{\partial Z_N\Pi}{\partial t_w} = 0$$

$$(21e) \qquad \frac{\partial Z_N\Pi}{\partial t_c} = 0$$

Once more the results accord with Mair's conclusions (see Table 3.1 row 5).

Rearranging (17b), we further define equilibrium net rentier income as follows:

$$Y_R = [1 - t_j] \; [\frac{\Pi^1}{P} - t_p K] \; \beta \, [1 - t_r] = \frac{\bar{I} - \bar{D} - [1 - \beta] [1 - t_j] \Pi / P - t_p K}{S_r}$$

Consumption is a fraction $[1 - S_r]$ of net income, minus rentiers property tax burden. Hence:

(22) $$C_R = (\bar{I} - \bar{D} - [1 - \beta][1 - t_j][\frac{\Pi}{P(1-t_c)} - t_pK])(\frac{[1 - S_r]}{S_r}) - t_pV_r$$

It follows that:

(22a) $$\frac{\partial C_r}{\partial t_j} = \frac{\partial ZN\Pi}{\partial t_j} \frac{\partial C_r}{\partial ZN\Pi} = 0$$

From (22) we observe that $\partial C_r / \partial ZN\Pi < 0$, and from (21a) we know that $\partial ZN\Pi / \partial t_j = 0$. Hence equation (22a) is zero. Similarly:

(22b) $$\frac{\partial C_r}{\partial t_r} = \frac{\partial ZN\Pi}{\partial t_r} \frac{\partial C_r}{\partial ZN\Pi} < 0$$

From equation (21b) we know that $\partial ZN\Pi / \partial t_r > 0$, and from (22) $\partial C_r / \partial ZN\Pi < 0$, hence the overall expression in (22b) is negative. Next we define :

(22c) $$\frac{\partial C_r}{\partial t_p} = \frac{\partial ZN\Pi}{\partial t_p} \frac{\partial C_r}{\partial ZN\Pi} + \frac{\partial C_r}{\partial t_p} < 0$$

From equation (21c) we observe that $\frac{\partial ZN\Pi}{\partial t_p} = 0$, and hence the first term in (22c) is zero. However, from equation (22) we know that $\frac{\partial C_r}{\partial t_p} < 0$, and hence equation (22c) is negative. Finally, we note that:

(22d) $$\frac{\partial C_r}{\partial t_w} = 0$$

and

(22e) $$\frac{\partial C_r}{\partial t_c} = 0$$

The signs of the partial derivatives are thus congruent with Mair's conclusions.

Consider next the equilibrium change in real wages. It will be recalled that workers consume all their after-tax incomes. We therefore derive the equilibrium real wage as follows:

From equation (6) we have:

$$(6a) \qquad \frac{Y}{P} = \frac{wL}{P} + \frac{\Pi}{P} + \bar{D} + t_c C$$

$$(6b) \qquad \therefore \quad \frac{\Pi}{P} = \frac{Y}{P} - \frac{wL}{P} - \bar{D} - t_c C$$

From equation (20) we know that equilibrium profits are:

$$(20) \qquad \frac{\Pi}{P} = \frac{\bar{I} - \bar{D}}{\left([1 - t_j] \; ([1 - \beta] + \beta \, S_r [1 - t_r] \;) \right.}$$

Eliminating $\frac{\Pi}{P}$ and rearranging:

$$(23) \qquad \frac{wL}{P} = \frac{Y}{P} - \bar{D} - t_c C - \left[\frac{\bar{I} - \bar{D}}{[1 - t_j] \; ([1 - \beta] + \beta \, S_r [1 - t_r] \;)} \right]$$

Now define equilibrium workers consumption as:

$$(24) \qquad C_w = \left[\frac{wL}{P} ([1 - t_w) - t_p V_w \right] = \frac{Y}{P} - \bar{D} - t_c C - \left[\frac{\bar{I} - \bar{D}}{[1 - t_j] \; ([1 - \beta] + \beta \, S_r [1 - t_r] \;)} \right] \left\{ [1 - t_w] - t_p V_w \right\}$$

It will be recalled that nominal wages are fixed in the model. Consequently real wages and hence workers consumption can only be varied either by direct taxation, or through changes in the price level. We present below the results for the non-competitive version where prices are assumed to be fixed. Thus:

(24a) $\frac{\partial C_w}{\partial t_j} = \frac{\partial P}{\partial t_j}\frac{\partial C_w}{\partial P} = 0$ (Since $\frac{\partial P}{\partial t_j} = 0$ under oligopoly)

(24b) $\frac{\partial C_w}{\partial t_r} = \frac{\partial P}{\partial t_r}\frac{\partial C_w}{\partial P} = 0$ (Since $\frac{\partial P}{\partial t_j} = 0$ under oligopoly)

(24c) $\frac{\partial C_w}{\partial t_p} = \frac{\partial P}{\partial t_p}\frac{\partial C_w}{\partial P} + \frac{\partial C_w}{\partial t_p} < 0$ (Since $\frac{\partial C_w}{\partial t_p} < 0$ in (24))

(24d) $\frac{\partial C_w}{\partial t_w} < 0$

(24e) $\frac{\partial C_w}{\partial t_c} < 0$

These results accord with Mair's conclusions in Table 3.1.

We have thus shown by contradiction and verification that Mair's results are based on the implicit and unsubstantiated assumptions that rentiers pay property taxes entirely out of consumption expenditures and that non-domestic property taxes are fully integrated into the profits tax schedule. These combine to ensure that balanced increases in property taxes and government expenditure have no effect on aggregate demand, and hence employment and output are unaffected. Specifically, since domestic property taxes are absorbed wholly by consumption expenditures, the decline in private sector spending is exactly counterbalanced by government expenditures. Furthermore, since non-domestic property taxes are integrated into the profits tax schedule, increase in the former are automatically offset by a lower profits tax burden. Hence, aggregate demand is unaffected and " . . . the short period incidence of the property tax (Table 3.1, row 5) is equivalent . . . . . . to the incidence of the tax on the consumption good (Table 3.1, row 4)". Mair (Op cit.). Mair's results are thus broadly analogous to those of the partial equilibrium framework (see Section 2.2). This is not surprising, for the combination of theoretically incompatible assumptions embodied in the consumption function serve to neutralise demand effects. In the following section we therefore amend Mair's model, and provide a test of its "Post Keynesian" nature by comparing the results with Kalecki's [1937] study entitled "A Theory of Commodity, Income and Capital Taxation".

3.3 The Amended Model:

In this section, we eschew the theoretically inconsistent assumptions embodied in Mair's model, and reintroduce "Keynesian" features into the consumption and profit functions. Thus, following Keynes [1936] we assume that consumption is a function of current <u>net</u> income, and hence taxes are absorbed partly by savings and in part by consumption expenditure. Analogously, we assume that non-domestic taxes are paid out of gross profits (conventionally defined) PRIOR to its division between retentions and distributions. Thus, taxes are shared between rentiers and firms in proportion to the fraction (β) of profits which are distributed. Total net profits can therefore be defined as :

(25) $$Z_N\Pi = [1 - t_j]\frac{\Pi}{P} - t_pK$$

Thus non-domestic property taxes are not accorded tax allowance status, and net profits are given by:

(26) $$[1 - \beta]\left([1 - t_j]\frac{\Pi}{P} - t_pK\right)$$

Subtracting (26) from (25) we obtain net distributed profits (or gross rentier incomes.):

(27) $$\beta\left([1 - t_j]\frac{\Pi}{P} - t_pK\right)$$

Net rentier incomes (Y_r) and savings ($S_r^{!}$) may therefore be defined as:

(28) $$Y_r = [1 - t_r]\left([1 - t_j]\frac{\beta\Pi}{P} - \beta t_pK\right) - t_pV_r$$

and

(29) $$S_r^{!} = s_r\left([1 - t_r]\left([1 - t_j]\frac{\beta\Pi}{P} - \beta t_pK\right) - t_pV_r\right)$$

In short-period equilibrium aggregate savings and investment are equal. Hence, combining (26) and (29) we define equilibrium as :

(30) $$S = \left([1 - t_j] \frac{\Pi}{P} - t_p K \right) \left([1 - \beta] + S_r \beta [1 - t_r] \right) - S_r t_p V_r = \bar{I} - \bar{D}$$

Rearranging (30) equilibrium gross profits ($\frac{\Pi}{P}$) are given by:

(31) $$\frac{\Pi}{P} = \frac{\bar{I} - \bar{D} + S_r t_p V_r}{\left([1 - t_j] \left([1 - \beta] + S_r \beta [1 - t_r] \right) \right.} + \frac{t_p K}{[1 - t_j]}$$

and it follows from (31) that:

(31a) $$\frac{\partial (\Pi/P)}{\partial t_j} > 0$$

(31b) $$\frac{\partial (\Pi/P)}{\partial t_r} > 0$$

(31c) $$\frac{\partial (\Pi/P)}{\partial t_p} > 0$$

(31d) $$\frac{\partial (\Pi/P)}{\partial t_w} = 0$$

(31e) $$\frac{\partial (\Pi/P)}{\partial t_c} = 0$$

Thus from (31c) it can be seen that balanced property tax and government expenditure increases raise gross profits, and hence in the competitive case prices rise, while under oligopoly output and employment increase.

Analogously, we define equilibrium net profits from (31):

(32) $$Z_{N\Pi} = [1 - t_j]\left[\frac{\Pi}{P} - t_p K\right]) = \frac{\bar{I} - \bar{D} + S_r t_p V_r}{([1-\beta] + S_r \beta [1 - t_r])}$$

and it follows that:

(32a) $$\frac{\partial Z_{N\Pi}}{\partial t_j} = 0$$

(32b) $$\frac{\partial Z_{N\Pi}}{\partial t_r} > 0$$

(32c) $$\frac{\partial Z_{N\Pi}}{\partial t_p} > 0$$

(32d) $$\frac{\partial Z_{N\Pi}}{\partial t_w} = 0$$

(32e) $$\frac{\partial Z_{N\Pi}}{\partial t_c} = 0$$

Following the procedure outlined earlier, equilibrium net rentiers consumption is given by:

(33) $$C_r = [1 - S_r]\left([1 - t_j]\frac{\Pi}{P} - t_p K\right)\beta\,[1 - t_r] - t_p V_r)$$

$$= (\bar{I} - \bar{D}[1 - \beta]([1 - t_j].$$

$$\left\{\frac{\Pi}{P[1 - t_c]} - t_p K\right\} - \frac{[1 - S_r]}{S_r}$$

and hence:

(33a) $$\frac{\partial C_r}{\partial t_j} = \frac{\partial Z_{N\Pi}}{\partial t_j}\,\frac{\partial C_r}{\partial Z_{N\Pi}} = 0$$

(33b) $$\frac{\partial C_r}{\partial t_r} = \frac{\partial Z_{N\Pi}}{\partial t_r}\,\frac{\partial C_r}{\partial Z_{N\Pi}} < 0$$

(33c) $$\frac{\partial C_r}{\partial t_p} = \frac{\partial Z_N \Pi}{\partial t_p} \frac{\partial C_r}{\partial Z_N \Pi} < 0$$

(33d) $$\frac{\partial C_r}{\partial t_w} = 0$$

(33e) $$\frac{\partial C_r}{\partial t_c} = 0$$

Finally, equilibrium workers consumption is given by:

(34) $$C_w = \frac{wL}{P}[1 - t_w] - t_p V_w - \left\{ \frac{Y}{P} - \bar{D} - t_c C - \left[\frac{\bar{I} - \bar{D} + t_p V_r S_r}{[1 - t_j]\ ([1 - \beta] + S_r \beta [1 - t_r]} \right] - \frac{t_p K}{[1 - t_j]} \right\} [1 - t_w] - t_p V_r$$

Hence in the non competitive case we find that:

(34a) $$\frac{\partial C_w}{\partial t_j} = \frac{\partial P}{\partial t_j} \frac{\partial C_w}{\partial P} = 0 \text{ (Since } \frac{\partial P}{\partial t_j} = 0 \text{ under oligopoly)}$$

(34b) $$\frac{\partial C_w}{\partial t_r} = \frac{\partial P}{\partial t_r} \frac{\partial C_w}{\partial P} = 0 \text{ (Since } \frac{\partial P}{\partial t_r} = 0 \text{ under oligopoly)}$$

(34c) $$\frac{\partial C_w}{\partial t_p} = \frac{\partial P}{\partial t_p} \frac{\partial C_w}{\partial P} + \frac{\partial C_w}{\partial t_p} < 0 \text{ (Since } \frac{\partial C_w}{\partial t_p} < 0 \text{ in (24)}$$

(34d) $$\frac{\partial C_w}{\partial t_w} < 0$$

(24e) $$\frac{\partial C_w}{\partial t_c} < 0$$

The results for the competitive and oligopolistic versions are summarised in Tables 3.2 and 3.3 below. Contrary to Mair's conclusions. in the present model balance property and government expenditure increases augment aggregate demand, raising employment and output. or prices. Specifically. property taxes initially lower retained profits and rentiers savings. With investment exogenously given. equilibrium can only be restored by increasing savings. via a rise in profits. However. since rentiers consumption falls (i.e. $\frac{\partial C_r}{\partial t_p} < 0$ see equation (33c), and the propensity to save (S_r) is constant, rentiers net savings decline. Thus the burden of restoring equilibrium falls entirely on net retained profits. In the competitive version output is fixed and consequently prices rise. In contrast, in the oligopolistic version, prices are fixed and hence output and employment increase via the multiplier effects of higher aggregate demand.

The "Kaleckian" nature of these results can be illustrated by comparing these conclusions to Kalecki's [1937] analysis of tax incidence. Kalecki examined the incidence of income, commodity and capital taxes in a model of underemployment equilibrium. Capital taxes are defined as " . . . a tax on every type of owned capital . . . " (Kalecki (Op. cit.). A capital tax, thus defined, is broadly analogous to a uniform property tax in the A-B model.

Kalecki assumed for simplicity that capitalists consumption is fixed in the short period, and unaffected by taxes. The Kaleckian consumption function is thus wholly incompatible with Mair's treatment of consumption. In the

TABLE 3.2

THE AMENDED MODEL
COMPETITIVE VERSION

Change In

	After Tax Profits	Profits	Rentiers Consumption	Post Tax Wage Rate	Mark-Up
1. $\Delta t_j > 0$ $\Delta t_w = \Delta t_r = \Delta t_c = 0$	0	+	0	0	+
2. $\Delta t_j > 0$ $\Delta t_j = \Delta t_r = 0$	0	0	0	-	0
3. $\Delta t_r > 0$ $\Delta t_j = \Delta t_w = \Delta t_c = 0$	+	+	-		+
4. $\Delta t_c > 0$ $\Delta t_j = \Delta t_w = \Delta t_r = 0$	0	0	-	-	0
5. $\Delta t_p > 0$ $\Delta t_j = \Delta t_w = \Delta t_r$ $= \Delta t_c = 0$	0	+	-	-	+

TABLE 3.3

THE AMENDED MODEL
NON-COMPETITIVE VERSION

Change In

	After Tax Profits	Profits	Rentiers Consumption	Post Tax Wage Rate	Employment and Output
1. $\Delta t_j > 0$ $\Delta t_w = \Delta t_r = \Delta t_c = 0$	0	+	0	0	+
2. $\Delta t_w > 0$ $\Delta t_j = \Delta t_r = \Delta t_c = 0$	0	0	0	-	0
3. $\Delta t_r > 0$ $\Delta t_j = \Delta t_c = \Delta t_w = 0$	+	+	-	0	+
4. $\Delta t_c > 0$ $\Delta t_j = \Delta t_w = \Delta t_r = 0$	0	0	-	-	0
5. $\Delta t_p > 0$ $\Delta t_j = \Delta t_w = \Delta t_r = \Delta t_c = 0$	0	+	-	-	+

amended model, we have assumed that the property tax burden is apportioned between consumption and savings. This assumption, however, merely alters the details of Kalecki's results rather than the main thrust of his conclusions.

Since current consumption in Kalecki's model is unaffected by taxes, it follows that equivalent increases in capital taxes and government expenditure raise aggregate demand, thereby increasing gross profits and employment. Kalecki's conclusions are thus congruent with the results of the amended model. However, the analysis does not end with this mechanical result, as Kalecki further explores the long run impact of capital taxes.

The tax is levied uniformly across all sectors of the economy. Hence, firms neither have the incentive or opportunity to escape the tax by migrating into lower taxed sectors (or regions).[9] Instead, since gross and net profits are higher, investors are likely to be more optimistic and hence investment, employment and output will increase in the long run.

However, as a practical matter Kalecki (Op cit.) believed that capital taxes were unlikely to be used extensively "for it may seem to undermine the principle of private property". The article thus concludes with a quotation from Robinson: " . . . any government which had both the power and the will to remedy the major defects of the capitalist system, would have the will and the power to abolish it altogether."

3.4 A Comparison with Neoclassical Theory

"The classical theorists resemble Euclidean geometers in a non-Euclidean world who, discovering that in experience straight lines apparently parallel often meet, rebuke the lines for not keeping straight. . ."

Keynes [1936]

The general equilibrium models are based on the assumption that wages and prices are flexible, and resources fully employed. Given these stringent assumptions, taxes can only be shifted by reducing the supply of the taxed activity. A general factor, or product tax, represents a clear case where the taxed activity cannot be varied, and hence the economic incidence of the tax is equivalent to its legal incidence. In contrast, discriminatory or partial taxes, divert resources from taxed to untaxed activities, thereby inducing allocative distortions within the system. Central to these conclusions is the assumption that resources are fully employed . Hence 'notional' and 'effective' demands (and supplies) are equal, and taxes merely alter the DISTRIBUTION of income, rather than its LEVEL. In essence, the assumption of full employment serves to neutralise the demand effects of taxation, and consequently the incidence problem is reduced to one of inferring the allocative effects of taxes, to the neglect of the macro-stabilisation consequences.

In contrast, in the Keynesian framework, "effective" and "notional" demands (and supplies) diverge, and hence taxes which affect the distribution of income between differential spending groups, alter the level of effective demand and hence output. Thus, the total LEVEL of income is a function of the DISTRIBUTION of income, and incidence depends crucially on the interaction between the "demand" and "allocative" effects of taxation.

It will be recalled, that for "notional" and "effective" demands to diverge, it is sufficient to assume that agents transact at "false" (i.e. non-market clearing) prices. Hence, the A-B model discards the assumption of price and wage flexibility, together with the marginal productivity theory of distribution. The relationship which is central to their analysis is the Keynesian equilibrium condition that ex-ante savings equals investment. With investment fixed by decisions taken in the past, and saving a fixed proportion of <u>net</u> profits, it follows that in the short run the <u>equilibrium</u> value of <u>net</u> profits is unaffected by tax changes. Thus, none of the burden of a general property tax falls on firms.

In contrast, in the general equilibrium framework, investment is endogenously determined, and hence tax increases lower private consumption and investment by an amount equivalent to the increase in government expenditure. Aggregate demand is therefore unchanged and hence output and employment are unaffected. Fixed investment in the A-B model thus serves to enhance the expansionary demand effects of balanced tax and government expenditure increases.

However, the distinguishing feature of the property tax system is its discriminatory nature. Thus, property taxes are neither uniform between or within sectors (and regions). In the long run, tax differentials therefore induce allocative distortions as factors migrate from high to low taxed sectors (and regions). However, in the A-B model, output is aggregated into a single multi-purpose good and hence tax differentials between sectors are ignored. The A-B analysis thus focuses on the short run demand effects of taxation, to the neglect of the long run allocative distortions. Arguably, in the Post-Keynesian framework, the extent to which variations in tax rates induce variations in after-tax profits will depend on the "degree of monopoly" enjoyed by firms (see Mair [1985]). Ceteris paribus, the greater the monopoly power of a firm vis-a-vis its lower taxed rivals, the greater will be its ability to shift the differential tax burden into prices.[10]

However, unless it is assumed that differential taxes are fully shifted into prices, discriminatory taxation will cause some variation in net profits thereby inducing capital flows between sectors in the long run. It may therefore be argued that both the A-B, and general equilibrium models are incomplete; for while the A-B analysis focuses on aggregate demand to the neglect of the "substitution effects", the general equilibrium models concentrate on the allocative distortions and supply-side consequences. In general, tax incidence will depend on the interaction of both the demand and substitution effects.[12]

NOTES TO CHAPTER THREE

1. It is perhaps worth noting in passing that the Austrian School also places considerable emphasis on time and uncertainty, but their analytical results differ considerably.

2. In the *logical extreme* where all decisions are "crucial" and hence unique, past experience can offer no guidance about the future. Keynes' expectation formation process therefore, not unrealistically, assumes some regularity or broad pattern/trend.

3. In a sence, the Post-Keynesian view appears to be broadly analogous to that of the American institutionalist such as Williamson. In the institutionalist approach "bounded rationality" limits forecasting abilities, while in the Post-Keynesian approach, informational inadequacies preclude accurate long run forecasting.

4. There are other differences between the Post-Keynesian neoclassical schools which have not been mentioned in this section. Perhaps most important among these are the Post-Keynesian view of capital (discussed in Ch.2), pricing (see section 3.2), and market clearing (see section 3.4)

5. Differences in saving propensities were ignored by Keynes in his later work. However, they do figure in the Treatise on Money. According to Robinson [1969], Keynes' neglect of differential saving groups resulted from his ideological views of " social harmony, which slurs over class differences . . . .Kalecki was not brought up so. The only economics he had studied was in Marx. . . But starting from Marx would have saved him a lot of trouble." (Robinson [1969]).

6. The postulated consumption function is also incompatible with the Friedman "permanent income hypothesis", where consumption is a function of permanent net income. Hence, current tax increases, which have little effect on permanent income, will leave consumption unaffected.

7. The practice of treating property taxes as a tax expenditure or allowance deductable from other sources of income is not unusual. What is being criticised here is the peculiar, implicit and unconventional definition of gross profits.

8. Since the economics of deceipt is as yet in a nascent stage, we have discounted the possibility of a "capitalist conspiracy" in which property taxes are covertly returned to firms. We further neglect the possibility that taxes mystically vanish from the system.

9. Assuming a closed economy.

10. We retain the assumption that government expenditure is uniformly distributed across firms.

11. This result, conditional on the degree of monopoly, is rather vague when compared with the more deterministic results of neoclassical theory.

12. The Barro and Grossman [1971] model appears to provide a useful framework for combining the two effects in a disequilibrium system. The extension of this model, however, would involve a considerable amount of algebraic manipulation requiring the introduction of an additional sector with two factor inputs.

CHAPTER FOUR

A REVIEW OF THE EMPIRICAL EVIDENCE

The non-domestic property tax has been the focus of much attention in recent years. Many hold it responsible for the low level of business investment in the UK, and it has been criticised as an illogical and unfair tax because it imposes a levy on firms on the basis of their location, rather than profits or economic performance. More recently, the emphasis has shifted towards the impact of the non-domestic property tax on regional unemployment. Critics of the tax have alleged that high property taxes have accelerated the decline of the depressed regions, and undermined the economic base of these communities by inducing firms to relocate in lower taxed areas. This chapter reviews the empirical literature on the economic effects of the non-domestic property tax in the UK. The next section introduces the background to the debate, and the following three sections review the empirical studies on the effects of the tax on regional employment, profitability and prices respectively.

4.1 The Background

Any analysis of the economic impact of the non-domestic property tax should begin with a consideration of what has happened over the years to the tax. Put simply, the general trajectory of property tax burdens has been rising steadily upwards.[1] The estimated property tax revenue from industry and commerce in England and Wales increased in nominal terms from a total of

£360 million in 1963/4 to over £4.6 billion in 1983/4 (Birsdeye & Webb [1985]). Similarly, the tax burden has increased from 21% of profits in 1978 to 42% in 1982. (see Bennett [1986]). The property tax thus represents a major tax on business, and constitutes half of the non-oil business tax bill. It is no surprise therefore that representatives of commerce and industry have called for its abolition. (see Davidson [1985]), and the present government is considering reform of the rating system.

However, supporters of the rating system, in particular the local authority associations, have claimed that non-domstic property taxes do not constitute a serious problem for businesses. Four widely differing views seem to be responsible for this conclusion. One is that other costs will adjust to offset the influence of a higher property tax in any area. The most obvious adjustment would be the price of land and property.[2] Clearly, if differentially higher property taxes are capitalised into lower land and property prices, no impact on business location decisions would occur. Firms in high tax areas would enjoy lower land and property costs and visa-versa, so that total costs and net profits would be unaffected by variations in property taxes. It may, however, be argued that in practice capitalisation of tax differentials is likely to be limited because firms cannot generally respond by varying land usage, and the costs of re-location may outweigh the potential tax savings. However, even if land prices do fall, this merely implies that the property tax burden has been shifted from firms to land owners (i.e. a different category of capital owner). Hence, the overall returns to capital in the high taxed areas will still be lower than in the lower taxed regions.

A second argument in favour of the rating system is that the burden of property taxes is shifted forward into higher prices, and hence has no impact on profitability and firm location. The extent to which business rates can be passed onto consumers is extremely controversial. In general, three conditions must be met if forward shifting is to be profitable. First, demand for the firms product must be relatively inelastic so that an increase in prices raises total revenue. Second, profitable forward shifting implies that firms set prices below the optimum profit maximising level. Clearly, if prices are at the profit maximising level, a further increase intended to recoup the tax would merely serve to depress profits. Even if full cost pricing were the dominant practice, it would not necessarily ensure successful short run shifting. Finally, the conditions necessary to support the hypothesis of full forward shifting at the macro-level are similar to those which allow a cost push inflation. When prices rise, *ceteris paribus,* money expenditures and hence the demand for cash balances increase. If real output is to be unaffected, the authorities must passively accommodate the increase in the demand for money. There has been little empirical work in this field. A recent study by Mair (see Section 4.4) suggests that there is little evidence of forward shifting, and this general conclusion is confirmed in the econometric analysis presented in Chapter 7.

A third argument in favour of the existing rating system is based on the observation that non-domestic property taxes represent only a small fraction of total costs; 2% to 5% on average (Bennett [1986b]). However, as noted in Chapter 1, a comparison of tax burdens based on *ex-post* cost data is likely to be misleading, since no account is taken of the possible response of firms to the tax. For instance, if differentially higher property taxes induce firms to migrate to lower taxed areas, a measure of tax burdens based on actual *ex-post* costs will considerably understate the importance of the tax. Arguably, the impact of the property tax will in general depend at least partly on how firms perceive the tax. If the property tax is viewed as a levy on the use of capital in a particular location, it will be equivalent in its effects to a local profits tax. Thus, for example, if the after-tax profits of a firm expressed as a fraction of its assets are 10%, a property tax differential of 1% would correspond to the imposition of a 10% tax on the profits of firms in high taxed areas. Since actual tax differentials are considerably greater than this (see section 4.3), it is possible that profit maximising firms will take account of the differential tax burdens across locations.

Finally, it has been argued that non-domestic property taxes are a rightful burden on firms for the services they receive from local authorities. There has, however, been no empirical work to support this assertion. The North American econometric studies suggest that non-domestic property tax revenues are typically used to finance domestic services such as education and health (see Inter alia Ballentine and Thirsk [1982], Feldstein [1975], Bowman

[1974], McLure [1962]). Without confronting the issue in full, Bennett [1986b] has noted that in 1981/82 businesses paid 46% of the total rate bill. In contrast, 52% of local authority expenditure was directed towards education, 5% on environmental services, and 15% on law and order. Thus, businesses appear to have gained little direct benefit from local services. It can, however, be argued that part of the expenditure on domestic services results from the negative externalities generated by firms. For example, expenditure on environmental services and housing might increase with a larer business base. Thus interpreted the non-domestic property tax may be viewed as a levy necessary to offset the external costs imposed on the residents of a jurisdiction. However, in the absence of a more comprehensive empirical study which takes account of both the direct and indirect benefits of government expenditure, it is difficult to draw definitive conclusions.

4.2 The Impact of Property Taxes on Regional Unemployment

Despite the controversy surrounding the property tax, little systematic analysis of its economic impact has been undertaken. This section reviews the existing empirical studies on the effect of the tax on regional employment. It is argued that much of this work is based on theoretically misspecified and econometrically flawed models. Consequently, these studies do little to dispel doubts about either the impact of property taxes on employment, or the related issue of its incidence.

There have been four published statistical investigations on the effect of property taxes on regional employment. The first by Straw [1981] compares the increase in unemployment in each county with the increase in propety taxes. No statistical association between the two could be found and hence it was concluded that no such link exists. The second study undertaken by Hughes [1981] compared the level of unemployment in each region with the level of property taxes. Once again, no statistical relationship could be identified.

However, these results appear to be somewhat misleading, for both studies assume that the relationship between property taxes and unemployment is linear. Moreover, no attempt is made to test for the impact of lagged values of the property tax variable, or control for other non-fiscal factors on regional unemployment. Furthermore, at the regional level, the link between property taxes and unemployment is likely to be highly tenuous. Thus if labour is mobile between regions, the loss of a job in one area may lead to an increase in unemployment in some other region if the worker either commutes to work or migrates. It is therefore hardly surprising that neither study finds a link between property taxes and regional unemployment.

In contrast, the other two econometric studies by Gripaios and Brooks [1982] and Crawford, Fothergill and Monk [1985] [CFM hereafter] examine the relationship between property taxes and regional employment. However, while Gripaios and Brooks find the evidence consistent with the view that property taxes "crowd out" employment, CFM assert that the tax has no effect on regional employment. In the remainder of this section, attention is focused on these two studies and it is argued that the conflicting conclusions derive from a combination of theoretically misspecified models and econometric deficiencies.

Both studies distinguish between the determinants of employment in the manufacturing and service sectors of the economy. However, while CFM estimate separate single equation models for the different sectors, Gripaios and Brooks utilise a simultaneous equation approach. Furthermore, the Gripaios and Brooks model is restricted to a cross-sectional study using 1974 data, while CFM's analysis is based on pooled cross-section/time series data from 1974 to 1981. In what follows, we focus on the analysis of the manufacturing sector, but the general criticisms which will be made apply equally to the service sector.

Table 4.1 overleaf summarises the key explanatory variables used by the authors to explain the distribution of employment in the manufacturing sector. In the CFM model industrial structure is seen to be an important determinant of regional employment. Thus it is argued that employment will be lower in those areas dominated by declining industries. The impact of industrial structure on employment is measured using shift-share analysis. It will be recalled, that this is based on the difference between the "expected" employment growth in a region and the overall national employment growth rate. The "expected" growth rate is defined as the rate of growth of employment which would occur if each industry in the region grew at the same rate as its national counterpart. In addition, CFM include a measure of the size of firms in each region (i.e. the size structure variable). Specifically, it is argued that a disproportionately large number of new firms are founded by individuals who were previously employed in small firms. Hence, the size of existing firms in a region is held to influence the rate of new firm formation, and hence employment. The size structure variable is derived from the relationship between the size of establishments in an area and the rate of new firm formation. Furthermore, the degree of urbanisation is seen to influence the distribution of employment across regions. In general, the higher the level of urbanisation, the greater are held to be the difficulties involved in accommodating new and expanding firms, and hence the lower the level of employment. The impact of urban structure on employment is obtained by dividing each region into one of six urban categories on the basis of their degree of urbanisation. The measure of urban structure is based on the employment change which would have occurred if each category within a region had grown at the average rate for its type. The model further includes two dummy variables. The first encapsulates the impact of regional policy and the poor growth of peripheral regions, while the second is designed to capture the differential growth of New Towns. Finally, the impact of property taxes on employment is measured by the level and the change in each region.

In contrast in the Gripaios and Brooks model, the level of agglomeration is seen to be an important determinant of regional employment. Thus agglomeration economies are measured by the spatial concentration of employment in each area, while the diseconomies of agglomeration are proxied by population density. Furthermore, the market potential of an area is held to influence employment, and is measured by the transport costs to major markets. The model further includes a dummy variable to capture the effects of regional policy in the assisted areas. Finally, Gripaios and Brooks argue that property taxes tend to lower employment by raising costs, while local expenditures raise employment via the multiplier. The fiscal effects on employment are measured by the level of property taxes and government expenditure in each region.

TABLE 4.1

Determinants of regional employment in the manufacturing sector

	Gripaios & Brooks	CFM
Dependent Variables	Level of employment	Change in Employment
Explanatory Variables	economies of agglomeration	Size Structure
	Diseconomies of agglomeration	Urban Structure
Structure	Market Potential	Industrial
	Regional Dummy Variable	Regional Dummy Variable
Fiscal Variables	Level of property taxes per employee	Level and change in property taxes
	Level of local authority expenditure	

It will be noted from Table 4.1 that the CFM model ignores local authority expenditure. Hence, while the Gripaios and Brooks study is concerned with the overall budgetary consequences, CFM focus on the impact of the property tax is isolation. In the conventional parlance of public finance, this corresponds to the distinction between the "budget" and the "absolute" incidence of a tax (see Musgrave 1959). More generally, however, the variables used to explain the distribution of employment in the two models differ considerably. Hence the conflicting results could readily be attributed to the inadequacies of the explanatory variables used in one of the models. In the remainder of this section it will be argued that the contradictory conclusions derive from more fundamental deficiencies - in particular theoretical misspecification.

The most striking feature of both papers lies in their neglect of theoretical issues. The authors make no reference to the well developed body of incidence theory which was described in earlier chapters. While Gripaios and Brooks define the tax burden in terms of absolute levels on the assumption that " . . . higher taxation means higher costs and *ceteris paribus* lower profitability", CFM assert that "It is not necessary to take a specific view of the incidence of rates in order to analyse the impact on the location of jobs". Instead, the authors propound two *ad hoc* mechanisms through which property taxes are seen to influence employment. Thus, it is argued that the level of property taxes may affect employment if firms that are unable to pay high taxes migrate to other regions. This mechanism is distinguished from the impact of an <u>increase</u> in property taxes since " . . . business in an area where the increase is above average, for example, may be disadvantaged." Hence the CFM model uses the level and change in rates as a measure of the tax burden. However, as noted in earlier chapters, tax incidence theory suggests that employment responds neither to the level of property taxes nor the temporal change in property taxes, but tax differentials between sectors and regions. While this might not affect the statistical results, it does have important implications for both model specification and the interpretation of the conclusions. Furthermore, incidence theory reveals that property taxes affect the distribution of employment only in the long run. This therefore implies that lagged rather than contemporaneous values of the tax variable influence employment. However, neither study makes any allowance for lagged effects.

It will be recalled that property tax differentials influence the distribution of employment through movements of capital from high to low taxed regions. This therefore suggests that property taxes are likely to be correlated with the other structural explanatory variables in the model. Thus for example, the exit of firms from differentially higher taxed regions will, *ceteris paribus*, lead to changes in the urban structure and the level of agglomeration in a region. However, neither study adequately tests for the existence of multicollinearity between the property tax variables and the structural explanatory variables. CFM provide a matrix of correlation coefficients in their appendix, and assert that " . . . neither measure of the rate burden variable is highly correlated with any of the structural variables." However, despite this claim their models do appear to suffer from severe collinearity. Farrar and Glauber (1967) describe an approximate test for diagnosing the impact of collinearity in a model. They suggest that multicollinearity distorts the parameter estimates substantially when the simple correlation coefficients exceed the coefficient of determination (i.e. the R^2). The CFM matrix reveals correlation coefficients of 0.39 and -0.35 between the level of property taxes and the measures of industrial and urban structure respectively, and this exceeds the value of the coefficients of determination in the main regression equations. Thus, there are strong empirical and theoretical reasons to expect multicollinearity in the models, thereby casting doubt on the reliability of their conclusions. The point here is stronger than simply asserting that the results depend on the assumption that the explanatory variables are independent. As noted earlier, the migration of firms between regions will typically lead to changes in the industrial and urban structure of the affected areas. In a sense, the structural explanatory variables in the model represent the mechanism through which property taxes affect the distribution of employment. Thus the neglect of theoretical issues has meant that the studies ignore the crucial distinction between the final impact of the property tax on regional employment, and the mechanism through which taxes influence employment.

Having established the theoretical inadequacies of the tax measures used in the studies, it would seem appropriate to assess the validity of the econometric tests employed by the authors. CFM employ two procedures to assess the impact of property taxes on the distribution of employment. In the first the explanatory variables described in Table 4.1 are regressed on the change in employment in each region. Both measures of the property taxes burden are found to be statistically insignificant, while the structural explanatory variables are found to be highly significant. It is therefore argued that property taxes have no impact on the distribution of employment. However, it will be recalled that the structural explanatory variables are derived using techniques such as shift-share analysis. These variables therefore have as arguments elements of the dependent variable. That is, the measures of industrial structure, urban structure, and size structure are components of the change in employment (the dependent variable). It can easily be shown that this leads to biased parameter estimates. For ease of exposition we consider only the bias in the industrial structure variable, but the general criticisms apply equally to the other structural explanatory variables in the CFM model.

Consider the following simple regression model:

(1) $Gr = \alpha_0 + \alpha_1 I + \varepsilon$

where: Gr = change in regional employment

I = measure of industrial structure (derived using shift-share analysis)

ε = disturbance term

It will be recalled that shift-share analysis divides regional employment growth into three elements: the national (N), structural (I) and the differential (D) components.

Therefore:

(2) $Gr = N + I + D$

Equation (2) is simply an accounting identity. More generally, regional employment change may be subdivided in a number of ways. Thus for example, the size structure variable divides employment into the component due to new firm formation and the "unaccounted" remainder, while the urban structure term divides employment into the average change in each urban category and the "residual".

However, rearranging equation (2)

(3) $I = Gr - N - D$

Substituting in equation (1), we obtain the following "reduced form" expressions for G^r and I:

(4) $$G^r = \frac{\alpha o}{1 - \alpha_1} - \frac{\alpha_1}{1 - \alpha_1} (D + N) + \frac{\varepsilon}{1 - \alpha_1}$$

and

(5) $$I = \frac{\alpha o}{1 - \alpha_1} - \frac{1}{1 - \alpha_1} (D + N) + \frac{\varepsilon}{1 - \alpha_1}$$

From equation (1) we know that the OLS estimator α_1 is given by

$$(6) \quad \hat{\alpha}_1 = \frac{\Sigma\ G^r\ I}{\Sigma\ I^2}$$

Substituting for G^r from equation (1):

$$\hat{\alpha}_1 = \frac{\Sigma\,(\alpha o + \alpha 1\ I + \mathcal{E}\,)\ I}{\Sigma\ I^2}$$

$$= \alpha_1 + \frac{\Sigma\ \alpha o . I + \Sigma\,\mathcal{E}\cdot I}{\Sigma\ I^2}$$

To find the bias in estimator $\hat{\alpha}_1$, we calculate the expected value of the second term on the right hand side of equation (7) after substituting for I using equation (5). It is clear that this expected value is non-zero, and it follows that the estimator $\hat{\alpha}_1$ is biased[3]. It is well established that in such cases the difficulty can be circumvented by employing a simultaneous equation model.

However, CFM attempt to buttress their conclusions with a further single equation regression "test", in which the structural explanatory variables are subtracted from the change in employment, and the resulting difference is used as the dependent variable. More formally, let U denote the urban structure variable, I the measure of industrial structure, and S the measure of size structure. Then, the CFM regression procedure is given by:

$$(8) \quad [G^r - [U + I + S]] = \beta o + \beta 1 T + \beta 2 R + \mathcal{E}$$

where:

G^r = change in regional employment

T = measure of the property tax burden

R = regional policy dummy variable

ε = disturbance term

This technique is seen as removing the influence of urban structure (U), industrial structure (I) and size structure (S). Once again, the property tax variables are found to be statistically insignificant, and the authors conclude that property taxes have no impact on the distribution of employment in the manufacturing sector. However, as noted earlier, the impact of property taxes on employment is likely to obtain through changes in the structural variables, and the measures of industrial structure and urban structure were found to be correlated with the level of property taxes. This technique, while perhaps removing the impact of the structural variables on employment, therefore fails to separate out the tax effects from the structural effects. Indeed, in this case it is not clear that this separation can be meaningfully undertaken, for the migration of firms from high taxed regions will inevitably lead to structural changes. Thus, by removing the impact of the structural variables on employment, this technique automatically eliminates the tax effects. The conditions under which such a procedure would be valid seem to be far more stringent than might first appear. It requires the tax induced migration of firms to have no effect on either the industrial structure, urban structure or size structure.[4] Furthermore, the impact of taxes on employment must be instantaneous, for the model ignores lagged variables. It is perhaps not unreasonable to suggest that none of these conditions are likely to hold in practice. Consequently, the CFM results appear to be highly misleading.

Arguably, choices among econometric explanations of economic behaviour should be made not merely with reference to statistical criteria, but by considering their economic implications. The Gripaios and Brooks study revealed that while local authority expenditure had a positive and significant effect on employment, property taxation had a negative impact, and the overall tax-expenditure effect of the budget was found to be positive. Thus, their results appear to vindicate a broadly Keynesian view of property taxation where, *ceteris paribus,* balanced tax and government expenditure increases have an expansionary effect on demand and hence employment. In contrast, the CFM model is based on the assumption that firms shift out of a region if either the level of property taxes is deemed to be too high, or the increase in taxes is regarded as excessive. Their analysis revealed that neither the level nor the change in taxes affect employment. The economic implications of these findings transcend in importance the narrow question of the tax burden. These results imply that the property tax has neither any effect on demand (as suggested by Keynesian analysis), nor the location of firms (via the mechanism described by neoclassical incidence theory). By default the CFM analysis thus suggests that the entire property tax burden is either profitably shifted forward into prices with the beneficient aid of an inelastic demand curve, or that the tax is shifted back into costs. Hence, the CFM mechanism in which firms respond to the level or change in taxes, require a world in which the absolute rather than the differential tax burden is shifted. This clearly contradicts the fundamental tenets of incidence theory. Furthermore, shifting the whole tax or even the bulk of it would imply that heavy and increasing property taxation itself has tended to raise profit margins, whereas margins have in fact experienced a secular decline in the UK over much of the post-war period.[5] By implication these results therefore suggest that rising property taxes through the recent recession have served to increase profitability. Thus, the theoretical and statistical deficiencies of CFM's model have resulted in a set of implausible conclusions which can neither be reconciled with the observed secular decline in margins nor incidence theory.

In conclusion, it therefore appears reasonable to suggest that the statistical tests used in both studies fail to establish conclusively the relationship between property taxes and the distribution of employment. However, while the results of Gripaios and Brooks were shown to be theoretically plausible, those of CFM were found to be untenable. This discrepancy it was argued resulted from a combination of theoretical inadequacies and statistical deficiencies. Thus, both studies failed to distinguish between the final impact of the property tax on employment, and the mechanism through which taxes influence employment. As a result, the structural explanatory variables in the CFM model were found to be correlated with the tax variable. Furthermore, the statistical procedures employed by CFM were shown to be inappropriate. Thus, the studies do little to dispel doubts about the impact of property taxes on employment.

4.3 The Impact of Property Taxes on Profits

The most comprehensive study of the impact of non-domestic property taxes on profits has been undertaken by Bennett (1986b) who uses the "cost of capital approach". This approach provides a measure of the fiscal wedge between post and pre-tax rates of return to an investment project discounted over its life span. The fiscal wedge can then be used to calculate effective tax rates on capital assets financed from different sources, in different sectors and local authority jurisdictions. (see Auerbach [1983a], [1983b], Feldstein and Summers [1978]).

However, an important limitation of the cost of capital approach lies in its partial equilibrium nature. Thus key parameters such as interest rates, wages, and prices are assumed to be exogenously given. Obviously, since the property tax is a broad-based tax, it will have non-trivial general equilibrium repercussions on these parameters. Hence, the "cost of capital approach" can be viewed as providing estimates of the direct impact of the non-domestic property tax, rather than the final general equilibrium incidence effects of the tax.

The Cost of Capital Approach:

Profit maximising firms, it will be recalled, attempt to adjust their capital inputs so that the marginal revenue product of capital equals the marginal cost. Capital assets, however, are durable and hence it becomes necessary to impute to each period a cost associated with holding an asset. There are four components that make up the imputed cost. First, there is the cost of financing the purchase of an asset. There are three main sources of finance: debt issue, retained earnings, and new share issues. Second, the asset will depreciate due to wear and tear. Clearly, the rate of depreciation will depend on the type of asset under consideration. Following King and Fullerton [1984], Bennett distinguishes between three types of assets: machinery, buildings and inventories. Third, the value of a given asset may change due to obsolescence, changes in relative prices or inflation. The value of the asset will depend at least partly on the industry in which it is employed. Thus, the economy is divided into three main sectors: manufacturing, commerce, and others (excluding extractive industries). Finally, the tax system discriminates against certain types of investors in capital markets. Hence it becomes necessary to distinguish between: households, tax exempt institutions and non-exempt institutions. These four components of the cost of holding an asset can be aggregated to arrive at what is referred to as the user cost of capital. In the absence of time lags and adjustment costs, a profit maximising firm will invest until the marginal revenue product equals the user cost of capital. If the user cost increases, the inducement to invest falls and vice-versa.

The mathematical expression for the user cost of capital employed by Bennett is based on King and Fullerton's [1984] comparative study of the tax system. The formula is given by:

$$(9) \qquad P_i = [(\varphi + \delta - \Pi) + (1 - T)\,T_r^K V^K + d_2 T V \Pi] \frac{(1 - A)}{(1 - T)} - \delta$$

where:

φ = corporate rate of time preference

δ = book value depreciation rate

Π = inflation rate

T = corporation tax rate

T_r^K = property tax in local authority r for property of type K

V^K = value of property of type K

d_2 = proportion of inventories in total assets

T = coporation tax rate

V = proportion of inventories taxed on historical cost principles

A = capital allowances against corporation tax

The first term on the right hand side of (9) represents the user cost of capital in the absence of taxes. Thus, φ represents the interest cost to the firm of financing each unit of capital, and δ the depreciation per unit of capital. The second term represents the non-domestic taxes paid per unit of capital. Following King and Fullerton (1984), the tax rate (T_r^K) is defined as the ratio of the tax yield to the net stock of industrial and commercial buildings at replacement cost. The expression further allows for the deductability of property taxes from corporation taxes. The third term in (9) accounts for the tax paid on inventories valued on historical cost principles. Finally, the term (1 - A) accounts for tax deductable investment allowances. These four components provide an estimate of the cost of capital to the firm (i.e. the user) net of depreciation. The precise value will vary between sources of finance (through changes in φ), between incorporated and unincorporated firms (via T), and between different local authorities (through T_r^K). For simplicity Bennett calculates the tax burden by comparing the maximum and minimum rate poundages across England and Wales. This approach thus gives the extremes between which all local authorities must lie.

The after-tax returns to <u>investors</u> in capital markets is given by the formula:

(10) $$Si = (1 - m)(r + \Pi) - \Pi - T_r^K$$

where:

m = marginal income tax rate on interest income

r = real rate of interest

S_i represents the post-tax returns to the investor, and p_i the pre-tax returns (or the user cost of capital to firms). The fiscal wedge is given by:

(11) $$W_i = P_i - S_i$$

and the effective tax rate is defined as :

(12) $$\frac{P_i - S_i}{P_i}$$

Effective tax rates are calculated for two cases. In the first, the cost of capital to firms (i.e. P_i) is held constant at 10%, and the effects of the tax are evaluated on S_i. In the second case, S_i is held constant at 5% and the effects of the tax are evaluated on P_i. The results are summarised in Tables 4.2 and 4.3 overleaf.

The most striking general feature revealed by the estimates are the higher effective tax rates on commercial investment. In the main, this stems from the subsidy to machinery as a result of the allowance against coporation taxes. A further notable feature are the lower tax rates paid by tax exempt institutions.

The burden of property taxes is assumed to be borne entirely by building assets. In Table 4.2, this leads to a variation in tax rates of 20.6 percentage points. Compared with other assets, the property tax clearly raises the effective tax on buildings. In turn, this leads to a large variation in effective tax rates paid by the manufacturing and commercial sectors.

TABLE 4.2

Range of Effective Tax Rates and Post-Tax Rate of Return Necessary to Earn a 10% Pre-Tax Real Rate of Return Net of Corporation Tax and Rates (Fixed-p Case, 1985 Tax System)

	p	*s*		*p-s*		*100 × (p-s)/p*		*Difference in*
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	*(p-s)/p*
Asset								
Machinery	10.0	6.8	6.8	3.2	3.2	31.6	31.6	0.0
Buildings	10.0	6.1	4.0	3.9	6.0	39.0	59.6	20.6
Inventories	10.0	3.3	3.3	6.7	6.7	66.6	66.6	0.0
Industry								
Manufacturing	10.0	6.7	6.0	3.3	4.0	33.4	40.1	6.7
Other	10.0	5.0	4.6	5.0	5.4	50.0	54.0	4.0
Commerce	10.0	4.6	3.8	5.4	6.2	53.8	62.1	8.3
Source of finance								
Debt	10.0	9.0	8.2	1.0	1.8	9.9	18.2	8.3
Shares	10.0	6.8	6.1	3.2	3.9	32.0	39.2	7.2
Retentions	10.0	5.1	4.4	4.9	5.6	49.5	55.9	6.4
Owner								
Households	10.0	4.1	3.5	5.9	6.5	58.8	64.7	5.9
Tax-exempt	10.0	9.0	8.1	1.0	1.9	10.1	18.6	8.5
Insurance companies	10.0	4.4	3.8	5.6	6.2	55.8	61.9	6.1
Total	10.0	5.9	5.2	4.1	4.8	41.1	47.9	6.8
'Tax-exhausted case'	10.0	8.7	7.8	1.3	2.2	13.3	21.9	8.6

Source : Bennett (1986b)

TABLE 4.3

Range of Effective Tax Rates and Pre-Tax Rate of Return Necessary to Earn a 5% Post-Tax Real Rate of Return Net of Corporation Tax and Rates (Fixed-r Case, 1985 Tax System)

	p		*s*	*p-s*		*100 × (p-s)/p*		*Difference in (p-s)/p*
	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum	
Asset								
Machinery	6.8	6.8	3.9	2.9	2.9	42.4	42.4	0.0
Buildings	7.7	10.3	3.9	3.8	6.4	49.2	62.3	13.1
Inventories	11.1	11.1	3.9	7.2	7.2	65.0	65.0	0.0
Industry								
Manufacturing	7.1	7.9	3.9	3.2	4.0	45.3	50.6	5.3
Other	8.8	9.3	3.9	4.9	5.4	55.9	58.3	2.4
Commerce	9.3	10.6	3.9	5.4	6.7	58.2	63.4	5.2
Source of finance								
Debt	4.7	5.5	3.6	1.0	1.9	21.7	34.2	12.5
Shares	6.8	7.7	4.0	2.9	3.8	42.3	48.8	6.5
Retentions	8.8	9.7	4.0	4.9	5.8	55.2	59.3	4.1
Owner								
Households	7.6	8.4	2.0	5.6	6.5	73.8	76.5	2.7
Tax-exempt	8.4	9.3	7.1	1.4	2.2	16.2	24.1	7.9
Insurance companies	8.0	8.9	2.7	5.3	6.2	66.3	69.7	3.4
Total	7.9	8.8	3.9	4.0	4.9	50.9	55.8	4.9
'Tax-exhausted case'	5.2	6.1	3.9	1.3	2.2	25.3	36.1	10.8

Source : Bennett (1986)

Turning to the fixed s case, Table 4.3 summarises the effective tax rates when firms earn a post-tax real return of 5%. The effective tax on buildings varies by 13% between localities. The major diference in tax rates are for debt financed investments and tax exempt institutions. In part this reflects the reduced benefits from corporation tax deductability of rates for tax exempt firms. These results thus confirm the overall conclusions of the fixed p case, that property taxes have a significant and distortionary impact on profitability. Moreover, the impact varies between types of assets, sources of finance, and ownership of assets. In general higher taxes are paid by the commercial sector, and debt financed investments. These conclusions therefore suggest that in the absence of any shifting, the property tax will lead to substantial allocative distortions in the economy.

4.4 Shifting of the Property Tax

In a recent, and as yet unpublished econometric study, Mair (1986) has attempted to infer the incidence of propety taxes in a Kaleckian model of income distribution (see KalecLi (1943), (1938), and Asimakopulus (1975)), The critical step in adopting the Kaleckian approach is acceptance of the Post-Keynesian view of price determination. Kalecki (1943) distinguished between two types of price changes in the short run: "cost determined" and "demand determined". Changes in the price of raw materials and food, according to this view are governed primarily by demand conditions, for the supply of these products is fixed in the short run. In contrast, Kalecki saw the industries of the advanced capitalist economies as being essentially oligopolistic and normally operating under conditions of excess capacity. He further assumed that marginal costs can reasonably be assumed to be constant over the normal range of output, hence it follows that in: "The production of finished goods . . . When demand increases it is met mainly by an increase in the volume of production while prices remain stable. The price changes which do occur results mainly from changes in costs of production". (Kalecki (1943)).

Thus the price of manufactured goods are assumed to be set according to a mark-up over unit prime costs (defined as direct labour and material costs). The size of the mark-up reflects the degree of monopoly enjoyed by the firm, and is assumed to be sufficient to cover profits and overhead costs. In general the higher the degree of monopoly, the higher will be the mark-up.

The Kaleckian theory of mark-up pricing, together with the familiar Keynesian theory of output, determine the distribution of income between wages and profits. In Keynesian theory, the level of real income is determined by the level of investment and autonomous consumption. Thus the level of profits depends on the level of autonomous expenditure in the economy. On the limiting assumption that workers consume all their income, workers' autonomous consumption and their propensity to save will be zero, and hence the level of profits is uniquely related to the level of investment and capitalists' autonomous consumption. This conclusion is succinctly summarised in Kalecki's famour aphorism that " . . . workers spend what they earn, while capitalists earn what they spend".

In contrast, the share of profits in national income depends primarily on the mark-up and hence the degree of monopoly. This result follows from the assumed form of pricing behaviour. It will be recalled that the mark-up is sufficient to cover profits and overhead costs. It follows that the ratio of price to prime costs will be related to the ratio of profits and overhead costs to prime costs, while the degree of monopoly (i.e. the ratio of price minus prime costs to price) will define the share of profits plus overheads in national income (see Cowling (1978)). If there is assumed to be "overhead" or "indirect" labour [6] in the model, an increase in output will raise total (i.e. direct and indirect) labour productivity and hence the share of profits in income.[7] Thus the share of profits depends on the degree of monopoly and the level of output (or autonomous expenditure).

Mair (1986) attempts to test the empirical validity of the Kaleckian approach. A basic hypothesis underlying Kalecki's theory is the notion that in the short run the mark-up is mainly influenced by changes in overhead costs relative to prime costs. During the downturn of a business cycle, demand falls and raw material prices and prime costs decrease. Thus the ratio of overhead costs to prime costs rises in a recession. In order to maintain net profits, firms are assumed to increase the mark-up. Kalecki therefore hypothesises an anti-cyclical movement in the mark-up. More specifically, it is argued that a recession " . . . provides a background for tacit agreements not to reduce prices in the same proportion as prime costs. As a result there is a tendency for the degree of monopoly to rise in the slump, a tendency which is reversed in the boom." (Kalecki (1943)).

The notion that firms colude in a recession is not wholly unreasonable, for in a slump the level of concentration may increase as smaller and less efficient firms close, thereby increasing both the ability and desire of existing firms to collude.

The cyclical movement of the mark-up is tested for the UK by the following simple regression model:

(13) $$\text{Log } k = \beta o + \beta_1 \log S + e$$

where:

k = mark-up

S = ratio of salaries (used as a proxy for overheads) to prime costs

e = distrubance term

The coefficient of s is found to be statistically significant, and it is therefore concluded that the mark-up (k) is in the short run mainly influenced by overhead costs relative to prime costs in the short run. This result is seen to vindicate the use of the Kaleckian approach, which it will be recalled, relies critically on the assumption that profit shares are determined by the mark-up and hence the degree of monopoly. Following Cowling (1983) the degree of monopoly is measured as follows:

(14) $$\mu = \frac{\text{Net output - Operatives Wages}}{\text{Gross Output}}$$

where: μ = degree of monopoly

Thus Mair tests for the degree of tax shifting by using the following equation:

(15) $$\log k = \alpha o + \alpha_1 \log \left[\frac{R}{PC}\right] + \alpha_2\mu + e$$

where:

k = mark-up

R = non-domestic property taxes

PC = prime costs

e = disturbance term

The coefficient of the ratio of property taxes to prime costs is found to be positive and statistically significant, with a value ranging from approximately 0.05 to 0.19. These results therefore suggest that in the short run, only between 5% and 20% of property tax increase have been shifted into higher prices.

Interpreted in conjunction with Bennett's (1986b) calculations of the effective tax rate, Mair's results imply that the property tax burden falls mianly on firms, and hence the tax is likely to impede investment in the differentially higher taxed sectors (or regions) of the economy[8]. Given the wide variation in tax rates between different sources of finance, sectors, and regions, the allocative distortions can be expected to be substantial. This issue is explored in greater detail in Chapter 5 where a simple general equilibrium model is used to derive estimates of the impact of non-domestic property taxes.

NOTES TO CHAPTER FOUR

1. See Chapter One.

2. Since wages are typically determined at the national rather than the local level, it is unlikely that wage costs will adjust in response to a differentially higher tax. This assertion is supported by the econometric evidence presented in Chapter 7 of this thesis.

3. Specifically, the expected value of the second term on the right hand side of the equation (8) is given by:

$$\frac{\alpha_0}{1-\alpha_1}(\alpha_0 E(\varepsilon)) - \frac{1}{1-\alpha_1}[E(\Sigma D\varepsilon) + E(\Sigma N\varepsilon) + E(\Sigma D)\alpha_0 + E(\Sigma N)\alpha_0]$$

$$+ \frac{1}{1-\alpha_1}[E(\Sigma\varepsilon)\alpha_0 + E(\Sigma\varepsilon)] \neq 0$$

4. Thus for example, the size structure variable is derived from the relation between the rate of new firm formation and the number of large plants in the region. It seems somewhat contradictory for CFM to propound a mechanism in which the level or change in property taxes induces an outmigration of firms, and yet require the rate of new firm formation to be unaffected by the tax.

5. By analogous reasoning the CFM results imply that a fall in property taxes in a region will lead to a decline in profit margins.

6. Indirect or overhead labour may be defined as the number of worker necessary to operate a plant at any non-zero level of capacity. This number is independent of the degree of plant utilisation.

7. That is total labour costs per unit of output decrease, as output increases and ceteris paribus profits increase.

8. Assuming that we ignore the balanced multiplier impacts on investment.

CHAPTER FIVE

THE INCIDENCE OF THE NON-DOMESTIC PROPERTY TAX IN THE UK

A GENERAL EQUILIBRIUM ASSESSMENT

The incidence of the non-domestic property tax in the UK remains an inconclusive issue. This chapter endeavours to measure its distributional impact in a general equilibrium context. It will be recalled that the antecedents of general equilibrium incidence theory lie in Harberger's analysis of coporation taxes. Harberger (1962) introduced into public finance a two sector model which provided the theoretical breakthrough necessary to analyse incidence in a general, rather than a partial equilibrium framework. The analysis presented here seeks to extend the standard model by introducing a stylised production hierarchy based on the observed flows of intermediate goods in the economy. The approach thus contrasts with previous empirical work in attempting to discern the incidence of the non-domestic property tax in a theoretically derived general equilibrium framework. However, before proceeding with the analysis, it would appear useful to briefly summarise the main conclusions of general equilbrium analysis of property tax incidence.

General equilbrium theory focuses on the economy-wide consequences of a differentially higher property tax levied on a region. The typical neoclassical assumptions of perfect commodity and factor markets employed in the model ensure that net-of-tax returns to mobile factors are uniform across regions in equilibrium. Thus, a relatively higher property tax imposed on one area induces an outward flight of capital (the mobile factor) to the untaxed regions. The increased supply of capital in these areas lowers marginal productivity and hence the post-tax returns to capital, while the reduced supply of capital in the taxed region increases marginal productivity and after-tax returns.

Equilibrium is eventually attained when sufficient capital has migrated from the taxed region to equalise the net-of-tax returns to capital. However, while equilibrium ensures the uniformity of after-tax returns to mobile factors, differences in returns to imperfectly mobile factors persist in the long run. Thus for example,in a "new-view" equilibrium, rent differentials between regions may exist. The important conclusion that distinguishes the "new-view" general, from partial equilibrium analysis, is the insight that while a uniform property tax across all local authority jurisdictions depresses the after-tax returns to capital throughout the economy, property tax rate differentials between areas lead to differences in the returns to immobile and imperfectly mobile factors.

However, in contrast to the literature on corporation taxes, there have been no previous attempts to estimate the economy-wide incidence of property taxes in a theoretically derived general equilibrium model.[1] Hence the analysis presented in this paper has been formulated with the primary objective of obtaining numerical estimates of the incidence of non-domestic property taxes in the UK. However, the paucity of spatially disaggregated data has necessitated an important modification to the conventional general equilibrium approach. Instead of analysing the consequences of spatial movements of mobile factors induced by geographical variations in tax rates, the model focuses on movements of capital between sectors resulting from inter-sectoral propety tax rate differentials. The sectoral variations in tax rates derive partly from the operation of the rating system, which tends to tax more heavily those sectors which are intensive in the use of land and structures. These differences are further accentuated by the fact that agricultural land and buildings are exempted from rates, and industry is partially derated in certain regions - notably Scotland. Thus, different sectors in the economy are distinguished in the model presented below, on the basis of the actual variation in effective tax rates. In addition, the analysis incorporates a hierarchical production process in which intermediate goods serve as factor inputs.

The model further departs from the standard literature on property tax incidence in its factor mobility assumptions. Much of the existing theoretical work is concerned with the spatial variation in property tax rates, and thence the geographical migration of factors. Consequently, while capital mobility is central to the "new-view" theories, labour mobility is not among its assumptions. Since the present model focuses on the sectoral variations in tax rates, there is little reason to retain this assumption, and hence it is assumed that all factors are perfectly mobile in the long run.

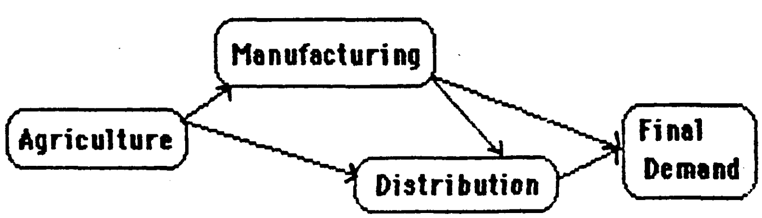
The analysis presented here thus seeks to augment the existing general equilibrium literature by introducing intermediate goods to the analysis of property tax incidence, and by examining the consequences of a differential tax levied on several sectors located at different points in the production hierarchy. Section 5.1 thus presents the basic model. while section 5.2 solves for the expressions and enumerates the theoretical conclusions. Finally, section 5.3 attempts to empirically estimate the economy-wide incidence of property taxes in the UK.

5.1 The Model

The model employs the typical entourage of neoclassical assumptions which are briefly restated here without further elaboration. Thus it is assumed that factor and product markets are perfect, and that resource endowments consisting of "primary" factors (i.e. labour and capital) are fixed and fully employed.[2] In addition, production functions are assumed to be linearly homogeneous and quasi-concave.

The model, however, departs from the standard literature in attempting to encapsulate the more prominent features of the non-domestic property tax in the UK. It was noted earlier that the rating system is characterised by substantial inter-sectoral tax rate differentials and hence the model distinguishes between three sectors: the rate exempt agricultural sector (A), the partially derated manufacturing sector (M), and the distribution sector (D). This division, however, closely corresponds to the hierarchical structure of production in the economy. (Thus the UK input-output tables for 1979 reveal that 75% of the agricultural sector's output is sold to the manufacturing sector, while 70% of the manufacturing sector's product is sold through the distribution sector.) Hence the model explicitly incorporates intermediate goods. For simplicity, it is assumed that the agricultural sector produces only intermediate goods which are sold to the manufacturing and distribution sectors. In contrast, the manufacturing sector is assumed to sell its homogeneous product partly as an intermediate good to the distribution sector and the remainder directly to final demand. The distribution sector on the other hand, produces and sells only final goods. Figure 5.1 below provides a schematic illustration of the assumed inter-sectoral flows. It is evident that the intermediate goods serve as additional factor inputs in the model.

FIGURE 5.1



The Structural Equations:

The economy is initially assumed to be at a Pareto optimal point on its production possibility frontier. Thus, all resources are fully employed and the assumption of perfect markets serves to ensure that prices equal marginal costs. The full employment condition can be expressed as follows:

(1a) $a_{LA}A + a_{LM}M^* + a_{LD}D = L$

(1b) $a_{KA}A + a_{KM}M^* + a_{KD}D = K$

(1c) $a_{AM}M^* + a_{AD}D = A$

(1d) $a_{MD}D + M = M^*$

where:

$M^* = m + M$ = total output of the manufacturing sector

$m = a_{MD}D$ = quantity of manufacturing sector's output sold to D as an intermediate good.

M = quantity of manufacturing sector's output sold to final demand

a_{iA} = quantity of input i requried to produce a unit of A

a_{iM} = quantity of input i required to produce a unit of M

a_{iD} = quantity of input i required to produce a unit of D

L = labour

K = capital

In Equations (1a) and (1b) the intermediate goods (i.e. A and m) can usefully be decomposed into their "primary" factor components thereby simplifying the above system. Substituting (1d) into (1c), we obtain:

(1e) $a_{AM}\, a_{MD} D + a_{AM} M + a_{AD} D = A$

Substituting (1d) and (1e) into (1a) and (1b) yields:

(2a) $Q_{LD} D + Q_{LM} M = L$

(2b) $Q_{KD} D + Q_{KM} M = K$

where:

$Q_{LD}\ (a_{LA} a_{AM}\, a_{MD} + a_{LA} a_{AD} + a_{LM} a_{MD} + a_{LD})$

$Q_{KD} = (a_{KA}\, a_{AM} a_{MD} + a_{KA} a_{AD} + a_{KM} a_{MD} + a_{KD})$

$Q_{LM} = (a_{LA}\, a_{AM} + a_{LM})$

$Q_{KM} = (a_{KA}\, a_{AM} + a_{KM})$

The terms Q_{LJ} and Q_{KJ} represent GROSS amounts of labour and capital embodied in the final goods D and M (i.e. the direct purchases of primary factors, and their indirect consumption deriving from the purchase of intermediate goods.) In what follows the distinction between GROSS (i.e. total) and NET (i.e. direct) factor inputs will play a crucial role in the analysis.

In a perfectly competitive equilibrium, firms earn zero profits and hence unit costs reflect market prices. Thus:

(3a) $a_{LD}w + a_{KD}r + a_{AD}P_A + a_{MD}P_M = P_D$

(3b) $a_{LM}w + a_{KM}r + a_{AM}P_A = P_M$

(3c) $a_{LA}w + a_{KA}r = P_A$

where:

P_J = Price of good J

w = wage rate

r = rental on capital

The assumption that production functions are linearly homogeneous makes each input-output coefficient dependent on input prices, and implies that factor demands are homogeneous of degree zero. Thus we have the following input demands:

(4a) $a_{iD} = f_D\ (w, r, P_A, P_M)$

(4b) $a_{iM} = f_M\ (w, r, P_A)$

(4c) $a_{iA} = f_A\ (w, r,)$

We now introduce a distortion into the system in the form of a differential property tax. In keeping with the rating system in the UK, it is assumed that a tax is levied on the manufacturing and distribution sectors at the rates t_M and t_D respectively. Following Mieszkowski's (1972) seminal paper, the property tax is treated as a tax on the stock of capital in each sector. For greater generality, it is assumed that the tax rates levied on the two sectors differ, and hence the situation where tax rates are uniform is subsumed as a special case of the model. The yield from the tax is given by:

$$T = t_D K_D + t_M K_M = t_D(a_{KD} D) + t_M(a_{KM} M)$$

where:

$K_D = a_{KD} D$ = Direct stock of capital in D

$K_M = a_{KM} M$ = Direct stock of capital in M

It is perhaps worth noting paranthetically, that this formulation of the property tax differs from that used in several important extensions of Mieszkowski's model (e.g. Breukner(1981)). Typically, these studies treat the property tax as a tax on the housing or construction industry. In a frequently cited proof, Musgrave (1959) has shown that a tax on the output of a constant returns industry is analytically indistinguishable in its effects from a tax at equal rates on all inputs in the industry. Thus, in contrast to these studies the commodity being taxed in the present model is unambiguously the stock of capital.

With the introduction of a tax it becomes necessary to amend the price equations as follows:

(5a) $a_{LD} w + a_{KD}(r + t_D) + a_{AD} P_A + a_{MD} P_M = P_D$

(5b) $a_{LM} w + a_{KM}(r + t_M) + a_{AM} P_A = P_M$

(5c) $a_{LA} w + a_{KA} r = P_A$

Restated in terms of final goods and primary factors we have:

(6a) $Q_{LD}w + Q_{KD}r + a_{KD}t_D + a_{KM}a_{MD}t_M = P_D$

(6b) $Q_{LM}w + Q_{KM}r + a_{KM}t_M = P_M$

The comparative static properties of the system and the solution are deduced from the equations of change; differentiating equations (2a) and (2b) yields:

(7a) $\lambda_{LD}\hat{D} + \lambda_{LM}\hat{M} = \hat{L} - (\lambda_{LD}\hat{Q}_{LD} + \lambda_{LM}\hat{Q}_{LM})$

(7b) $\lambda_{KD}\hat{D} + \lambda_{KM}\hat{M} = \hat{K} - (\lambda_{KD}\hat{Q}_{KD} + \lambda_{KM}\hat{Q}_{KM})$

where:

$\lambda_{LD} = \frac{Q_{LD}D}{L}$ = fraction of the labour force employed in D

$\lambda_{LM} = \frac{Q_{LM}M}{L}$ = fraction of the labour force employed in M

the circumflex (^) is used to denote proportional changes.

(i.e. $\hat{D} = \frac{dD}{D}$; $\hat{L} = \frac{dL}{L}$; etc.)

Similarly differentiating the price equations (5a) and (5b) we obtain:

(8a) $\alpha_{LD}\hat{w} + \alpha_{KD}(\hat{r} + \hat{t}_D) + \alpha_{AD}\hat{P}_A + \alpha_{MD}\hat{P}_M = \hat{P}_D$

(8b) $\alpha_{LM}\hat{w} + \alpha_{KM}(\hat{r} + \hat{t}_M) + \alpha_{AM}\hat{P}_M = \hat{P}_M$

(8c) $\alpha_{LA}\hat{w} + \alpha_{KA}\hat{r} = \hat{P}_A$

where:

$\alpha_{LD} = \dfrac{a_{LD}w}{P_D}$ = labour's share of sector D's income

$\alpha_{LM} = \dfrac{a_{LM}w}{P_M}$ = labour's share of sector M's income, etc.

Expressed in terms of primary factors and final goods, we have:

(9a) $\theta_{LD}\hat{w} + \theta_{KD}\hat{r} + \alpha'_{KD}\hat{t}_D + \alpha'_{KM}\alpha_{MD}\hat{t}_M = \hat{P}_D$

(9b) $\theta_{LM}\hat{w} + \theta_{KM}\hat{r} + \alpha'_{KM}\hat{t}_M = \hat{P}_M$

where:

$\theta_{LD} = \dfrac{Q_{LD}w}{P_D}$ = labour's GROSS share of sector D's income, etc.

$\alpha'_{KD} = \dfrac{a_{KD}t_D}{P_D}$ and $\alpha'_{KM} = \dfrac{a_{KM}t_M}{P_M}$

Subtracting (9a) from (9b) we obtain an expression for the change in relative prices of the final goods:

(10a) $(\hat{P}_D - \hat{P}_M) = \hat{w}\,(\theta_{LD} - \theta_{LM}) - \hat{r}\,(\theta_{KM} - \theta_{KD}) + \alpha'_{KD}\hat{t}_D + \alpha'_{KM}t_M\,(\alpha'_{MD} - 1)$

From Equation (10a) it follows that *ceteris paribus* the impact of a change in factor rewards on prices depends crucially on the coefficients $(\theta_{LD} - \theta_{LM})$ and $(\theta_{KM} - \theta_{KD})$. These terms represent factor shares and hence if sector D pays a relatively greater share of its income to labour then

$(\theta_{LD} - \theta_{LM}) > 0$ and it follows that $(\theta_{KM} - \theta_{KD}) > 0$ which implies that sector M is relatively capital intensive. Let $|\theta|$ denote the determinant of equations (9a) and (9b). Jones (1971) has shown that $|\theta|$ provides a measure of relative factor intensities based on factor SHARES IN VALUE ADDED. In contrast, the determinant of Equations (7a) and (7b) (i.e. $|\lambda| = \lambda_{LD} - \lambda_{KD} = \lambda_{KM} - \lambda_{LM}$) yields a measure of factor intensities in PHYSICAL terms rather than factor shares. Jones (1971) proved that in an undistorted market, both $|\theta|$ and $|\lambda|$ must have the same sign, implying that a factor which is utilised relatively intensively also receives a greater share of the income of the industry. From the Samuelson-Stolper theorems it then follows than an exogenous disturbance has a "magnified effect" on the intensively used factor. However in the presence of a distortionary factor tax this condition no longer holds, and hence $|\theta|$ and $|\lambda|$ may have opposite signs thereby implying than an intensively used factor receives a smaller share of the industry's income.[3] Thus "perverse" supply responses may result if the distortions are sufficiently severe. To ensure that the supply curves in this model are "well behaved", we therefore assume that $|\theta|$ and $|\lambda|$ have identical signs.

To close the model it becomes necessary to specify the demand side. In an effort to isolate the impact of the tax from the concomitant income and demand effects, we employ an artifact commonly used in the literature. Specifically it is assumed that the government spends its taxes so that the reduction in private expenditures is exactly counterbalanced by increases in government spending. Furthermore, it is assumed that marginal propensities to consume final goods are equal and constant. Hence any changes in demand resulting from the distributive effects of the tax will be exactly offsetting. This together with the assumption of full employment implies that only relative prices are meaningful., and there is only one demand equation which can be expressed as follows:

(11a) $D = f_1 (\hat{P}_D / \hat{P}_M)$

Differentiating:

(11b) $\hat{D} = \varepsilon_D (\hat{P}_D - \hat{P}_M)$

where:

ε_D = income compensated elasticity of demand for D

Finally substituting Equations (9a) and (9b) for $\hat{P}_D$ and $\hat{P}_M$ in (11b) yields an expression for $\hat{D}$ in terms of factor shares and primary factor returns:

(11c) $\hat{D} = \varepsilon_D (\theta_{LD}\hat{w} - \theta_{LM}\hat{w} + \theta_{KD}\hat{r} - \theta_{KM}\hat{r} + \alpha'_{KD}\hat{t}_D - \alpha'_{KM}\hat{t}_M + \alpha'_{KM}\alpha_{MD}\hat{t}_M)$

5.2 The Solution:

The final incidence of the tax can be deduced from the changes in after tax rewards. Thus for instance, if the wage-rental ratio remains constant after the imposition of a property tax, then by implication the relative shares of labour and capital in national income remain unaffected (i.e. $d(rK/wL) = 0$). Expressed in terms of changes in relative factor rewards this "equi-burden" condition implies that $\hat{r}=\hat{w}$. However, if this condition is to be expressed in terms of relative prices then it becomes necessary to assign one factor/commodity as a numeraire. Following Harberger (1962) we assume here that the wage rate is the numeraire (i.e. $\hat{w}=0$) and hence r represents the relative price of capital. It then follows that the "equi-burden" condition reduces to $\hat{r}-\hat{w}=0$, or merely $\hat{r}=0$. If on the other hand, capital were to bear a proportionately greater burden of the tax relative to its share in national income, it follows that $\hat{r}<\hat{w}$, but since $\hat{w}=0$ this simplifies to $\hat{r}<0$. Thus the incidence of the tax can be inferred from the sign of $\hat{r}$.

The model is solved for $\hat{r}$ by equating the proportionate changes in the demand for D as embodied in equation (11c) with the corresponding changes in supply.

Applying Cramer's Rule to (7a) and (7b) and solving for $\hat{D}$, we obtain the following supply side expression:

$$(12) \quad \hat{D} = \frac{\lambda_{LM}\lambda_{KD}\hat{Q}_{KD} - \lambda_{KM}\lambda_{LD}\hat{Q}_{LD} + \lambda_{KM}\lambda_{LM}\hat{Q}_{KM} - \lambda_{KM}\lambda_{LM}\hat{Q}_{LM}}{\lambda_{LD}\lambda_{KM} - \lambda_{KD}\lambda_{LM}}$$

The terms Q_{ij} in Equation (12) represent gross factor shares and thus contain $\hat{r}$. To solve for $\hat{r}$ it therefore becomes necessary to decompose the $\hat{Q}_{ij}$ terms into their constituent components. This process is rather tedious and complicated and is therefore relegated to the appendix where it is shown that:

(13a) $\hat{Q}_{LM} = (\rho\hat{r} + \Pi\hat{t}_M)/\theta_{LM}$

(13b) $\hat{Q}_{KM} = (\rho\hat{r} + \Pi\hat{t}_M)/\theta_{KM}$

(13c) $\hat{Q}_{LD} = (\beta\hat{r} + \Upsilon\hat{t}_M + \eta\hat{t}_D)/\theta_{LD}$

(13d) $\hat{Q}_{KD} = -(\beta\hat{r} + \Upsilon\hat{t}_M + \eta\hat{t}_D)/\theta_{KD}$

where:

$$\rho = \{\alpha_{LM}\alpha_{KM}\sigma^M_{KL} - \alpha_{LM}\alpha^2_{KA}\alpha_{AM}\sigma^M_{AL} + \alpha^2_{LA}\alpha_{AM}\alpha_{KM}\sigma^M_{KA} + \alpha_{LA}\alpha_{AM}\alpha_{KA}\sigma^A_{KL}\}$$

$$\Pi = \{\alpha_{LM}\alpha_{KM}\sigma^M_{KL} + \alpha_{LA}\alpha_{AM}\alpha_{KM}\sigma^M_{KA}\}$$

$$\beta = \{[\alpha_{KD}\alpha_{MD}(\alpha_{LM} + \alpha_{AM}\alpha_{LA})^2]\sigma^D_{KM} + [\alpha_{MD}\alpha_{KD}\alpha^2_{LA}]\sigma^D_{MK} + [\alpha^2_{KA}\alpha_{AD}\alpha_{LD}]\sigma^D_{AL}$$

$$+ [\alpha_{KD}\alpha_{LD}]\sigma^D_{KL} + [\alpha_{KA}\alpha_{LA}(\alpha_{AM}\alpha_{MD} - \alpha_{AD})]\sigma^A_{LK} + [\alpha^2_{LA}\alpha_{KM}\alpha_{MD}\alpha_{AM}]\sigma^M_{KA}$$

$$+ [\alpha^2_{KA}\alpha_{AM}\alpha_{MD}\alpha_{LM}]\sigma^M_{LA} + [\alpha_{KM}\alpha_{MD}\alpha_{LM}]\sigma^M_{KL}\}$$

$$\Upsilon = \{[\alpha_{MD}\alpha_{KM}\alpha_{LD}(\alpha_{KA}\alpha_{AM} + \alpha_{KM})]\sigma^D_{LM} + [\alpha_{KD}\alpha_{MD}\alpha_{KM}(\alpha_{LA}\alpha_{AM} + \alpha_{LM})]\sigma^D_{MK}$$

$$+ [\alpha_{MD}\alpha_{KM}\alpha_{AD}(\alpha_{KM} + \alpha_{AM}\alpha_{KA} - \alpha_{KA})]\sigma^D_{MA} + [\alpha_{LA}\alpha_{AM}\alpha_{MD}\alpha_{KM}]\sigma^M_{KA}\}$$

$$\eta = \{[\alpha_{MD}\alpha_{KD}(\alpha_{LA}\alpha_{AM} + \alpha_{LM})]\sigma^D_{MK} + [\alpha_{AD}\alpha_{KD}\alpha_{LA}]\sigma^D_{AK} + [\alpha_{KD}\alpha_{LD}]\sigma^D_{KL}\}$$

The σ_{ij}^{K} terms in expression (13) denotes Allen Partial Elasticities of Substitution (AES hereafter) (i.e. $\sigma_{ij} = \frac{\partial a_{jK}}{\partial P_i} \frac{P_i}{a_{jK}}$). While a negative AES signifies factor complementarity, a positive AES is indicative of factor substitutability. The signs of the AES are crucial to the stability of the input demand functions. Allen (1969) has shown that a sufficient condition for the stability of the factor demands requires that:

$$\alpha_{LD}\sigma_{LK}^{D} + \alpha_{KD}\sigma_{KK}^{D} + \alpha_{MD}\sigma_{MK}^{D} + \alpha_{AD}\sigma_{AK}^{D} = 0$$

Since each own price AES is by definition negative (i.e. $\sigma_{KK}<0$), the other positive cross price AES must be more numerous or important than the negative AES to ensure that the above condition holds. Thus by implication the stability conditions restrict the maximum number of negative AES in a production function (see Appendix 2). For simplicity, we therefore initially assume that all cross AES are positive. This restriction is relaxed in section 5.4 in an attempt to explore the empirical consequences of factor complementarity.

The final solution for $\hat{r}$ is obtained by substituting (13) into (12) and equating this supply side expression with the demand side as embodied in Equation (11c). Thus the tax burden borne by capital is given by:

(14)

$$\hat{r} = \frac{(\varepsilon_D . A[\alpha'_{KD}\hat{t}_D + \alpha'_{KM}\alpha_{MD}\hat{t}_M - \alpha'_{KM}\hat{t}_M]) - [\gamma C/(\theta_{KD}\theta_{LD}) + \pi/(\theta_{KM}\theta_{LM})]\hat{t}_M - \{\Omega/(\theta_{KD}\theta_{LD})\}\hat{t}_D}{(\varepsilon_D . A(\theta_{KM} - \theta_{KD})) + [\beta C/\theta_{LD}\theta_{KD}) + (\rho/\theta_{KM}\theta_{LM})]}$$

where: $A = \dfrac{\lambda_{KD}}{\lambda_{KM}} - \dfrac{\lambda_{LD}}{\lambda_{LM}} = \dfrac{K_D^*}{K_M^*} - \dfrac{L_D^*}{L_M^*}$

$$C = \theta_{LD}\frac{\lambda_{KD}}{\lambda_{KM}} + \theta_{KD}\frac{\lambda_{LD}}{\lambda_{LM}} - \theta_{LD}\frac{K_D^*}{K_M^*} + \theta_{LD}\frac{L_D^*}{L_M^*}$$

(*) denotes GROSS quantity of a factor

The denominator of (14) is frequently referred to as the "aggregate elasticity of substitution" (Jones 1965). Under the stringent assumptions underlying the model, the denominator can be shown to be positive, and hence the sign of r will depend crucially on that of the numerator.

THE SIGN OF THE DENOMINATOR:

$$\left[\text{i.e. } \varepsilon_D \left[\frac{K_D^*}{K_M^*} - \frac{L_D^*}{L_M^*}\right] [\theta_{KM} - \theta_{KD}] + \left[\frac{\beta}{\theta_{LD}\theta_{KD}}\right] . C + \left[\frac{\rho}{\theta_{KM}\theta_{LM}}\right]\right.$$

The first term in the denominator ε_D, is the income compensated elasticity of demand which is by definition negative, hence if it can be shown that $\left[\frac{K_D^*}{K_M^*} - \frac{L_D^*}{L_M^*}\right](\theta_{KM} - \theta_{KD})$ is negative the denominator will be positive. In Section 5.2 it was assumed that $|\theta|$ and $|\lambda|$ have the same sign thereby ensuring that a factor which is relatively intensively utilised, receives a greater share of the income of the industry. Hence, if (O_{KM}- O_{KD}) >0 sector M

pays a greater share of its income to capital, and is consequently capital intensive which implies that $\frac{K_D^*}{K_M^*} - \frac{L_D^*}{L_M^*}$ <0, and hence the denominator

will be positive. The second term in the denominator contains β and ρ whose signs depend on their constituent AES which are assumed to be positive. Thus the denominator of the incidence expression will be positive.

Having established the sign of the denominator certain general conclusions can be inferred from equation (14). The first term in the numerator embodies the demand effects and in Mieszkowski's parlance is termed the "output effect". The second and third terms are referred to as "substitution effects", and describe the impact of factor suitability on r. The sign of the "substitution effects" is ambiguous. Hence if the "output effect" is positive and greater in absolute value than the "substitution effects", r will be positive implying that part of the burden has been shifted to labour. The following conclusions can now be deduced from (14).

PROPOSITION 1

Labour bears a greater proportion of the tax, if and only if, the overall burden of the tax falls more heavily on the LABOUR INTENSIVE sector (i.e. $\hat{r}$>0).

It was noted earlier that when labour bears a proportionately greater burden of the tax, this implies that $\hat{r}>\hat{w}$, and since $\hat{w}$ is the numeraire (and hence $\hat{w}=0$) this condition simplifies to $\hat{r}>0$. Clearly, $\hat{r}$ will be positive only if the numerator and hence the "output effects" are positive and greater in absolute value than the "substitution effects". Consider the "output effects" in (14): i.e. $\varepsilon_D \left(\frac{K^*_D}{K^*_M} - \frac{L^*_D}{L^*_M} \right) (\alpha'_{KD}\hat{t}_D + \alpha'_{KM}\alpha_{MD}\hat{t}_M - \alpha'_{KM}\hat{t}_M)$

The third term represents the relative tax burdens borne by sector M and D. While, $\alpha'_{KD}\hat{t}_D$ and $\alpha'_{KM}\hat{t}_M$ reflect the direct taxes levied on the two sectors; $\alpha'_{KM}\alpha_{MD}\hat{t}_M$ on the other hand represents that fraction of the tax levied on M which is transmitted to sector D through the sale of higher priced intermediate goods. Thus the term $(\alpha'_{KD}\hat{t}_D + \alpha'_{KM}\alpha_{MD}\hat{t}_M)$ describes the OVERALL tax burden, both direct and transmitted, borne by sector D. The second term in the above expression represents the gross relative factor intensities, while ε_D denotes the income compensated elasticity of demand. Since ε_D is by definition negative, the "output effect" will be positive, if and only if, $\frac{K^*_D}{K^*_M} - \frac{L^*_D}{L^*_M} (\alpha'_{KD}\hat{t}_D + \alpha'_{KM}\alpha_{MD}\hat{t}_M - \alpha'_{KM}\hat{t}_M)<0$. Thus if sector D is labour intensive then $\left(\frac{K^*_D}{K^*_M} - \frac{L^*_D}{L^*_M} \right)<0$, and the "output effect" will be positive only if

$\left(\frac{K_D^* - L_D^*}{K_M^* - L_M^*}\right)(\alpha'_{KD}\hat{t}_D + \alpha_{KM}\alpha_{MD}\hat{t}_M - \alpha'_{KM}\hat{t}_M) < 0$ which implies that the overall relative tax burden suffered by the labour intensive sector D (i.e. $\alpha'_{KD}\hat{t}_D + \alpha'_{KM}\alpha_{MD}\hat{t}_M$) is greater than that borne by sector M. This result is in fact similar to Harberger's (1962) much quoted conclusion that the burden of a tax on capital income can only be shifted to labour if the taxed sector is labour intensive. In the present model, the general tenor of Harberger's result holds under the additional caveat that the labour intensive sector bears a higher proportion of the overall (i.e. direct and transmitted) tax burden.

PROPOSITION 2

The greater are the AES between capital and labour in the untaxed agricultural sector, the greater will be the tendency for labour and capital to bear the tax burden in proportion to their initial shares in national income (i.e. $\hat{r}$=0).

The AES between labour and capital in the untaxed agricultural sector (i.e. σ^A_{KL}) appear only in the denominator of equation (14) as a component of β. Thus, in the limit as σ^A_{KL} approaches infinity and all other elasticities tend to zero, $\hat{r}$ will approach zero.[4]

PROPOSITION 3

The greater are the AES between the product of the untaxed sector (A), and the untaxed primary factor (labour), the greater

will be the tendency for labour and capital to bear the tax in proportion to their initial shares in national income (i.e. $\hat{r}=0$).

Once again, σ^{D}_{AL} and σ^{M}_{AL} appear only in the denominator as components of β and ρ. Hence as these approach infinity, $\hat{r}$ tends to zero.

PROPOSITION 4

Increases in the following AES: σ^{D}_{MK}, σ^{D}_{ML}, σ^{D}_{KL}, σ^{D}_{AK}, σ^{M}_{AK}, σ^{M}_{KL} tend to raise the relative burden of the tax borne by capital relative to its initial share in national income (i.e. $\hat{r}<0$).

These AES appear in both the numerator and the denominator with equal coefficients but opposite signs. Hence as they approach infinity and all other elasticities tend to zero, $\hat{r}$ will approach $(-t_D \; -t_M)$. Thus the price of capital will fall by the amount of the tax. However, since the reduction in price applies to capital employed in all sectors, taxed and untaxed, the decline in the returns to capital will exceed the revenue garnered by the government in taxes.

The elasticities discussed in Propositions 2 and 3 above, reflect the ability of the untaxed sector to absorb the capital released from the taxed sectors. Hence increases in these AES tend to dampen the proportion of the tax borne by capital. In contrast, the result in Proposition 4 reveals that increases in substitutability between taxed factors and the products of a taxed sector provides little opportunity for capital to escape the burden of the tax and hence in the limit the returns to capital decrease by the amount of the tax.

PROPOSITION 5

When gross factor intensities in the final goods sectors are equal, the "output effect" is rendered impotent.

This result derives from the fact that when $\left(\frac{K_D^*}{K_M^*} - \frac{L_D^*}{L_M^*} \right)=0$, all terms containing the elasticity of demand and hence the "output effect" are reduced to zero, and consequently $\hat{r}$ depends only on the "substitution effects".

PROPOSITION 6

When all factors are used in fixed proportions (i.e. $\sigma_{ij}=0$) the incidence of the tax depends only on the "output effects".

In this case, expression (14) simplifies to:

$$\hat{r} = \frac{(\varepsilon_D . A\ (\alpha'_{KD} t_D + \alpha'_{KM} \alpha_{MD} \hat{t}_M - \alpha_{KM} \hat{t}_M)}{\varepsilon_D . A\ \ (\theta_{KM} - \theta_{KD})}$$

The numerator is the "output effect", whose sign was shown to depend on relative factor intensities, and the relative tax burdens. Thus with a positive denominator, the incidence of the tax depends on the sign of the "output effects".

PROPOSITION 7

If only one final goods sector is taxed, labour will bear a greater share of the tax burden in proportion to its initial share in national income, if and only if, the taxed sector is relatively labour intensive.

With a tax on only one final goods sector, the "output effects" simplify to: $\varepsilon_D \left(\frac{K_D^* - L_D^*}{K_M^* - L_M^*}\right)(\alpha'_{KD}\hat{t}_D)$ if sector D is taxed, and $\varepsilon_D \left(\frac{K_D^* - L_D^*}{K_M^* - L_M^*}\right)(-\alpha'_{KM}\hat{t}_M + \alpha'_{KM}\alpha_{MD}\hat{t}_M)$ if sector M is taxed. Clearly, the "output effects" will be positive only if the taxed sector is labour intensive. This result corresponds to Harberger's conclusion, and it therefore appears not unreasonable to suggest that the Harberger model can be regarded as a special case of this more general framework which incorporates intermediate goods, and a tax on two sectors of the economy.

PROPOSITION 8

When the tax rates levied on the two final goods sectors are EQUAL, the incidence expression simplifies to:

(15)

$$r = \frac{\varepsilon_D A(\alpha'_{KD}\hat{t} + \alpha'_{KM}\hat{t} - \alpha'_{KM}\alpha_{MD}\hat{t}) - \{C(\gamma+\Omega)/(\theta_{KD}\theta_{LD}) + \Pi/(\theta_{KM}\theta_{LM})\}\hat{t}}{\varepsilon_D A(\theta_{KM} - \theta_{KD}) + \{\beta C/(\theta_{KD}\theta_{LD}) + \rho/\theta_{KM}\theta_{LM}\}}$$

Once again $\hat{r}>0$ iff the labour intensive sector bears a greater proportion of the overall tax burden. This result is therefore a special case of that derived in Proposition 1. It would however be putative to thence conclude that the incidence of a uniform tax on the two final goods sectors is identical to that of an unequal tax, for by definition the "substitution effects" in the incidence expressions describe the consequences of a diversion of economic activity from high to low taxed sectors. Hence, this subsection attempts to discern the "differential incidence" of substituting an unequal property tax levied on the two final goods sectors, with an equal yield uniform tax. Algebraically, the alternative tax regimes yield the same revenues if the following condition is satisfied:

$$(16a)\quad \hat{t}_D \cdot \alpha_{KD} + \hat{t}_M \alpha_{KM} = \hat{t}(\alpha_{KD} + \alpha_{KM})$$

$$(16b)\quad \therefore \quad \hat{t} = \frac{\hat{t}_D \alpha_{KD} + \hat{t}_M \alpha_{KM}}{(\alpha_{KD} + \alpha_{KM})}$$

where:

$\hat{t}$ = uniform tax rate levied on sectors M and D.

The "differential incidence" resulting from a change to a uniform tax regime can be derived by subtracting expression (15) from (14) subject to (16b). For ease of exposition we analyse the "differential output" and "substitution effects" separately. Consider first the "output effects" under a system of unequal taxes. From Equation (14) we have:

$$(17a)\quad \varepsilon_D A\,(\alpha'_{KD}\hat{t}_D - \alpha'_{KM}\hat{t}_M + \alpha'_{KD}\alpha_{KM}\hat{t}_M) = \varepsilon_D A\,S$$

where: $S = \alpha'_{KD}\hat{t}_D - \alpha'_{KM}\hat{t}_M + \alpha'_{KD}\alpha_{KM}\hat{t}_M$

If on the other hand an equal yield uniform tax is levied on sectors M and D from (15), the "output effects" are:

(17b) $\varepsilon_D A\,(\alpha'_{KD}\hat{t}_D - \alpha'_{KM}\hat{t} + \alpha'_{KD}\alpha_{KM}\hat{t}) = \varepsilon_D\ A\ R$

where: $R = \alpha'_{KD}\hat{t} - \alpha'_{KM}\hat{t} + \alpha'_{KD}\alpha_{KM}\hat{t}$

and $\hat{t}$ is as defined in (16b)

Subtracting (17b) from (17a) yields the "differential output effect":

(18) $\varepsilon_D A\,[\alpha'_{KD}\ (\hat{t}_D - \hat{t}) + \alpha'_{KD}\alpha_{KM}\ (\hat{t}_M - \hat{t}) - \alpha'_{KM}\ (\hat{t}_M - \hat{t})\ ]$

Substituting (16b) for $\hat{t}$ and solving:

(19) $\varepsilon_D A\,[\alpha'_{KD}\alpha_{KM}\,\{2\ (\hat{t}_D - \hat{t}_M) - \alpha'_{MD}\ (\hat{t}_D - \hat{t}_M)\}\ ]$

Equation (19) reveals that $[\alpha'_{KD}\alpha_{KM}\,\{2\ (\hat{t}_D - \hat{t}_M) - \alpha'_{MD}\ (\hat{t}_D - \hat{t}_M)\}\ ]$ determines the <u>absolute magnitude</u> of the "differential output effects", and $\varepsilon_D A$ <u>the eventual sign</u>. Thus if sector D is capital intensive, then $(K^*_D / K^*_M > L^*_D / L^*_M)$ and hence $\varepsilon_D A < 0$. If in addition $(t_D - t_M) > 0$ then $\{\alpha'_{KD}\alpha_{KM}\,\{2\ (\hat{t}_D - \hat{t}_M) - \alpha'_{MD}\ (\hat{t}_D - \hat{t}_M)\ \} > 0$ and hence (19) will be negative implying that the output effects under a uniform tax regime exceed those under a differential tax system. Thus *ceteris paribus* the tax changes will lower the burden borne by capital. Conversely, if sector D is labour intensive, then $\varepsilon_D A>0$ and if in addition $(t_D-t_M)>0$ then (19) will be positive and consequently the substitution of an equal yield uniform tax for the unequal taxes will reduce the "output effects" thereby increasing the burden on capital. Table 5.1 summarises the main results:

TABLE 5.1

(t_D-t_M)	$\varepsilon_D A$	"Output Effects" under a differential tax i.e. $(t_D \neq t_M)$		"Output Effects under a uniform tax i.e. $(t_D = t_M)$
1. If $(t_D-t_M)>0$	and $\varepsilon_D A>0$	"	$>$	"
2. If $(t_D-t_M)>0$	and $\varepsilon_D A<0$	"	$<$	"
3. If $(t_D-t_M)<0$	and $\varepsilon_D A<0$	"	$>$	"
4. If $(t_D-t_M)<0$	and $\varepsilon_D A>0$	"	$<$	"

Clearly the overall effect of the tax change depends on the combined impact of the "output" and "substitution effects". From (14) we have the following "substitution effects" under unequal taxes:

(20) $-(\gamma C/(\theta_{KD}\theta_{LD}) + \Pi/(\theta_{KM}\theta_{LM})\hat{t}_M - (\eta C/(\theta_{KD}\theta_{LD})\hat{t}_D = X\hat{t}_M + Y\hat{t}_D$

where: $X = \gamma C/(\theta_{KD}\theta_{LD}) + \Pi/(\theta_{KM}\theta_{LM})$ and $Y = \eta/(\theta_{KD}\theta_{LD})$

Under uniform taxes, the "substitution effects" are:

(21) $-(C(\gamma+\eta)/(\theta_{KD}\theta_{LD}) + \Pi/(\theta_{LM}\theta_{KM}))\hat{t}$

where: $\hat{t}$ is as defined in (16b)

Subtracting (21) from (20) we obtain:

(22) $X(\hat{t}_M - \hat{t}) + Y(\hat{t}_D - \hat{t})$

Simple algebraic manipulation of (16a) and (16b) reveals that:

If $(\hat{t}_D-\hat{t}_M) > 0 \Leftrightarrow (\hat{t}_D-\hat{t}) > 0$ and if $(\hat{t}_D-\hat{t}_M) < 0 \Leftrightarrow (\hat{t}_M-\hat{t}) > 0$, it then follows that if $(\hat{t}_D-\hat{t}) > 0$ then $(\hat{t}_M-\hat{t}) < 0$ and vice versa. Thus in equation (22) when $(\hat{t}_D-\hat{t}) > 0$ then $(\hat{t}_M-\hat{t}) < 0$, if in addition the coefficient of $(\hat{t}_M-\hat{t})$ (i.e. X) is greater than the coefficient of $(\hat{t}_D-\hat{t})$ (i.e. Y) then equation (22) will be positive, which implies that the <u>negative</u> "substitution effects" under the differential tax system exceed those under a uniform tax regime. The results are summarised in Table 5.2

TABLE 5.2

	$(t_D - t_M)$	$X \gtrless Y$	The NEGATIVE "Substitution Effects" $t_D \neq t_M$	$\gtrless$	The NEGATIVE "substitution effects" $t_D = t_M$
1.	$(t_D - t_M) > 0$ (i.e. $(t_M - t) < 0$	$X > Y$	"	$>$	"
2.	$(t_D - t_M) > 0$ (i.e. $(t_M - t) < 0$	$X < Y$	"	$<$	"
3.	$(t_D - t_M) < 0$ (i.e. $(t_M - t) > 0$	$X > Y$	"	$<$	"
4.	$(t_D - t_M) < 0$ (i.e. $(t_M - t) > 0$	$X < Y$	"	$>$	"

The overall impact of the tax change is provided by the combined results of Tables 5.1 and 5.2, which are summarised in Table 5.3 below.

TABLE 5.3

	$(t_D - t_M)$	$\varepsilon_D A$	$X > Y$	=	$\hat{r}$ under differential taxes (i.e. $(t_D \neq t_M)$	>	$\hat{r}$ under uniform taxes i.e. $(t_D = t_M)$
1.	>0	>0	X > Y	=	"	?	"
2.	>0	>0	X < Y	=	"	>	"
3.	>0	<0	X > Y	=	"	<	"
4.	>0	<0	X < Y	=	"	?	"
5.	<0	<0	X > Y	=	"	>	"
6.	<0	<0	X < Y	=	"	?	"
7.	<0	>0	X > Y	=	"	?	"
8.	<0	>0	X < Y	=	"	<	"

There appear to be two relevant inferences to be drawn from the ambiguity portrayed in Table 5.3. Firstly, the results suggest that a move towards a uniform tax system will not necessarily serve to dampen the distortions emanating from the "substitution effects", which depend crucially on the coefficients X and Y, and their constituent factor shares and AES. Thus in the absence of further restrictions on the form of the Production function and thence the factor shares and AES, it seems impossible to draw more definitive conclusions about the differential incidence of the tax. However, the model has yielded unambiguous conclusions regarding the "budget incidence" of the property tax. Thus, the spirit of Harberger's conclusions have shown to endure, albeit with minor aberations, the introduction of a three sector hierarchical production process, and a tax on the stock of capital in two sectors. Hence while the intermediate goods were seen to provide additional "escape hatches" for capital thereby increasing opportunities for factor substitutability, a tax on two sectors of the economy necessitated a distinction between the direct tax burden levied on an industry, and the overall tax burden. The eventual incidence of the property tax thus reflected the complex interaction between these and other frequently conflicting forces.

5.3 Empirical Estimates of Incidence:

Perhaps the most significant contribution of the general equilibrium framework lies in its ability to generate numerical estimates of the economy wide distortions resulting from a tax. Hence this section seeks to infer from the above model the overall incidence of the UK non-domestic property tax. The computations are restricted to the year 1978-1979; the period for which the most recent data on input-output coefficients are available. It would, however, seem worth stressing at the outset that the estimates are at best suggestive rather than definitive, partly owing to the strong assumptions invoked to obtain a theoretical solution, and partially as a result of the inadequacies of the available data. The statistics used to estimate the incidence were derived mainly from the National Income Accounts. However, in applying these to a general equilibrium model, it becomes necessary to convert the "Keynesian" macro-aggregates into their "Walrasian" microeconomic components. In the first instance, the general equilibrium models implicitly assume competitive behaviour, as exemplified by the assumptions of perfect commodity and factor markets. Thus in so far as the decision making process in the public sector is guided by political fiat rather than market forces, it becomes necessary to exclude the public sector from the incidence estimates. Appendix 3 outlines the procedure employed to purge the public sector contribution to national income. A further difficulty stems from the assumption that factors of production are homogeneous, thereby implying that in equilibrium returns to mobile factors are equalised. This clearly contradicts the observed wage and rental differentials between sectors, industries and regions. Following Harberger (1962), this impasse is circumvented by defining a physical unit of a factor as that quantity which is capable of generating £ 1/- worth of net-of-tax income. Thus the physical measure of a factor corresponds to the income earned by a factor. Following the procedure outlined in the data appendix the direct shares of capital and labour in the agricultural, manufacturing and distribution sectors in 1978 are presented below in Table 5.4

TABLE 5.4

DIRECT SHARES OF CAPITAL AND LABOUR (1978)

	Agriculture	Manufacturing	Distribution	Total
Capital	1,773	10,570	2,396	14,739
Labour	1,945	77,147	14,163	93,255

Estimates of the gross (i.e. direct and indirect) shares of labour and capital in national income were derived from the data on inter-industry transactions provided in the UK Input-Output Tables (1979), which revealed that 75% of the agricultural sector's output was sold to manufacturing, and hence 25% was assumed to have been sold to the distribution sector. Similarly, 70% of the output of the manufacturing sector was sold through distribution, and 30% directly to final demand. Using these estimates Table 5.5 below presents data for the gross shares of labour and capital in national income.

TABLE 5.5

GROSS SHARES OF CAPITAL AND LABOUR IN NATIONAL INCOME

	Manufacturing	Distribution	Total
Capital	3,570	11,169	14,739
Labour	23,582	69,673	93,255

From the above information the factor shares in the incidence expression (14) can be calculated as shown in Table 5.6

TABLE 5.6

FACTOR SHARES

$\alpha_{KD} = 0.03$	$\alpha_{KM} = 0.12$	$\alpha_{KA} = 0.48$	$K_D^*/K_D^* = 3.1$
$\alpha_{LD} = 0.18$	$\alpha_{LM} = 0.85$	$\alpha_{LA} = 0.52$	$L_D^*/L_D^* = 2.9$
$\alpha_{AD} = 0.01$	$\alpha_{AM} = 0.03$		
$\alpha_{MD} = 0.78$	$\alpha'_{KM} = 0.02$		
$\alpha'_{KD} = 0.01$	$\theta_{KM} = 0.13$		
$\theta_{KD} = 0.14$	$\theta_{LM} = 0.87$		
$\theta_{LD} = 0.86$			

The incidence of the non-domestic property tax is to be estimated using an elasticity measure derived from the algebraic solution in (14). The required elasticity is given by:

(23a) $\varepsilon_{(tD + tM)} = (dr/r) / (dt_D/t_D + dt_M/t_M)$

We derive $\varepsilon_{(tD + tM)}$ from the incidence expression (14) as follows:

Let $X_M = t_M/t_M + t_D$ and $X_D = t_D/t_M + t_D$

then $X_M + X_D = 1$, and hence $\varepsilon_{(tD + tM)}$ can be expressed as the weighted sum of partial elasticities as follows:

(23b) $\varepsilon_{(tD + tM)} = (dr/r) / \{ X_M (dt_M/t_M) + X_D (dt_D/t_D) \}$

But $(dr/r)(dt_M/t_M) = \varepsilon_{tM}$ = the PARTIAL elasticity of capital income with respect to t_M.

Thus,

(23c) $\varepsilon_{(tD + tM)} = \{ \varepsilon_{tM} X_M + \varepsilon_{tD} X_D \}$

From Equation (14) the partial elasticities ε_{tD} and ε_{tM} can readily be deduced, and hence the elasticity of capital income with respect to property taxes is given by:

$$(24) \quad \varepsilon_{(tD+tM)} = \frac{X_M \frac{t_M}{r}\left[\varepsilon_D A \alpha'_{KM}(\alpha_{MD}-1) - \frac{\gamma}{\theta_{KD}\,\theta_{LD}} \cdot C + \frac{\pi}{\theta_{KM}\,\theta_{LM}}\right] + \left[\varepsilon_D A \alpha'_{KD} - \frac{\eta}{\theta_{KD}\,\theta_{LD}} \cdot C\right] X_D \frac{t_D}{r}}{\varepsilon_D A\left(\theta_{KM} - \theta_{KD}\right) + \frac{\beta}{\theta_{LD}\,\theta_{KD}} \cdot C + \frac{\rho}{\theta_{KM}\,\theta_{LM}}}$$

The absence of data on the AES renders it necessary to assume "plausible" values for the elasticities in the equation (24). Thus in Table 5.7 Row 1 reveals the value of $\varepsilon_{(tD+tM)}$ under Cobb-Douglas assumptions. Specifically, it is assumed that (a) all intermediate goods are used in fixed proportions, hence their AES are zero, and (b) all other elasticities in production and demand are assumed to equal unity. Harberger (1962) formally proved that in this situation "capital will bear precisely the full burden of the tax". Heuristically, this result can be seen to derive from the peculiar property of a unitary elasticity of substitution production function (see Silberberg 1981), which ensures that the total payments to factors of production are unaffected by the substitution of one factor for another. Thus, if the post-tax returns to labour are to remain constant, the burden of the tax must fall entirely on capital. Hence the value of $\varepsilon_{(tD+tM)} = -0.107$ in the Cobb-Douglas case implies that capital bears a 100% of the tax burden. Row 1 will be used as a benchmark for comparison with other equilibria.

TABLE 5.7

INCIDENCE ESTIMATES ($\mathcal{E}_{tD + tM}$)

Value of σ	V = -1	V = 0	V = -1.5
1. $\sigma^A_{KL} = \sigma^M_{KL} = \sigma^D_{KL} = 1$ all other $\sigma_{ij} = 0.000001$	-0.107	-0.108	-0.107
2. All $\sigma^z_{ij} = 1$	-0.09	-0.09	-0.09
3. All $\sigma^D_{ij} = 0.00001$ all other $\sigma^z_{ij} = 1$	-0.107	-0.106	-0.107
4. All $\sigma^M_{ij} = 0.00001$ all other $\sigma^z_{ij} = 1$	-0.013	-0.011	-0.013
5. All $\sigma^A_{ij} = 0.00001$ all other $\sigma^z_{ij} = 1$	-0.097	-0.096	-0.096
6. $\sigma^D_{MK} = \sigma^D_{AK} = \sigma^M_{AK} = 0.00001$ all other $\sigma^z_{ij} = 1$	-0.1	-0.101	-0.1
7. $\sigma^D_{KL} = \sigma^M_{KL} = \sigma^A_{KL} = 0.00001$ all other $\sigma^z_{ij} = 1$	-0.02	-0.02	-0.02

The results in row 2 are derived under the assumption that all AES in equation (24) are unity, and thus $\mathcal{E}_{(tD + tM)}$ is seen to fall to -0.09 implying that capital bears 86% of the tax burden. In contrast, in row 3, it is assumed that all AES in sector D are approximately zero, while those in other sectors are unity. (Specifically, it is assumed that the AES are 0.00001 to ensure that the stability conditions outlined in Section 2 are satisfied). Once again, capital bears a 100% of the tax burden. In rows 4 and 5, the AES in sectors M and A are assumed to be zero respectively, and it can be seen that in the former case, capital bears a mere 13% of the burden, and in the latter 92% of the tax. When AES in sector A are zero, it becomes impossbile for A, the untaxed sector, to absorb the capital released from the taxed sectors and thus the tax burden rises to 92%. In contrast, by constraining the AES in M to zero, opportunities for substituting untaxed factors for capital are substantially diminished, thereby lowering the burden of the tax on capital. A comparison of rows 3 and 4 reveals that factor substitutability in sector M is of far greater significance than in sector D. This result appears to derive from the location of sector M in the production hierarchy, which allows the impact of factor substitutability and taxes to be transmitted through to sector D.

In Row 6, the AES between capital (the taxed factor), and all intermediate goods are assumed to be zero, and $\varepsilon_{tD} + _{tM}$ equals -0.10 implying that capital bears 95% of the tax burden. In contrast, in row 7, the AES between "primary" factors (i.e. labour and capital) are assumed to be zero, and $\varepsilon_{tD} + _{tM}$ falls to approximately -0.02 implying that capital suffers only 19% of the tax burden.

Columns 2 and 3 of Table 5.7 reveals the consequence of varying the elasticity of substitution in demand (denoted V) between the final goods D and M from 0 to 1.5. The elasticity of substitution in demand is related to the elasticity of demand via the following formula (see Harberger 1962): $\varepsilon_D = V\left(\frac{M}{D+M}\right)$. In the main, the table reveals that the incidence estimates are unaffected by the change, thereby revealing the insensitivity of $\varepsilon_{(tD + tM)}$ to variations in the elasticity of demand.

Finally, Table 5.8 presents the results of introducing complementarity between factor inputs. The cases considered satisfy the stability conditions outlined in Section 2 above. However, complementarity between labour and capital, rather unrealistically, implies that increases in the rental on capital induce decreases in the demand for labour, and this case is consequently ignored in the foregoing analysis.

TABLE 5.8

	V = -1
1. $\sigma_{MK} = \sigma_{LA} = \sigma_{AK} = -1$ all other $\sigma_{ij} = 1$	-0.118
2. $\sigma_{MK} = \sigma_{LA} = \sigma_{AA} = -1$ all other $\sigma_{ij} = 1$	-0.121
3. $\sigma_{AK} = \sigma_{AM} = \sigma_{AK} = -1$ all other $\sigma_{ij} = 1$	-0.094
4. $\sigma_{AK} = \sigma_{AM} = \sigma_{AL} = -1$ all other $\sigma_{ij} = 1$	-0.101

In general Table 5.8 appears to reveal that in sector D, complementarity between M and K on the one hand, and L and A on the other, tend to increase the burden on capital, while complementarity between A and K, and A and M lower the burden. Similarly, in sector M complementarity between A and L raises the tax burden borne by capital, when compared with complementarity between A and K.

Perhaps the most definitive conclusion to emerge from the numerical simulations stems from the crucial role played by the location of a multi-sector tax in a hierarchical production economy. The exercise reveals that the overall distortionary impact of a property tax levied on intermediate goods producers, exceeds the deleterious consequences of a tax on the final goods sectors. Overall, the empirical results appear to suggest that over a large range of not inplausible situations, capital bears much of the property tax burden.

APPENDIX 1

DERIVATION OF $\hat{a}_{iJ}$ and $\hat{Q}_{iJ}$

From equation 4a, we know that:

(1) $a_{LD} = a_{LD}\,(w,\ r,\ P_{M},\ P_{A},\ t_{D})$

Differentiating totally:

$$(2)\quad \hat{a}_{LD} = \frac{\partial a_{LD}}{\partial w} \cdot \frac{dw}{w} \cdot \frac{w}{a_{LD}} + \frac{\partial a_{LD}}{\partial (r+t_D)} \cdot \frac{(r+t_D)}{a_{LD}} + \frac{\partial a_{LD}}{\partial P_M} \cdot \frac{dP_M}{P_M}\ \frac{P_M}{a_{LD}} + \frac{a_{LD}}{\partial P_A}\ \frac{dP_A}{P_A}\ \frac{P_A}{a_{LD}}$$

Now define Allen partial elasticities of substitution (i.e. AES) between factor i and factor J in sector D as:

$$\alpha_{iD}\, \sigma^{D}_{iJ} = \frac{\partial a_{JD}}{\partial P_i} \cdot \frac{P_i}{a_{JD}}$$

Applying the AES formula to (2) yields:

$$(3)\quad \hat{a}_{LD} = \alpha_{LD} \cdot \sigma^{D}_{LL} . \hat{w} + \alpha_{KD} \cdot \sigma^{D}_{LK} \cdot (\hat{r} + \hat{t}_D) + \alpha_{MD} \cdot \sigma^{D}_{LM} \cdot \hat{P}_M + \alpha_{AD} \cdot \sigma^{D}_{AL} \cdot \hat{P}_A$$

Allen (1969) has shown that:

$$(4)\quad \alpha_{LD} \cdot \sigma^{D}_{LL} + \alpha_{KD} \cdot \sigma^{D}_{LK} + \alpha_{MD} \cdot \sigma^{D}_{LM} + \alpha_{AD} \cdot \sigma^{D}_{AL} = 0$$

In addition from (8b) and (8c) we have:

$$(8b)\quad \alpha_{LM}\hat{w} + \alpha_{KM} \cdot (\hat{r} + \hat{t}_M) + \alpha_{AM} \cdot P_A = P_M$$

$$(8c)\quad \alpha_{LA} . \hat{w} + \alpha_{KA} . \hat{r} = \hat{P}_A$$

We know that $\hat{w} = 0$, since w is the numeraire.

Hence substituting (8b) and (8c) into (3) yields:

$$\hat{a}_{LD} = \hat{r}\,[\,\alpha_{KD}\cdot\sigma^{\mathcal{D}}_{LL} + \alpha_{MD}\cdot\sigma^{\mathcal{D}}_{ML}\cdot(\,\alpha_{KM} + \alpha_{AM}\quad\alpha_{KA}\,) + \alpha_{AD}\cdot\,\alpha_{AD}\cdot\alpha_{KA}\cdot\sigma^{\mathcal{D}}_{AL}$$

$$+\ \hat{t}_{M}\cdot[\,\alpha_{M\mathcal{D}}\quad\cdot\alpha_{KM}\cdot\sigma^{\mathcal{D}}_{ML}] + \hat{t}_{D}\ [\,\alpha_{KD}\cdot\sigma^{\mathcal{D}}_{KL}]$$

Derivation of $\hat{a}_{KD}$:

From (4a) we have:

(1) $\hat{a}_{KD} = a_{KD}(\,w, r, P_D, P_A, t_D)$

Defined in terms of AES this yields:

(2) $\hat{a}_{KD} = \alpha_{LD}\cdot\sigma^{\mathcal{D}}_{LL}\cdot\hat{w} + \alpha_{KD}\ \cdot\sigma^{\mathcal{D}}_{KK}\cdot(\hat{r} + \hat{t}_D) + \alpha_{MD}\,\sigma^{\mathcal{D}}_{MK}\cdot\hat{P}_M$

$$+\quad \alpha_{AD}\cdot\sigma^{\mathcal{D}}_{AK}\cdot\hat{P}_A$$

In addition w is the numeraire, and Allen (1969) proved that:

(3) $\alpha_{LD}\cdot\sigma^{\mathcal{D}}_{KL} + \alpha_{KD}\cdot\sigma^{\mathcal{D}}_{KK} + \alpha_{MD}\,\sigma^{\mathcal{D}}_{MK} + \alpha_{AD}\cdot\sigma^{\mathcal{D}}_{AK} = 0$

We know that:

(8b) $\hat{P}_M = \alpha_{LM}\cdot\hat{w} + \alpha_{KM}\cdot(\hat{r} + \hat{t}_M) + \alpha_{AM}\cdot\hat{P}_A$

(8c) $\hat{P}_A = \alpha_{LA}\cdot\hat{w} + \alpha_{KA}\cdot\hat{r}$

Substituting into (2) and using (3):

$$\hat{a}_{KD} = -\ \hat{r}\cdot[\alpha_{LD}\cdot\sigma^{\mathcal{D}}_{KL} + \alpha_{MD}\cdot\sigma^{\mathcal{D}}_{MK}\cdot(\,\alpha_{LM} + \alpha_{AM}\quad\alpha_{LA}\,) + \alpha_{AD}\cdot\alpha_{LA}\cdot\ \sigma^{\mathcal{D}}_{AK}\,]$$

$$-\,\hat{t}_{D}\ [\,\alpha_{LD}\cdot\sigma^{\mathcal{D}}_{LL} + \alpha_{MD}\cdot\sigma^{\mathcal{D}}_{MK} + \alpha_{AD}\cdot\sigma^{\mathcal{D}}_{AK}\,]$$

$$+\ \ \hat{t}_{M}\cdot[\,\alpha_{MD}\cdot\alpha_{KM}\cdot\sigma^{\mathcal{D}}_{MK}\,]$$

Derivation of $\hat{a}_{AD}$:

(1) $$\hat{a}_{AD} = \alpha_{LD} \cdot \sigma^{D}_{AL} + \alpha_{KD} \cdot \sigma^{D}_{AK} (\hat{r} + \hat{t}_D) + \alpha_{MD} \cdot \sigma^{D}_{MA} \cdot \hat{P}_M + \alpha_{AD} \cdot \sigma^{D}_{AA} \cdot \hat{P}_A$$

We know that:

(2) $$\alpha_{AD} \cdot \sigma^{D}_{AA} + \alpha_{LD} \cdot \sigma^{D}_{AL} + \alpha_{KD} \cdot \sigma^{D}_{AK} + \alpha_{MD} \cdot \sigma^{D}_{MA} = 0$$

and

(8b) $$P_M = \alpha_{LM} \cdot \hat{w} + \alpha_{KM} \cdot (\hat{r} + \hat{t}_M) + \alpha_{AM} \cdot \hat{P}_A$$

(8c) $$\hat{P}_A = \alpha_{LA} \cdot \hat{w} + \alpha_{KA} \cdot \hat{r}$$

Substituting in (1) and setting $\hat{w} = 0$:

$$\hat{a}_{AD} = -\hat{r} \cdot [\alpha_{KD} \cdot \alpha_{LA} \cdot \sigma^{D}_{AK} + \alpha_{MD} \cdot \sigma^{D}_{MA} \cdot (\alpha_{LM} + \alpha_{AM} \cdot \alpha_{KA} - \alpha_{KA})$$

$$- \alpha_{LD} \cdot \alpha_{KA} \sigma^{D}_{AL}] + \hat{t}_M [\alpha_{MD} \cdot \alpha_{KM} \cdot \sigma^{D}_{MA}] + \hat{t}_D \cdot \alpha_{KD} \cdot \sigma^{D}_{AK}$$

Derivation of $\hat{a}_{MD}$:

(1) $$\hat{a}_{MD} = \alpha_{LD} \cdot \sigma^{D}_{LM} \hat{w} + \alpha_{KD} \cdot \sigma^{D}_{KM} (\hat{r} + \hat{t}_D) + \alpha_{MD} \cdot \sigma^{D}_{MM} \cdot \hat{P}_M + \alpha_{AD} \cdot \sigma^{D}_{MA} \cdot \hat{P}_A$$

We know that:

$$\alpha_{MD} \cdot \sigma^{D}_{MM} + \alpha_{LD} \cdot \sigma^{D}_{LM} + \alpha_{KD} \cdot \sigma^{D}_{KM} + \alpha_{MD} \cdot \sigma^{D}_{MM} = 0$$

and

(8b) $$\hat{P}_M = \alpha_{LM} \cdot \hat{w} + \alpha_{KM} \cdot (\hat{r} + \hat{t}_M) + \alpha_{AM} \cdot \hat{P}_A$$

(8c) $$\hat{P}_A = \alpha_{LA} \cdot \hat{w} + \alpha_{KA} \cdot \hat{r}$$

Substituting in (1) and setting $\hat{w} = 0$:

$$\hat{a}_{MD} = -\hat{r}.[\alpha_{KD}.\sigma^{D}_{KM}.(\alpha_{LM}+\alpha_{AM}.\alpha_{LA}) - \alpha_{LD}.\sigma^{D}_{LM}.(1-\alpha_{LM}-\alpha_{AM}.\alpha_{LA})$$

$$-\alpha_{AD}.\sigma^{D}_{MA}.(\alpha_{KM}+\alpha_{AM}\ \alpha_{KM}-\alpha_{KA})]$$

$$-\hat{t}_{M}.\ [\alpha_{KM}.\alpha_{LD}.\sigma^{D}_{LM}+\alpha_{KM}.\ \alpha_{KD}.\sigma^{D}_{MK}+\alpha_{KM}.\ \alpha_{AD}.\sigma^{D}_{MA}]$$

$$+\ \hat{t}_{D}\ [\alpha_{KD}.\sigma^{D}_{MK}]$$

Sector M

Derivation of $\hat{a}_{LM}$:

(1) $a_{LM} = a_{LM}.(r, w, P_A, t_M)$

(2) $\therefore\ \hat{a}_{LM} = \alpha_{LM}.\sigma^{M}_{LL}.\ \hat{w} + \alpha_{KM}.\sigma^{M}_{KL}(\hat{r}+\hat{t}_M) + \alpha_{AM}.\sigma^{M}_{AL}.\hat{P}_A$

We know that $\hat{w} = 0$ and $\hat{P}_A = \alpha_{LA}.\ \hat{w} + \alpha_{KA}.\hat{r}$

Substituting in (2):

$$\hat{a}_{LM} = \hat{r}.[\alpha_{KM}.\sigma^{M}_{KL} + \alpha_{AM}.\alpha_{KA}.\sigma^{M}_{AL}] + \hat{t}_M.[\alpha_{KM}.\sigma^{M}_{KL}]$$

Derivation of $\hat{a}_{KM}$:

(1) $a_{KM} = a_{KM}.(r, w, P_A, t_M)$

(2) $\therefore\ \hat{a}_{KM} = \alpha_{LM}.\sigma^{M}_{LK}.\ \hat{w} + \alpha_{KM}.\sigma^{M}_{KK}(\hat{r}+\hat{t}_M) + \alpha_{AM}.\sigma^{M}_{AK}.\hat{P}_A$

Since $\alpha_{LM}.\sigma^{M}_{LK} + \alpha_{KM}.\sigma^{M}_{KK} + \alpha_{AM}.\sigma^{M}_{AK}. = 0$

and $\hat{w} = 0$, and $\hat{P}_A = \alpha_{LA}.\ \hat{w} + \alpha_{KA}.\hat{r}$, then

Substituting in (2):

(3) $\hat{a}_{KM} = -\hat{r}.[\alpha_{LM}.\sigma^{M}_{LK} + \alpha_{AM}.\ \sigma^{M}_{AK}\ (1-\alpha_{KA})]$

$$-\hat{t}_M.[\alpha_{LM}.\sigma^{M}_{LK} + \alpha_{AM}.\sigma^{M}_{AK}]$$

However, since $\alpha_{LA} . \hat{w} + \alpha_{KA} . \hat{r} = \hat{P}_A$ it follows that:

$$\alpha_{LA} + \alpha_{KA} = 1$$

$$\therefore (1 - \alpha_{KA}) = \alpha_{LA}$$

Substituting in (3):

$$\hat{a}_{KM} = - \hat{r} . [\alpha_{LM} . \sigma^{M}_{LK} + \alpha_{AM} . \sigma_{LA} \sigma^{M}_{AK}]$$

$$- \hat{t}_M . [\alpha_{LM} . \sigma^{M}_{LK} + \alpha_{AM} . \sigma^{M}_{AK}]$$

DERIVATION OF $\hat{a}_{AM}$:

(1) $$\hat{a}_{AM} = a_{LM} . \sigma^{M}_{LA} . \hat{w} + \alpha_{KM} . \sigma^{M}_{KA} (\hat{r} + \hat{t}_M) + \alpha_{AM} . \sigma^{M}_{AA} . \hat{P}_A$$

Since $\alpha_{LM} . \sigma^{M}_{LA} + \alpha_{KM} . \sigma^{M}_{KA} + \alpha_{AM} . \sigma^{M}_{AA} . = 0$

and $\hat{w} = 0$, and $\hat{P}_A = \alpha_{LA} . \hat{w} + \alpha_{KA} . \hat{r}$, then

Substituting in (1):

(3) $$\hat{a}_{AM} = \hat{r} . [\alpha_{KM} . \sigma^{M}_{KA} (1 - \alpha_{KA})] - \alpha_{LM} . \alpha_{KA} . \sigma^{M}_{KA}]$$

$$+ [\alpha_{KM} . \sigma^{M}_{KA}] \hat{t}_M$$

Since $\alpha_{LA} = (1 - \alpha_{KA})$:

$$\hat{a}_{AM} = - \hat{r} . [\alpha_{KM} . \alpha_{LA} . \sigma^{M}_{KA} - \alpha_{LM} . \alpha_{KA} . \sigma^{M}_{LA}]$$

$$+ [\alpha_{KM} . \sigma^{M}_{KA}] \hat{t}_M$$

Sector A:

Derivation of $\hat{a}_{LA}$:

(1) $a_{LA} = a_{LA}\ (r, w)$

(2) $\therefore\ \hat{a}_{LA} = \alpha_{LA} \cdot \sigma^{A}_{LL} \cdot \hat{w} + \alpha_{KA} \cdot \sigma^{A}_{KL} \cdot \hat{r}$

Since $\hat{w} = 0$, then

$\hat{a}_{LA} = \alpha_{KA} \cdot \hat{r}$

Derivation of $\hat{a}_{KA}$

(1) $\hat{a}_{KA} = \alpha_{LA} \cdot \sigma^{A}_{LK} \cdot \hat{w} + \alpha_{KA} \cdot \sigma^{A}_{KK} \cdot \hat{r}$

Since $\alpha_{LA} \cdot \sigma^{A}_{LK} + \alpha_{KA} \cdot \sigma^{A}_{KK} = 0$, then substituting in (1):

$\hat{a}_{KA} = -\alpha_{LA} \cdot \sigma^{A}_{LK} \cdot \hat{r}$

Derivation of $\hat{Q}_{ij}$:

In equation (2a) of section 5.2 we defined:

(1) $Q_{LM} = \alpha_{LA} \cdot a_{AM} + a_{LM}$

Totally differentiating and manipulating this result yields: (See Bhatia (1981)):

(2) $$\hat{Q}_{LM} = \frac{\alpha_{LM} \cdot \hat{a}_{LM} + \alpha_{LA} \cdot \alpha_{AM} \cdot (\hat{a}_{LA} + \hat{a}_{AM})}{\theta_{LM}}$$

Substituting for $\hat{a}_{LM}$, $\hat{a}_{LA}$ and $\hat{a}_{AM}$ from above and rearranging

we obtain:

$$Q_{LM} = \frac{(\rho \hat{r} + \Pi \hat{t}_M)}{\theta_{LM}}$$

where:

$$\rho = [\alpha_{LM} \cdot \alpha_{KM} \cdot \sigma_{KL}^{M} + \alpha_{LM} \cdot \alpha_{KA}^{2}\ \alpha_{AM} \cdot \sigma_{AL}^{M} + \alpha_{LA} \cdot \alpha_{AM} \cdot \alpha_{KM} \cdot \sigma_{KA}^{M}$$

$$+ \alpha_{LA} \cdot \alpha_{AM} \cdot \alpha_{KA} \cdot \sigma_{KL}^{A}]$$

$$\Pi = [\alpha_{LM} \cdot \alpha_{KM} \cdot \sigma_{KL}^{M} + \alpha_{LA} \cdot \alpha_{AM} \cdot \alpha_{KM} \cdot \sigma_{KA}^{M}]$$

The other $\hat{Q}_{iJ}$ terms are derived in an analogous manner and defined in equation (12) of section 5.2.

APPENDIX 2

THE STABILITY CONDITION

Allen (1969) proved that the weighted sum of the AES in a linearly homogenous production function equals zero i.e. in sector D we have:

I $$\alpha_{LD}\sigma^{D}_{LL} + \alpha_{KD}\sigma^{D}_{KL} + \alpha_{MD}\sigma^{D}_{ML} + \alpha_{AD}\sigma^{D}_{AL} = 0$$

II $$\alpha_{LD}\sigma^{D}_{KL} \quad \alpha_{KD}\sigma^{D}_{KK} + \alpha_{MD}\sigma^{D}_{KM} + \alpha_{AD}\sigma^{D}_{AK} = 0$$

III $$\alpha_{LD}\sigma^{D}_{ML} \quad \alpha_{KD}\sigma^{D}_{KM} + \alpha_{MD}\sigma^{D}_{MM} + \alpha_{AD}\sigma^{D}_{AM} = 0$$

IV $$\alpha_{LD}\sigma^{D}_{AL} \quad \alpha_{KD}\sigma^{D}_{AK} + \alpha_{MD}\sigma^{D}_{AM} + \alpha_{AD}\sigma^{D}_{AA} = 0$$

Each own AES is negative. Thus in the above system of equations, the terms in the leading diagonal are negative. If the above conditions are to be satisfied then the positive AES in each row must be more numerous or important than the negative AES. In particular, all the AES in each row cannot be negative. Thus, for example, if $\sigma^{D}_{KL} < 0$ and $\sigma^{D}_{ML} < 0$ then $\sigma^{D}_{AL} > 0$. If in addition $\sigma^{D}_{KM} < 0$ then $\sigma^{D}_{AK} > 0$ and $\sigma^{D}_{AM} > 0$. On the other hand with $\sigma^{D}_{KL} < 0$, $\sigma^{D}_{ML} < 0$, σ^{D}_{AM} and $\sigma^{D}_{AK} < 0$ we must have $\sigma^{D}_{AL} > 0$, $\sigma^{D}_{KM} > 0$. It follows that the above conditions are satisfied either if all AES are positive, or specified combinations are negative so that each row has at least one positive AES.

APPENDIX 3

CALCULATION OF LABOUR INCOME AND CAPITAL INCOME

Labour Income:

Private sector labour income is calculated as income from employment, and the component of income from self employment which accrues to labour. Income from employment for each industry is taken from the GDP accounts in National Income and Expenditure (NIE hereafter). To obtain data for the private sector alone, a correction must be made. For this purpose, employment data by industry group for central government, local authorities, public corporations and the private sector, published in Economic Trends 1980 was used. This data was converted to an industrial basis consistent with the disaggregation employed in the National Income and Expenditure Accounts.

Total income generated by self employed persons and partnerships is published in the NIE accounts. However, it becomes necessary to disaggregate these statistics by industry group. For this purpose, Inland Revenue Statistics on net income by self employed persons and partnerships was used. The industry wise data thus obtained was divided into returns to labour and capital using average weekly income published in the New Earnings Survey. The self employment return to labour is computed as the income which self employed persons would have received had they been employees receiving the average income for their industry.

Capital Income:

Capital Income originating in the private sector is taken to comprise trading profits, rental income, the component of income accruing to self employed persons which represents a return to capital and capital gains/losses.

Data on trading profits (including rental income) are taken from the NIE accounts. Data on capital gains on an industrial basis are not available. However, to the extent that retentions are included in the data on trading profits, and these represent future capital gains, some account is taken of this factor. The method employed to calculate the proportion of self employed income accruing to capital was discussed above.

Division of the Economy into sectors:

The NIE Accounts divide the economy into the following industries:

1. Agriculture
2. Forestry, Fishing
3. Mining, Quarrying and Manufacture
4. Gas, Water and Electricity
5. Transport and Communications
6. Other Services
7. Insurance, Banking and Finance

8 Distribution

It was assumed that the "agricultural sector" comprised of the rate exempt sectors which are agriculture, forestry and fishing. Industries 2 - 7 were defined as the "manufacturing sector", and 8 the "distribution sector".

Calculation of Effective Property Tax Rates Paid by Each Sector:

Payments of "rates" are difficult to assign by industry group. The method used is to take assessments of rateable values for 1978 by type of structure and assign these to industrial groupings. The rateable values were assigned to each industry using capital stock data on buildings published in NIE Accounts. This data was used as weights for assigning each year's rate payments given in the aggregate in NIE Accounts. To purge the public sector from these estimates, Economic Trends data on public sector capital stock was used as weights to scale down the figures.

NOTES TO CHAPTER FIVE

1. There are, however, two notable exceptions: Whalley (1975) and Piggott and Whalley (1985) in a study of the distortionary impact of the UK tax system, include in their general equilibrium models, property taxes together with other major factor taxes. Their computations thus describe the distortionary impact of the entire tax system rather than property taxes in isolation. Hence a number of "new-view" conclusions have remained largely unestimated. Specifically, there have been no previous attempts to compute the economy-wide incidence of property taxes per se. This is the main purpose of the current endeavour. The approach employed here, however, differs considerably from that of Whalley (1975) and Piggott and Whalley (1985). These authors have articulated elaborate general equilibrium models and obtained solutions employing Scarf's algorithm. The objective of this exercise is much more modest, both in terms of size and computational techniques. The method adopted here draws mainly from the literature on corporation taxes, and in particular the work of Harberger (1962) and Bhatia (1981).

2. The paucity of data on land rents in the manufacturing and distribution sectors has rendered it necessary to assume that "capital" as defined here includes land as a factor of production.

3. Thus, for example, if an industry is labour intensive in physical terms, and the tax on labour is excessively high, then it is possible that in terms of income shares labour receives a relatively smaller fraction of the industry's income. That is $|\lambda|$ and $|\Theta|$ will have opposite signs.

4. In essence, this result reflects the fact that the untaxed agricultural sector acts as a "reserve", which absorbs factors released from the taxed sectors.

CHAPTER SIX

METHODOLOGICAL ISSUES

"It cannot be that axioms established by argumentation can suffice for the discovery of new works, since the sublety of nature is greater many times over than the subtlety of argument".

Bacon, Novum Organum I.14 (translation Ellis and Spedding)

Introduction

This Chapter deals with the main methodological difficulties encountered in measuring the incidence of a broad based tax such as the property tax. Section 6.1 thus introduces a coherent framework for comparing the different measures of incidence, while the following three sections discuss the assumptions underlying the measures based on the income distribution approach, the general equilibrium framework and econometric techniques. It is suggested that the income distribution and general equilibrium approaches rely on highly restrictive assumptions which are imposed on the data rather than empirically verified, and therefore appear to be of questionable value. In contrast, the econometric approach provides a framework for both testing existing incidence theories and generating data consistent estimates of tax shifting. Section 6.4 therefore discusses the pioneering Krzyzaniak and Musgrave (1963) econometric study of corporation tax incidence, and its methodological implications. The final section briefly reviews an approach to dynamic specification due to Sargan (1964) and Hendry (1983), which appears to overcome the major econometric inadequacies of the Krzyzaniak and Musgrave (K-M hereafter) study.

6.1 An Operational Definition of Tax Incidence

The deficiencies of the various techniques used to measure tax incidence appear to stem from the difficulties involved in defining the incidence of a tax. Rather than survey the voluminous literature surrounding the precise meaning of this term, the definition provided in Musgrave's (1959) widely accepted work can be used to discuss certain methodological issues within a coherent framework. Musgrave distinguishes between the incidence, output and resource transfer effects of taxation. The incidence effects are defined as " . . . the resulting change in the distribution of income available for private use". The incidence of a tax is then primarily concerned with its effect on equity, and in particular upon the distribution of income defined by size brackets. In contrast, the resource transfer effects refer to the transfer of resources from private to public use at a given level of employment, while the output effects are concerned with the change in output or real income associated with a tax, given the distribution of income.

There appear to be three central points implied by Musgrave's definition of incidence. First, the definition suggests that incidence is to be measured with reference to the distribution of income in the absence of a tax. Hence, as in most policy studies, it becomes necessary to compare the prevailing distribution of income with a hypothetical state that would have existed if the tax had not been levied. More formally, let Y_H denote the hypothetical distribution that would have existed in the absence of the tax, and Y_A the actual distribution of income. A measure of incidence is then given by the difference between the two values, i.e.

(1) $(Y_A - Y_H) = f(t)$

where:

t = a tax under consideration

f = functional relation to be specified

Y_H being hypothetical, cannot of course be observed, and must therefore be derived or estimated using quantitative techniques. The various procedures used to measure tax incidence differ in two important respects: (a) in the techniques used to infer the hypothetical distribution of income, and (b) the specification of the functional form f ( ).

It is perhaps worth noting parathetically, that the pre-tax distribution of income is only one of several possible points of comparison which could be applied. A number of alternative hypothetical states have been proposed in the literature[1], and the usefulness of any of these clearly depend on considerations of analytical tractability, and the policy issue under investigation.

Musgrave's definition further appears to suggest that it is nccessary to consider the entire adjustment process induced by a tax. This therefore implies that a full general equilibrium assessment of the distributional changes is required. Thus Shoup (1969) has shown that if an estimate of incidence is confined to the taxed sectors (i.e. partial equilibrium analysis), it must be assumed that (a) the elasticity of substitution in production between factors of production in the taxed and untaxed sectors are zero, and (b) there are no close substitutes for the products of the taxed sector. The first assumption serves to ensure that supply conditions in the untaxed sectors are unaffected, while the second confines tax induced demand changes to the taxed sector. In general, neither condition is likely to be satisfied by a broad based tax (such as the non-domestic property tax) which covers a large section of the economy. Hence, a general equilibrium measure of incidence, or some quantitative approximation to it, is required if the analysis is not to yield incidence estimates which are either appreciably incomplete or incorrect.

Finally, it would seem worth noting that Musgrave's demarcation between the output and incidence effects of a tax, are only valid if the economy is at full employment. It will be recalled that in the Post Keynesian framework the level and distribution of income are functionally related. Thus taxes which alter the distribution of income, change the level of output[2]. The distinction between the output and incidence effects therefore appears to be of questionable value in the seemingly more general Keynesian system which subsumes full employment as a special case.

6.2 The Income Distribution Approach

Perhaps the oldest and most popular quantitative exercise in public finance has been to distribute tax burdens by income class. Households are categorised into differential income groups, and the resulting division is deemed to provide a measure of the hypothetical distribution of income before considering the effects of taxes. In the next stage the total tax bill is allocated to the different income groups under a variety of assumptions regarding tax shifting. It is typically assumed that direct taxes fall on their legal base, while indirect taxes are shifted forward into prices. The measure of incidence is then based on a comparison of the "pre-tax" and "post-tax" distribution of income in each group.

In the UK, these studies have typically treated the property tax as an indirect tax which is fully shifted into prices. This assumption is employed by the Central Statistical Office in its official computations, and used by Mair (1974) in a study of the distributive effects of non-domestic property taxes. Not suprisingly, the property tax is found to be highly regressive in its impact, falling more heavily on lower income groups who consume a larger proportion of their gross incomes.

In contrast, the North American studies have focused on the issue of property tax exporting (i.e. the extent to which a particular jurisdiction exports its tax bill to firms and households located elsewhere). The most comprehensive study was undertaken by McLure (1960) who found that 25% of all local and state taxes were borne by non-residents.

However, the income-distribution approach has been heavily criticised by a number of authors (see Interalia Prest (1955) (1968), Shome (1985), Peacock and Wiseman (1968)). The most far reaching criticisms are due to Prest (1955) who, with customary clarity and incisiveness, has shown the assumptions implicit in these calculations to be inconsistent and contradictory. The studies allocate the total tax bill to different income groups on the assumption that the total level of income is held constant. For income to remain constant, it must therefore be assumed that factor supplies are perfectly inelastic. Consider, for example, a study of the incidence of a general property tax which is assumed to be shifted fully into prices. For prices to rise by the amount of the tax, the supply of goods must be perfectly elastic[3]. However, a perfectly elastic supply of goods cannot be produced with a completely inelastic supply of factors. Hence, the assumption of full forward shifting requires conditions which contradict the initial assumptions on which the calculations are based. It follows that the income-distribution studies use assumptions which are inappropriate for calculating the incidence of a broad based tax.

A further problem relates to the measure of the hypothetical pre-tax distribution of income. It will be recalled that the incidence measure is based on a comparison of gross incomes with post-tax incomes. Gross income is therefore seen to provide a measure of the hypothetical pre-tax distribution. Hence, it is implicitly assumed that the distribution of income before the tax levied is independent of the tax system. The problem is perhaps best illustrated with reference to equation (1). Incidence was formally defined as:

(1) $(Y_A - Y_H) = f(t)$

The actual post-tax distribution of income (Y_A) is calculated by allocating the total tax bill to different groups under a variety of shifting assumptions. In contrast, gross incomes are seen to provide a measure of the hypothetical distribution in the absence of a tax (i.e. Y_H). Consider for simplicity the limiting case where the tax falls entirely on its legal base. Equation (1) simplifies to:

(2) $(Y_A - Y_H) = t$

Rearranging:

(3) $Y_H = Y_A + t$

That is, hypothetical pre-tax incomes are assumed to be independent of taxes. In general, the introduction (or abolition) of any broad based tax will induce changes in relative prices, factor rewards and output as the economy adjusts to a new equilibrium. Thus, the assumptions underlying the income distribution studies seem difficult to justify[4] and inappropriate for assessing the incidence of a tax with broad coverage such as the non-domestic property tax.

6.3 The General Equilibrium Approach

Tax incidence in the general equilibrium approach is calculated by comparing the existing distribution of income to an algebraically derived hypothetical distribution that would have prevailed in the absence of the tax. Central to this approach is the notion that the economy is in a static equilibrium which can be adequately described by the simplifying assumptions of the marginal productivity theory of distribution. By employing the linearisation and approximation techniques pioneered by Harberger (see Chapters 2 and 5), the models generate an algebraic expression which can be numerically solved for the change in factor rewards due to the introduction of a tax. Neither the model or the assumed functional forms are statistically estimated. The analytical expression for tax incidence is thus *imposed on the data rather than statistically inferred.* It would seem useful to illustrate this issue by considering the hierarchical general equilibrium model desribed in Chapter 5. Using the standard assumptions of a static closed economy with fixed factor supplies, the numerical simulations revealed that capital bears much of the tax burden. However, if the economy is viewed as a price taker, participating in international capital markets (i.e. the "small country" assumption of international trade theory), the algebraic solution and the conclusions would necessarily change. In this case, it would be impossible for capital to bear the tax burden, since the tax would simply induce an outmigration of capital to lower taxed countries until the net returns equal that prevailing on world markets. The assumptions of the model can thus powerfully affect the numerical estimates of tax incidence.

The fundamental problem stems from the fact that there are several competing models proposed in the literature (see Chapters 2 and 3), each yielding a different measure of property tax incidence. General equilibrium analysis does not provide a way of discriminating between models, for no statistical testing is involved. Thus, while a uniform non-domestic property tax is non-distortionary in a static model, it is partly shifted if the taxed sector is oligopolistic, and becomes distortionary in a growth context due to the effect on savings. Conflicting theories clearly cannot be reconciled by imposing data on pre-specified algebraic expressions of tax incidence.

A further difficulty stems from the sensitivity of the results to the elasticity values in the incidence expression. In the absence of elasticity estimates, it is common to assume "plausible" values for these parameters. Typically, these elasticities are varied in an attempt to test the sensitivity of the results to a particular parameter. However, as noted by Shoven and Whalley (1984), the incidence expressions contain a large number of elasticities, and these may combine in compounding or offsetting ways, so that the robustness to any single elasticity may be of little significance.

It is also the case that incidence estimates have been found to depend crucially on the level of disaggregation employed in the model. Shoven (1976) showed that the welfare loss of the corporation tax in the US rises by

30% if the level of disaggregation is increased from two to twelve sectors. A similar results was discovered in Chapter 5, where the incidence varied according to the location of the tax in the production hierarchy[5].

In essence, these criticisms reflect the failure of the general equilibrium approach to test the restrictions and assumptions which are imposed on the data. Ignoring the ideological objections to alternative theories, proponents of the neoclassical paradigm have frequently alleged that empirical verification of their models is either unnecessary or misleading. There appear to be three separate, though closely linked views on this issue.

First, it has been argued that the general equilibrium system is vigorously derived from assumptions of optimising behaviour. Any alternative theory based on non-optimising principles (such as the Post-Keynesian theory) is deemed to be ad hoc.

Second, it has been suggested that if a theory based on non-market clearing assumptions is to be acceptable, it must be shown that it is in the interest of maximising agents <u>not</u> to undertake " . . . some PERCEIVED mutually advantageous trade". (Barr o (1977); emphasis added).

Finally, following Friedman's (1953) essay on positivism, it is asserted that it is inadmissible to evaluate a theory by the relevance of its assumptions. Rather a theory is to be judged by the accuracy of its predictions (see also Blaug (1980) and Katousian (1980)).

Consider first the charge that the superiority of the general equilibrium framework, over Keynesian theory is evinced by the fact that it is based on micro-economic optimising principles. In so far as Post-Keynesian theory is highly aggregated, and relies on non-optimising, non-market clearing assumptions, it may be deemed to be ad hoc. However, in contrast to general equilibrium theory, Post-Keynesian analysis yields empirically refutable hypotheses, and is based on less restrictive verifiable assumptions. Proponents of the general equilibrium framework reject the possibility of testing the assumptions underlying their models. The Walrasian general equilibrium system is regarded as the "Magna Carta of economics" (Schumpeter quoted in Tobin (1980)) which cannot be empirically refuted. Thus Hayek (1975) argues that:

"Nor can we statistically test our theory that it is the deviations from the equilibrium system of prices . . . which makes it impossible to sell certain products . . . at the prices at which they are offered".

In essence, by asserting that it is impossible to test the assumptions of their models, the general equilibrium theorists attempt to immunise their conclusions from empirical falsification. A general equilibrium model may provide a useful vigorous abstraction of the economy, but if it cannot be falsified, it is an empirically vacuous framework of questionable value. The framework must then presumably be accepted on a-priori reasoning (or perhaps even faith) rather than statistical inference.

Consider next Barro's assertion that a theory based on non-market clearing assumptions must show that it is in the interest of maximising agents not to undertake perceived mutually advantageous trades. In part, Barro's criticism appears to reflect the widely differing informational assumptions underlying Post-Keynesian and neoclassical theory. In Post-Keynesian analysis, unemployment derives from the fact that agents are supply constrained, so that notional and effective demands diverge. The price mechanism, however, only transmits information on effective demands; as a result not all mutually advantageous exchanges are perceived and unemployment persists. In contrast, neoclassical theory assumes that resources ae fully employed, so that notional and effective demands are equal, and hence prices accurately transmit information about agents desires.[6] Thus, in Barro's parlance, all mutually advantageous trades are perceived and undertaken. To counter Barro's criticisms, it is therefore sufficient for Post-Keynesian theory to show that in an economy operating through historical time, money is used as a medium of exchange and hence effective and notional demands can diverge.

Finally, following Friedman (1953) it is argued that if a theory is to be tested, it should be judged not by the relevance of its assumptions, but the accuracy of its predictions. Theorising involves abstraction, and hence it is argued that assumptions are best simplified to a point where they are interpreted "as if" they were true, even if they can be shown to be manifestly false. Friedman draws an analogy with the problem of predicting the shots of a billiard player: " . . . excellent predictions would be yielded by the hypothesis that the billiard player made his shots <u>as if</u> he knew the complicated mathematical formulae that would give the optimum directions of travel . . . Our confidence in this hypothesis is not based on the belief that billiard players . . . do go through the process described; it derives rather from the belief that, unless they were capable of achieving essentially the same result, they would not in fact be expert billiard players." Thus theories, according to Friedman, are only to be judged by their predictive power.

However, Friedman's positivist criterion for choosing between rival theories runs into the familiar inductive problem: any particular conclusion may be implied by a number of mutually incompatible theories. Thus predictive accuracy, though necessary, is not in itself a sufficient criterion for not rejecting a theory against a rival hypothesis which is also consistent with the data. Stated differently, the statistical results may accord with the predictions of a theory for reasons other than those implied by it. Thus, for example, in general equilibrium incidence theory the assumptions of perfect competition and profit maximising behaviour serve to preclude <u>short run</u> forward shifting. However, the observed absence of forward shifting might well derive from alternative forms of pricing behaviour such as normal cost pricing, or price leadership, or predatory pricing, or alternative firm objectives. Hence, the predictions of a number of rival hypotheses may be conformable with the data.

Friedman suggests that in these circumstances the most abstract and general theory should be chosen for it yields the " . . greatest economy, clarity and precision in presenting the hypothesis". However, it is well recognised that this proposal has no epistemological justification within positivism (see Hollis & Nell (1975)), and does little to distinguish genuine and spurious correlations between data sets.

Thus, the approach adopted in the present study differs somewhat from Friedman's suggestion. Rather than choose data comformable models on the basis of their degree of abstraction and generality, the data admissibility of the restrictions implied by rival theories are tested. The analysis thus begins with a general dynamic model which subsumes the rival explanations of tax shifting, and the restrictions implied by various theories are statistically tested rather than imposed on the data. Where two or more conflicting explanations are found to be data admissible either nested or non-nested tests are employed to choose the "best" fitting model.

6.4 The Econometric Approach

The econometric approach to tax incidence was pioneered by Krzyzaniak and Musgrave (1963) (K-M hereafter) in their seminal study of the corporation tax in the US. Using statistical procedures designed to isolate tax effects from the plethora of forces operating on income distribution, K-M concluded that the coporation tax is more than fully shifted to consumers in the form of higher prices. The K-M model has been heavily criticised by a number of eminent theorists, strongly defended by its authors, and applied uncritically to four foreign countries. Few of the points of controversy generated by the study appear to have been resolved, hence this section reviews some of the general methodological issues implicit in the debate. We begin with a brief description of the K-M study, and its purported methodological deficiencies.

The K-M study attempts to estimate and measure the degree of corporation tax shifting. Since the focus is on tax shifting rather than incidence *per se*, the analysis is confined to the corporate sector, and profits are used as an approximate indicator of the distributional impact of the tax. The K-M measure of incidence is thus given by:

(4) $\Pi_A - \Pi_H = f(t)$

where:

Π_A = actual profits

Π_H = hypothetical profits in the absence of the tax.

Equation (4) represents a sharp narrowing of the concept of incidence, which refers to the entire distribution of income disaggregated by size brackets. In the K-M approach, the focus is on the production sector, and in particular the single variable, profits. The incidence problem is thus limited to one of inter-sectoral equity - that is the extent to which firms shift the tax burden to households in their role as consumers and suppliers of labour services. Although the division between firms and households is not the complete answer to the incidence issue, the results if valid would arguably be at least broadly indicative of the distributional impact of a tax.

The econometric measure of incidence is based on a statistical estimate of the hypothetical no-tax level of profits (Π_H). Consider a simple linear regression model constructed to explain actual profits (i.e. Π_A):

(5) $\Pi_A = \beta o + \beta 1\, Zo + \beta 2\ t + \xi$

where:

Zo = vector of exogenous explanatory variables used to explain Π_A

t = tax

ξ = disturbance term

If t = 0, the model provides an estimate of the hypothetical no-tax position $\Pi_{H.}$ Thus the coefficient of the tax variable β2 yields a measure of the impact of the tax on profits. It follows that if the variables in the vector Z_0 are misspecified, or if the model fails to satisfy the statistical assumptions of regression analysis, the measure of the tax impact (β2) will be incorrect and misleading. Thus, the conclusions of the econometric approach are entitled to no more credence than the model that is intended to explain profits.

In their "preferred" model, K-M include three variables in the vector Z:

(1) the change in the ratio of consumption to GNP, (2) the ratio of inventories to sales, (3) the ratio of taxes other than the corporation tax to GNP.

Little explanation is provided to justify the inclusion of these variables in the model. Hence, much criticism has been directed at the choice of variables and lag structure (see for example Goode (1963), Slitor (1963), Cragg, Harberger, and Miezkowski (1967)).

It is unnecessary to repeat these criticisms here in detail, but it would seem useful to briefly mention certain important deficiencies of the K-M study which have more general implications.

In earlier versions of their model, K-M experimented with a variable representing the ratio of government expenditure to GNP. However, the coefficient was found to be negative, and when the variable was excluded from the model, there was a gain in reliability and overall goodness-ofit. K-M nevertheless agree that government expenditure will influence profits through its impact on aggregate demand, and concede that they are unable to separate the tax effects from expenditure effects. Critics of the K-M study such as Cragg, Harberger and Mieszkowski (1967) thus included a demand "pressure" variable in the model and calculated the bias in the shifting estimate.

The problem reflects a basic dilemma of incidence analysis: Tax changes are typically accompanied by a change in some other policy variables such as government expenditure, alternative taxes, the money supply, or stock of government debt. Thus, in practice, no broad based tax can have an incidence of its own: it only has an incidence relative to some other public finance instrument which will also affect the distribution of income. It follows that these instruments should, in principle, be included in the vector of explanatory variables Z.

This difficulty has its parallel in the theoretical literature in public finance. Following Musgrave (1959) theory distinguishes between the specific or absolute incidence, budget incidence and differential incidence. The absolute incidence measures the impact of changes in a tax, holding all othe fiscal instruments constant. In contrast, the budget incidence takes account of the effects of equivalent increases in both taxes and government expenditure. Finally, the differential incidence measures the effects of substituting one tax for another of equal yield in real terms. Clearly, the budget incidence has the important disadvantage of failing to isolate the expenditure effects from the tax. In contrast, in the differential approach, while the role of macro demand effects are minimised other insurmountable difficulties remain. Thus, Shoup (1969) argues that the concept is in fact meaningless, for a tax substitution will lead to a change in the pattern and level of demand and hence output and employment. If the authorities then seek to stabilise employment at its previous level, it will be necessary to change a third tax, and perhaps raise government expenditure. In this case the differential incidence does not reflect the impact of substituting two taxes, since three or more fiscal instruments have been changed. To quote Shoup (1969) " . . . if there are eight goals to be achieved by the public finance system, eight public finance instruments will normally be required . . . If the value for one of these goals is to be changed, . . . the values of all eight of the public finance instruments must normally be changed. . . . The new distribution of disposable income is necessarily the "incidence" of changes in eight public finance instruments".

Following the exposition in Davis (1972), the relevance of these definitions for econometric estimation of incidence may be illustrated as follows. Consider the following regression equation:

(6) $\Pi_A = \beta_0 + \beta_1 Z + \beta_2 t + \beta_3 R + \beta_4 G + \varepsilon$

where:

R = vector of other taxes

G = Government expenditure

The absolute incidence of a tax may be measured by β_2 - the coefficient of t. However, the accuracy of this measure clearly depends on the assumption that t, R and G are independent. Thus, if t and G are collinear, then β_2 will contain elements of budget incidence. Similarly, if t and R are correlated, then β_2 will measure elements of differential incidence.

In contrast, a measure of the budget incidence is given by the sum of the coefficients of β_2 and β_4 on the pre-condition that they are independent.

However, if these variables are correlated, then the estimated coefficients will be biased thereby yielding imprecise results. It may be possible to circumvent this difficulty by including a proxy for government expenditure and estimating the model using instrumental variable techniques.

The differential incidence appears somewhat more difficult to measure. Differential incidence analyses the effects of substituting one tax for another of equal yield. The exercise is therefore purely conceptual, and hence cannot be directly estimated. It may, however, be possible to discern the differential incidence by simulating an estimated model. This would clearly require an economy-wide macroeconometric model, specified at a high level of disaggregation in order to increase the sensitivity of the results to variations in different taxes. Even if this could be achieved, there appears to be no obvious way of taking account of Shoup's (op cit) goals - instruments criticisms, unless seemingly cavalier *ceteris paribus* assumptions are invoked.[7]

The objective of the present study is much more modest. Following much of the existing empirical literature, we merely attempt to estimate the absolute incidence. To the extent that the model fails to separate out expenditure effects from the tax, the results might overstate the degree of shifting. However, as K-M note, with the available techniques, " . . . the best we can do is to aim at absolute effects, but even this proves difficult."

Despite the controversy surrounding the specification of the K-M profits equation, the model has been used uncritically to measure the degree of tax shifting in the UK (Davis (1972)), Canada (Spencer (1969)), West Germany (Roskamp (1965)), and India (Laumas (1965)). The main justification for the international application of the K-M model is given by Roskamp (1965) who asserts that:

"The rationale for using the US model for another country is our belief that corporations in mixed capitalist economies have basically a very similar behaviour with respect to taxes on income and property which is only slightly modified by different institutions".

Thus for Roskamp, the determinants of profits in countries as diverse as the US, West Germany and the undeveloped Indian economy are adequately captured in the K-M equation. If the K-M model performed reasonably in the US, this hypothesis might be worth testing, though it would be somewhat surprising if company behaviour in advanced capitalist economies and a rural undeveloped country could be adequately described by the same equation. Given the uncertain justification of the US model, its application to other countries might merely represent spurious correlation between trending time series observations, rather than an explanation of company behaviour.

An alternative justification for the international application of the model is provided by Spencer (1969) who argues that the equation should be judged according to statistical criteria and goodness-of-fit, rather than economic rationale. Thus:

" . . . variables included are important only in their ability to . . . remove non-tax influences . . . Variables are selected for inclusion in the equation using standard statistical tests and removed on . . . statistical grounds . . .". However, in all the international applications, the K-M model is evaluated merely in terms of the t - statistics and R^2. The authors therefore appear to be unaware of the "spurious regressions" problem (see Granger & Newbold (1974)), which render the R^2 uninterpretable.[8] Furthermore, no attempt is made to test the predictive power of the model in different countries, and the data admissibility of the lag structures. Consequently, the seemingly satisfactory performance of the K-M model appears to reflect serial correlation between trending time series variables, rather than a well specified dynamic regression equation.

In an attempt to overcome these difficulties, the approach adopted in the present study lies between the two extreme interpretations of the K-M model. Thus, in the following section, it is argued that a well-specified, data coherent model cannot be formulated without some theoretical foreknowledge, and that the results are uninterpretable in the absence of a proper theory. Furthermore, it is suggested that imposing theoretically deduced models on data is equally unjustifiable, for it neither constitutes a valid test of the theory, nor does it yield reliable statistical results. This is an old point recognised by John Neville Keynes (1890), which bears repetition:

"all induction is blind, so long as the deduction of causal connections is left out of account; and all deduction is barren so long as it does not start from observation".

6.5 Dynamic Specification: The General to Specific Approach

The econometric analysis presented in the following chapter is based on the statistical procedures pioneered by Sargan (1964), Hendry and Mizon (1978) and others. This section merely describes what appear to be the central features of this approach, and does not seek to adjudicate on the econometric controversy generated by these authors. However, since these statistical procedures appear to have gained the ascendency in much of the macro-econometric literature (especially on the demand for money and consumption function), they have been used to estimate the incidence of the non-domestic property tax. It is hoped that the results obtained are based on well specified, robust equations.[9]

Stated briefly, the Hendry-Sargan procedures can be viewed as an attempt to reconcile the statistical properties of dynamic econometric models which describe short run adjustments, with standard economic theory which is typically propounded within a static equilibrium framework. The modelling exercise is viewed as an attempt to characterise the data generation process using statistical procedures. However, since the actual data generation process is unkown, economic theory plays a vital role in determining the variables which are to be included in the initial model.

Consequently, both statistics and economic theory are relevant in the specification of a dynamic model.

The statistical procedures are perhaps best described within the framework developed by Hendry (1983) and Hendry et al (1984). The data generation process (denoted DGP) is defined as a stochastic process generating all the variables (w) sequentially through time. Ignoring initial conditions for ease of exposition, the density function of the DGP may be written as:

$$(1) \quad D(w_1 \ldots . w_T/\theta) = \prod_{t=1}^{T} D\ (wt/ w_{t-1} \ldots w_1; \theta)$$

where:

θ = vector of parameters of w

Since the DGP is unknown, an econometric model is obtained by: (a) ignoring all but a small subset of variables in w which are denoted x. In Hendry's parlance, this is termed marginalising with respect to x.

(b) In addition, it is typically assumed that one sub-vector y_t (which is endogenous) depends on the remaining subset of vectors termed z_t. That is we condition Y_t on z_t.

The variables included in the set x are typically suggested by theory, and can be described by:

$$(2) \quad \prod_{t=1}^{T} F\ (X_t / x_{t-1} \ldots \ldots \ldots . x_1; \lambda_t)$$

The conditional and marginal models for x are then given by:

$$(3)\quad F(x_1 \ldots\ldots x_t/\lambda) = \prod_{t=1}^{T} F(Y_t/z_t, x_{t-1} \ldots\ldots x_1; \alpha_1) \cdot \prod_{t=1}^{T} F(z_t/x_{t-1} \ldots\ldots x_1; \alpha_2)$$

The first term on the right hand side of (3) describes the conditional model for y_t (i.e. we assume that y_t the endogenous variables, depend on z_t the exogenous variables). The second term in (3) is the marginal model for z_t. Econometric models are typically confined to the conditional models for y_t and ignore the marginal model for z. Hence, it is implicitly assumed that the parameters α_1 and α_2 are unconnected or "variation free" so that no information is lost by ignoring α_2. In this case, z_t is said to be "weakly exogenous" so that the model for z_t does not have to be specified and efficient estimates of y_t can be obtained from the conditional model alone.

These definitions provide a convenient framework for discussing dynamic specification. Rival empirical models can be viewed as different recombinations of the DGP. Thus, while conflicting theories may be non-nested, the econometric models are all nested within the DGP. It follows that a parsimonious specification be obtained by adopting a strategy which begins with a general model which subsumes rival explanations, and sequentially tests the data admissibility of the various restrictions implied by the competing theories.

There is a second and more obvious reason why a modelling strategy proceeding from the general to the specific is to be preferred. Econometric models contain several explanatory variables. It is clearly impossible to ascertain whether a particular variable is statistically significant if it is not already included in the model. In contrast, if an attempt is made to identify a parsimonious restricted model at the outset, a test of (say) parameter significance will be conditional on more general assumptions which may be tested later. If these are rejected, all earlier inferences are invalidated.

Consider for example, the following simple autoregressive distributed lag model[10].

(4) $Y_t = \beta 1\, Z_t + \beta 2\, Z_{t-1} + \beta 3\, Y_{t-1} + \varepsilon_t$

where:

Z_t is weakly exogenous with respect to $\beta 1$, $\beta 2$, $\beta 3$.

$\varepsilon_t \sim IN(0, \sigma)$

Despite its simple lag structure, (4) subsumes nine types of dynamic models as special cases as shown in Table 6.1. overleaf.

Thus for example, imposing the restriction $\beta 2 = \beta 3 = 0$ yields a static regression equation of the form:

(5) $Y_t = \beta 1\, Z_t + \varepsilon_t$

It is well recognised that such models seldom provide a useful

TABLE 6.1

Type of Model	Equation	Restrictions
1. Static	$Y_t = \beta_1 Z_t + \varepsilon_t$	$\beta_2 = \beta_3 = 0$
2. Univariate Time Series	$Y_t = \beta_3 Y_{t-1} + \varepsilon_t$	$\beta_1 = \beta_2 = 0$
3. Differenced	$\Delta Y_t = \beta_1 \Delta Z_t + \varepsilon_t$	$\beta_3 = 1;\ \beta_2 = -\beta_1$
4. Leading Indicator	$Y_t = \beta_2 Z_{t-1} + \varepsilon_t$	$\beta_1 = \beta_3 = 0$
5. Distributed Lag	$Y_t = \beta_1 Z_t + \beta_2 Z_{t-1} + \varepsilon_t$	$\beta_3 = 0$
6. Partial Adjustment	$Y_t = \beta_1 Z_t + \beta_3 Z_{t-1} + \varepsilon_t$	$\beta_2 = 0$
7. Common Factor	$Y_t = \beta_1 Z_t + u_t$ $u_t = \beta_3 u_{t-1} + \varepsilon_t$	$\beta_2 = -\beta_1 \beta_3$
8. Error Correction	$\Delta Y_t = \beta_1 \Delta Z_t + (1-\beta_3)(Z-Y)_{t-1} + \varepsilon_t$	$\Sigma \beta_i = 1$
9. Reduced form	$Y_t = \beta_2 Z_{t-1} + \beta_3 Y_{t-1} + \varepsilon_t$	$\beta_1 = 0$

Source : Hendry et al (1984)

description to time series data. This is partly because the model imposes unrealistic constraints on the data, requiring short and long run responses to be instantaneous and identical. This suggests that the restrictions necessary to obtain (5), even if supported by theory, should be tested against the general form (i.e. equation (4)) to gain protection from misspecification. Clearly commencing from (4) when equation (5) is true, and testing the admissibility of the various restrictions would yield a well-specified model. The converse will not hold; fitting (5) when (4) is true will induce misspecification errors.

The models described in Table 6.1 can be derived from equation (4) by imposing the appropriate restrictions. However, in what follows, we focus on the error-correction mechanism (i.e. Case 8) which has been accorded considerable attention in the recent literature. Thus, Nickell (1980) has shown that the error-correction mechanism is the optimal decision rule when adjustment costs are quadratic. Moreover, the mechanism is compatible with "servomechanistic" behaviour, and yields a long run homogeneity solution consistent with static optimising behaviour. (Davidson et al (1978)). The mechanism thus has a potentially wide range of applications and has been used in the analysis described in the following chapter. The error correction mechanism implied by equation (4) can be obtained by imposing the restriction $\Sigma \beta i = 1$. Thus the mechanism is described by :

(6) $\Delta Y_t - \beta_1 \Delta Z_t + (1 - \beta 3)(Z - Y)_{t-1} + \varepsilon_t$

Equation (6) postulates that agents adjust from Y_{t-1} to Y_t in response to: (a) changes in Z_t (i.e. a short run adjustment process, (b) the previous disequilibrium between Z and Y [$(Z-Y)_{t-1}$] (i.e. a feedback effect resulting from disequilibrium in the previous period).

The error correction mechanism has the desirable property that it subsumes long run steady state adjustments as a special case. In a steady state, all variables grow at the same rate and hence:

(7) $\Delta Y_t = \beta_0 + \beta_1 \Delta Z_t + \varepsilon_t$

where: ε_t is white noise

That is, a simple difference model adequately describes the data in long run equilibrium. Moreover, equation (7) can be approximated by a levels formulation:

(8) $Y_t = \alpha_0 + \alpha_1 Z_t + v_t$

where: $v_t = (1 - \beta_3) v_{t-1} + \varepsilon_t$ is an auto-correlated error term.

In a useful way, equation (6) nests levels and differences as special cases. Adding a lagged dependent variable to (7) will yield a partial adjustment model with auto-correlated errors. In a similar manner, the error correction mechanism can be shown to subsume all the models in Table 6.1 as special cases. Consequently, beginning with the error correction mechanism, and testing the admissibility of the various restrictions would yield a well specified model, even when one of the other types represented the DGP. In contrast, fitting a more restricted form, when the error-correction mechanism describes the DGP will induce misspecification errors. Thus Hendry et al (1984) assert that:

".. error correction is essentially a necessary and sufficient model form and it is this property which explains the considerable practical success of error correction formulations in encompassing and reconciling diverse empirical estimates in many subject areas".

While the general-to-specific approach provides a useful modelling strategy designed to minimise dynamic misspecification, it cannot by itself establish whether an equation adequately characterises the DGP. It therefore becomes necessary to use a number of selection criteria which a model has to satisfy to be acceptable. The diagnostic tests suggested by Hendry et al seek to assess whether a model satisfactorily replicates the DGP:

Data Coherence

The purpose of constructing a model is to account for as much of the variation in the data as possible. Hence, if a model adequately characterises the data, it seems reasonable to require the residuals to be approximately random. Departures from randomness may then be taken as an indication of errors of conditioning, marginalising, measurement, or specification. Hence, a minimal condition for an acceptable model to fulfil is that the residuals be white noise. A white-noise process is one which cannot be predicted linearly from its own past. This condition therefore serves to eliminate low order residual auto-correlation.[11] However, as noted by Hendry and Richard (1982) a white noise process may be predictable given an extended information set[12], and may have temporal structure. Furthermore, white-noise residuals may be predictable using lagged values of the variables already included in the model. Hence a white noise residual is at best a weak necessary condition for an empirical model to satisfy.

A stronger condition is to require the residual to be an innovation process. A time series v_t is said to be an innovation process with respect to an information set F_t if and only if : $E (v_t | F_t) = 0 \ \forall \ t$ and $D (v_t | F_t) = D (v_t)$; where D is a density function. It follows from this definition that whether or not a series is an innovation process depends crucially on the information set (F_t). Thus, white noise may be an innovation process if the information set only contains its own past. In the present context, it seems reasonable to include in the information set all past variables and residuals in the model. It follows that the residuals will be an innovation process if and only if they cannot be predicted from their own past and the past of other variables in the model.

A measure of the innovation in a model is provided by its variance. This suggests a modelling strategy which requires a preferred parsimonious model to have a lower variance than its rivals. Intuitively, this result can be seen to derive from the fact that a true model which describes the DGP will have a lower variance than a false one. More generally, models can be ranked according to their variance: Model A is said to *variance dominate* model B if and only if $\hat{\sigma}_A^2 < \hat{\sigma}_B^2$ (where $\hat{\sigma}_i^2$ denotes estimated variance). Variance dominance is asymmetric and transitive, both of which are useful attributes for a selection criterion.

Parameter Constancy

A second selection criterion frequently suggested in the literature is that of parameter constancy. A model is said to have constant parameters (denoted θ) if $(\theta o, \theta t) = 0 \; \forall \; t = 1 \ldots, T$ (see Hendry and Richard (1982)). It follows that a well specified model with constant parameters will satisfactorily predict future changes of the endogenous variable, in the absence of structural shifts. Thus, in much of the literature predictive accuracy is used as an indirect test of either structural breaks or misspecification.

In contrast, Hendry (1980, 1983) argues that there is no necessary connection between predictive failure and functional misspecification. Specifically, a misspecified model will continue to forecast <u>within</u> the limits of its error variance as long as the system is stationary and the economic structure remains unaltered (Hendry 1977). Hence, predictive accuracy is compatible with functional misspecification. On the other hand, with an unchanged structure, a mispecified equation may fail to predict and reveal apparent structural breaks, if an excluded (though relevant) exogenous variable changes through time. It follows that forecast accuracy is consistent with misspecification, whereas predictive failure may reflect either a structural break or a misspecified equation interacting with a changing exogenous variable. Thus, predictive accuracy *per se* cannot be used as a criterion for diagnosing misspecification.

Encompassing

Rival statistical models may be viewed as different recombinations of the DGP. Hence, while the underlying theoretical models may be non-nested, their empirical counterparts are all subsumed within the DGP. It follows that a true model which adequately describes the DGP will be capable of accounting for the results obtained by other (false) models. A model which satisfies this condition is said to encompass its rivals. Model encompassing is both asymmetric and transitive, and hence provides a useful criterion for choosing between models. Furthermore, Hendry and Richard (1982) have proved that encompassing implies variance dominance, but is not implied by variance dominance. Intuitively, encompassing must entail variance dominance since a badly fitting model with a high variance cannot explain the findings of the true model with a lower variance. Encompassing, according to Hendry (1983) thus provides a sufficient selection criterion in the sense that if the encompassing model is known, rival explanations can be ignored.

Theoretical Consistency

A major strength of this approach is seen to derive from the fact that it yields a model which is " . . . consonant with the time series properties of the data and yields a long run solution which appears to be fully consistent with standard economic theory" Hendry (1983). Thus, in addition to satisfying the above mentioned statistical criteria, the preferred model is required to be consistent with economic theory. Since theories typically relate to long run static equilibria, while the empirical models describe short run adjustment dynamics, the error correction mechanism can be used to reconcile theory with the dynamic properties of the short run empirical model. In the present study, this line of reasoning is extended further and all long run parameters have been empirically estimated, rather than analytically derived from the short run model as in Hendry (1980) and Davidson et al (1978). The estimation procedures are based on a technique recently described by Bewley (1979) and will be discussed in greater details in Chapter 7.

Data Admissibility

Finally, a well specified model is required to satisfy all data and definitional constraints. Thus, for example, if a consumption function (C) has been estimated, savings (S) can be inferred from the identity:

$$Y \equiv C + S$$

where:

$Y \equiv$ income

C = consumption

S = saving

Alternatively both consumption and savings could be estimated in order to verify that the identity is satisfied. Clearly, if the relationships are correctly specified, the identity will hold automatically, and need not be imposed on the models.

Thus, a model which satisfies the above mentioned statistical criteria will :

(a) have an error which is an innovation process

(b) constant parameters

(c) encompass its rivals

(d) be data admissible

(e) meet the conditioning and exogeneity requirements

Such a model is termed a Tentatively Adequate Conditional Data Characterisation (TACD) by Hendry and Richard (1982). Since a TACD adequately describes the dynamic properties of the data, and encompasses its rivals, it is seen to constitute a "progressive research strategy". We note paranthetically that theory consistency has not been included as a condition since "there always exists some theory consistent with the observed results ." (Hendry and Richard (1982)).

In the present study an attempt is made to formulate a TACD by employing the following procedure and test statistics: Economic theories indicate which variables are to be included in each equation (i.e. marginalise with respect to all observables). The formulation suggested by theory is then estimated in its most general form, and sequential test procedures are used to identify the restrictions implied by the data.

At each stage of the simplification search a variety of disagnostic test statistics are employed. The usual t-statistics and R^2 apart, the Durbin-Watson statistic (denoted DW) is used to test for autocorrelation in the residuals. However, it is well established that the DW statistic is biased in models with a lagged dependent variable, and hence the Box-Pierce statistic (denoted Q_{20}) for a correlogram of white-noise residuals, and the Lagrange Multiplier test (denoted LM (4)) for autocorrelation up to the fourth order are also reported. The absence of serial correlation is seen to provide an indication of the data coherence of a model. The post sample forecast accuracy and parameter stability of each equation are tested using Theil's Inequality Coefficient (denoted U), and an asymptotic approximation of the Chow test derived by Hendry (1980) (denoted Z (4)). Moreover, an F-test is used to test the validity of restrictions in nested models. However, where non-nested hypotheses are compared the Cox-Pesaran test is employed. As noted by Hendry and Richard (1982) , this provides a test of variance dominance rather than encompassing. Thus models selected on the basis of non-nested tests satisfy the minimum conditions necessary for rejecting alternatives (i.e. variance dominance) rather than encompassing rival hypotheses. It is perhaps worth noting paranthetically that the exogeneity assumptions implicitly evoked in the modelling exercise cannot be tested directly. However, an approximate indication of valid conditioning is provided by the tests of parameter constancy and random residuals (Hendry 1983). Finally, the long run parameters of the preferred models are directly estimated using a procedure described by Bewley (1979). This provides a test of the theoretical consistency of the results.

NOTES TO CHAPTER SIX

1. For example, an equal yield neutral tax (i.e. differential incidence)

2. Recall that a tax induced change in income distribution, alter spending flows and hence output and aggregate demand.

3. Except in the limiting case where demand is totally inelastic.

4. In an attempt to rescue these studies, a number of authors such as Prest (1955) and Shoup (1969) have suggested that the calculations should be restricted to a comparison of taxes over different time period. The incidence calculations would then relate to the effects of a marginal change in taxes, rather than the effects of a tax with reference to the no-tax position.

5. It may be argued that in practice the policy implications of the general equilibrium framework are irrelevant for the analysis fails to take account of the "general theory of second-best". The theory of second best asserts that if "... one of the Paretian optimum conditions cannot be fulfilled, then an optimum situation can be achieved only by departing from all other Paretian conditions". Lipsey and Lancaster (1956). This suggests that the abolition of a single distortionary tax may reduce efficiency and welfare if there are other divergencies from the Paretian conditions. The failure to take account of these distortions may well imply that the policy inferences of the general equilibrium framework are totally misleading. The theory of second best thus appears to pose formidale problems of computation and interpretation which are ignored by proponents of general equilibrium analysis.

6. In addition, neoclassical general equilibrium theory assumes that all Arrow-Debreu future and contingent markets exist. There is therefore perfect knowledge and certainty about the future.

7. The existing macro models of the UK economy typically distinguish between the main direct taxes on firms and households and indirect taxes. It seems unlikely that these could be used to discern the incidence of say substituting a property tax for a corporation tax.

8. We note in passing that the "spurious regression" problem was first discussed by Yule (1923). There appears to have been little recognition in applied econometrics of the difficulties involved in modelling and evaluating time series data prior to Granger and Newbold's (1974) article.

9. In contrast to the macroeconometric literature, the empirical work in micro economics in general, and public finance in particular, appears to be based wholly within the more orthodox framework. It is hoped that the robust equations derived in the present study will immunise the results from the familiar charge of misspecification.

10. The foregoing argument is based on Hendry et al (1984).

11. e.g. $v_t - \alpha v_{t-1} + \varepsilon_t$

    where: ε_t is random

12. We can thus predict a white-noise series if we know the formula of a random number generator.

CHAPTER SEVEN

SHORT RUN SHIFTING OF THE NON-DOMESTIC PROPERTY TAX IN THE MANUFACTURING SECTOR: AN ECONOMETRIC ASSESSMENT

In this Chapter, we attempt to measure statistically the impact of the non-domestric property tax in the manufacturing sector. The analysis draws on and seeks to extend the work of Gordon (1967), Davis (1972), Coutts et al (1978) and Beath (1979) on the incidence of the corporation tax. The investigation is based on a general unrestricted model of mark-up pricing. The equation used is of a form that has obtained widespread empirical support in the UK literature (see for example Bain and El-Mokadem (1971), Coutts et al (1978), Nield (1963)). In this context, the analysis provides useful evidence on both the incidence of the non-domestic property tax in the manufacturing sector, and its impact on prices.

The study makes use of quarterly data for the manufacturing sector from 1963:1 to 1983:4. The data on costs, prices and taxes are all obtained from published sources which are described in Appendix 3.

Before discussing the econometric framework, it is perhaps worth commenting on the use of quarterly data to measure the impact of a tax which is levied annually. It will be recalled, that any measure of tax shifting relies crucially on the model that is used to explain firm behaviour (see

Chapter 6). Thus model specification and estimation are perhaps of greater importance in estimating the impact of a tax than in other areas of policy research. It was suggested earlier (see Chapter 6) that the general to specific techniques pioneered by Sargan (1963) and Hendry et al (1985) provide a procedure for obtaining well specified, data coherent models. With the use of annual data, and the consequent loss of degrees of freedom, it is clearly impossible to test a general dynamic model with a large number of variables and lags. In order to infer a well specified, restricted model, we are therefore compelled to use quarterly observations and convert the annual data on non-domestic property tax revenues into a quarterly series. A number of techniques were used to interpolate the annual property tax series, and these are described in Appendix 1. Initial experimentation revealed that the simplest interpolation technique due to Lisman and Sandee, (1964) yielded the most reliable results, which were consistent with estimates obtained using annual observations.

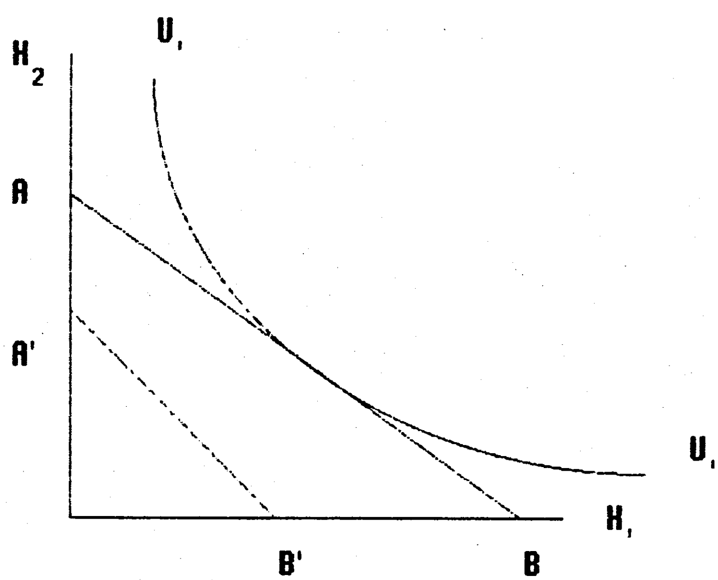
The remainder of this chapter is organised as follows. Section 7.1 discusses the rationale underlying the use of a mark-up equation to measure the short run impact of the non-domestic property tax. Section 7.2 describes the theoretical and the empirical framework, while sections 7.3 and 7.4 discuss the implications of introducing alternative expectational schemes in the empirical equation. Section 7.5 presents the final results, and the theoretical implications of the conclusions are dealt with in section 7.6.

7.1 A Measure of Tax Shifting:

Conflicting theoretical conclusions regarding the incidence of the non-domestic property tax appear to be inextricably linked to different models of firm behaviour. Thus the neoclassical general equilibrium conclusion that the property tax does not affect prices in the short run. relies crucially on the assumption that firms are constrained by market forces to maximise profits. Clearly, any attempt by a firm operating at its optimum point, to increase prices will lead to a fall in profits. At the other extreme, Post-Keynesian incidence theory is based on the assumption that prices are set by the dominant firms in oligopolistic markets. With rigid prices, output is below its full employment level, and hence balanced increases in taxes and government expenditure raise aggregate demand, thereby increasing employment output and profits. Thus, in the short run, none of the burden of the property tax falls on firms. Alternatively, if we assume that full cost pricing is the dominant form of firm behaviour, then property taxes together with other costs will be shifted directly into prices. Between the extremes of perfect competition and full cost pricing lie a profusion of theories, which allow for almost any degree of shifting. More generally, the difficulty one confronts in testing for the presence of tax shifting is that the effect is ambiguous, depending on the objectives of the firm, and the market structure within which it operates.

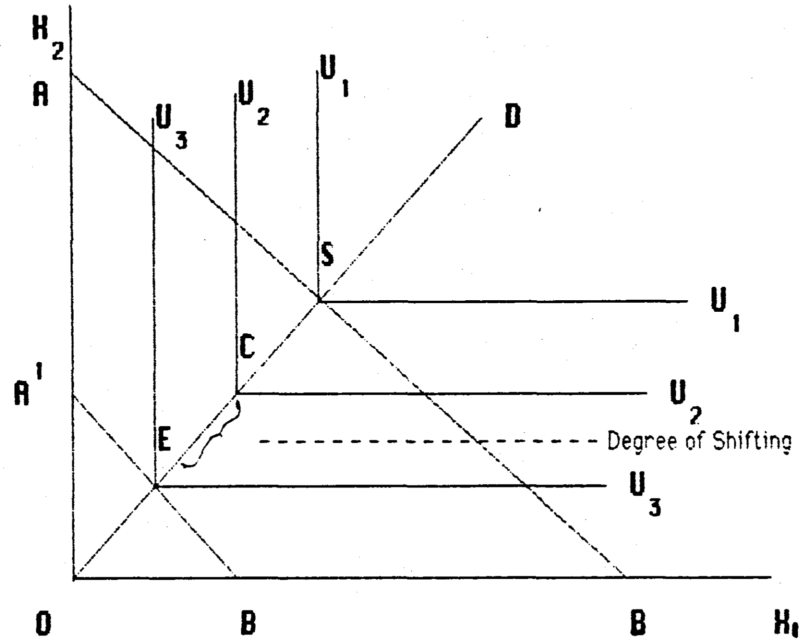
Following Coutts et al (1978), the problem can be illustrated with reference to diagram 7.1 below. In the diagram X_1 and X_2 represent firm objectives as embodied in managerial preference function - denoted U (X_1 X_2). Line AB portrays the post-tax budget constraint or opportunity locus between the two objectives, and Ui Ui the preference functions. Thus for a firm which maximises sales subject to a profit constraint X_1 might represent sales and X_2 profits.

DIAGRAM 7.1



Within this framework, an increase in taxes will, *ceteris paribus* lead to a downward shift in the opportunity locus to a position such as A'B'. Full shifting of the property tax would then require an increase in the mark-up sufficient to attain the original preference level U_1 U_1. In the special case of a profit maximising firm, if Xı represents profits, then B defines the pre-tax position and B' the post-tax position. Thus a measure of tax shifting based on these observed positions would yield precise conclusions. However, such a measure provides unambiguous results under a rather limited set of conditions. Clearly, a firm with multiple objectives could respond to the tax by changing the composition of bundles it consumes. Diagramatically this might leave the level of the opportunity locus AB unaffected, but change its slope. In general, a firms' response to a tax will clearly depend on its preferences and objectives. Thus, in an effort to minimise the ambiguity surrounding our measure of tax incidence, it is assumed that: (a) profits represent an important component of the firms' objectives, and hence in attempting to shift the tax burden, firms seek to increase profits. (b) We further assume that the ratio of profits to all other objectives remains constant over time. This implies that managerial preference functions are "L" shaped[1], and hence shifts in the pre and post tax in difference curves are confined to movements along a ray from the origin such as OD in Diagram 7.2.

DIAGRAM 7.2



Thus, for example, if the firm is initially at a point such as S, and there is an increase in taxes such that with prices and costs unchanged the opportunity locus shifts to A'B', but the firm is observed to be at point C, then the degree of shifting is defined by the distance CE. Under these assumptions, it then follows that in the short run, with a fixed stock of capital, any attempt to shift the tax will be reflected directly in the mark-up between prices and costs. Thus a measure of tax shifting in the short run can be formulated in terms of a mark-up pricing model. This is the approach adopted in the present study.

7.2 The Model:

The empirical analysis is based on a general unrestricted model of mark-up pricing in the manufacturing sector. The model is based on the presumption that prices are in general set by firms, and held constant over a finite period. Thus following Arrow (1959) we implicitly assume that the selling side of the market is much more concentrated than the buying side, and hence prices are set and adjusted by firms.[2] Under these circumstances, the price set by firms will at least partly depend on the expected level of output/sales. Corresponding to this level of output, we can then define a level of value added which the firm expects if all its plans are realised:

(1) $V^e = P.Q^e$

where: V^e = expected value added

Q^e = expected output

P = price of value added (value added in manufacturing being profits plus labour costs)

It is worth stressing that this assumption in no way precludes profit maximising behaviour. Thus the expected or target output might correspond to the lowest point on the firms' cost curve, or alternatively, a certain share of the market.

However, let β denote the share of gross profits in value added, then:

(2) $\Pi^e = \beta V^e = \beta P Q^e$

where: Π^e = expected <u>gross</u> profits.

Similarly we can define expected profits net of property taxes as follows:

(3a) $\Pi^e_N = (\Pi^e - T) = \beta_N V^e = \beta_N P Q^e$

Rearranging we obtain:

(3b) $\Pi^e = \beta_N P Q^e + T$

where: Π^e_N = expected <u>net</u> profits

β_N = share of net profits in value added

T = non-domestic property taxes

Value added in the manufacturing sector consists of wage costs and profits. We can therefore express value added from the cost side as:

(4) $V^e = \Pi^e + w^e Q^e$

where: w^e = expected unit wage costs

Substituting for V^e from (1) and Π^e from (3b):

(5) $$PQ^e = \beta_N P Q^e + T + w^e Q^e$$

Rearranging terms:

(6) $$P^* = \left[\frac{1}{1 - \beta_N}\right] \left[\frac{T}{Q^e} + w^e\right]$$

That is, the price set by firms P^* is a mark-up $\frac{1}{1 - \beta_N}$ on expected unit property taxes, and expected wage costs. Even though price is expressed in terms of a mark-up over costs, this approach does not rule out profit maximising bahaviour. Empirically all that is required to support this hypothesis, is a mark-up which is sensitive to demand, and a zero coefficient on expected unit property taxes. At the other extreme, if full cost pricing represents the main form of firm behaviour, the mark-up will be unaffected by demand, and fully reflect changes in costs and taxes. The model therefore imposes no *a-priori* constraints on the coefficients, and allows for any degree of tax shifting consistent with the data.

Linearising and rearranging equation (6), we obtain:

(7) $$(\ln P_t - \ln w^e_t) = C + \beta_N \ln \frac{T}{Q^e}$$

The mark-up in Equation (6) $\frac{1}{1 - \beta_N}$ represents the summation of a geometric series. We have approximated the series with the coefficient β_N, and relegated higher order terms to the constant C.[3] The dependent variable in equation (7) can arguably be interpreted as the expected or target mark-up.

There are a number of empirical and theoretical advantages in defining the dependent variable in equation (7) in terms of the mark-up (i.e. ($\ln P_t - \ln w^e_t$)) rather than price. (i.e. P_t): First, as noted in section 7.1, the empirical measure of the tax burden is based on the assumption that any attempt to shift the property tax is reflected directly in the mark-up. Furthermore, we seek to measure absolute rather than budget effects[3] of the non-domestic property tax. It therefore becomes necessary to separate out the impact of the tax from the demand effects of government expenditure, and this is done by including a measure of demand in the regression equation. However, it is well established in past empirical research that wages move procyclically. Thus, demand measures, when included together with wages are typically found to be insignificant (see McCallum (1972)). Arguably, the approach adopted here at least partly circumvents this difficulty.

An important question which arises with respect to equation (7) is whether in fact the mark-up responds to other factors which have not been formally integrated into the model. By ignoring these, we may be omitting important elements from the equation and hence to guard again spurious correlation, an extended dynamised version of (7) was estimated with a large number of variables lagged. The general form of (7) is given by:

$$(8) \quad \Delta(p-w^e) = \alpha o + \sum_{i=0}^{n}\alpha_{i1}\,\Delta(t-q^e)_{t-i} + \sum_{i=0}^{n}\alpha_{i2}\, d_{t-i} + \sum_{i=0}^{n}\alpha_{i3}\,\Delta.\, r_{t-i} + \sum_{i=0}^{n}\alpha_{i4}\, c_{t-i} + \alpha_5 D + \sum_{i=1}^{n}\alpha_{i6}\,\Delta(p-w^e) + \alpha_7\, \text{Time} + \text{(Seasonals)}$$

where: Lower case letters denote logs

$(t-q^e)$	=	expected unit property taxes
d	=	measure of demand
r	=	price of raw materials
c	=	measure of international competitiveness
D	=	dummy variable for the 1973-1974 revaluation
Time	=	time trend
(Seasonals)	=	seasonal dummy variables.

The first variable included in the extended equation is a measure of demand. As noted earlier, this is included in order to separate out the 'budget' and 'absolute' effects of the property tax. However, the impact of demand on prices and the mark-up is an issue which has generated a considerable amount of controversy. One view, proposed initially by Nield (1963), and supported by proponents of the normal cost hypothesis, asserts that the mark-up is unaffected by the level of demand in the short run. Instead, prices are seen to respond only to long run changes in costs (termed 'normal' costs). Critics of the normal cost hypothesis such as Smith (1979) and McCallum (1972) have argued that the empirical models on which the normal cost hypothesis is based are misspecified, and that if the model is properly formulated demand exerts a significant, though not powerful, impact on prices. In the present study, demand effects are proxied by three measures: the excess demand for labour (i.e. unemployment minus vacancies), real GDP which is assumed to measure the level of economic activity, and a Wharton Index of capacity utilisation. The initial results revealed that the measures based on the demand for labour and GDP were statistically insignificant and frequently had the wrong sign. In contrast, the Wharton Index was found to exert a powerful effect on the mark-up. The implications of this finding are discussed at length in later sections.

We further include a measure of raw material costs in the extended mark-up equation. It will be recalled, that our theoretical model (described in equations (1) to (7)) takes no account of variations in raw material costs, for these do not form part of the value added of the manufacturing sector. However, it is possible that in setting a target for their profits, firms take account of changes in raw materials, for these lead to changes in working capital which in turn warrant higher profits. While this possibility is not formally integrated into the structure of the theoretical model, it is allowed for empirically in the equation.

Furthermore, equation (8) includes a measure of international competitiveness which is based on the ratio of the wholesale price index to world export prices. The rationale underlying the inclusion of this variable derives from the monetarist 'law of one price' which asserts that export prices are influenced more by world prices and international competition than domestic costs. Hence, by way of a transmission mechanism linking traded and non-traded goods, it is argued that international competition has a greater influence on prices, than domestic costs or other factors. By implication, the 'law of one price' therefore suggests that in the short run, the property tax burden will fall wholly on firms, thereby leading to a decline in profits. Thus, in terms of equation (8), if the international competitiveness measure is found to be significant and close to unity, this would suggest that the coefficients of the property tax variable, and the domestic cost terms will be small, if not statistically insignificant. It is perhaps worth noting paranthetically, that in the longer run if capital is sufficiently mobile between countries, international tax differentials will induce capital flows which will eventually equalise net-of-tax returns.

Finally, a dummy variable is included in equation (8) to capture the possible impact of the 1974 revaluation which led to a redistribution of the tax burden from manufacturing to the service sector. The precise role of this variable remains somewhat ambiguous, for the revaluation broadly coincided with a number of "structural" changes such as entry into the EEC, the emergence of a ("dirty") floating exchange rate and the first "oil price shock" which led to a steep decline in the mark-up over this period. In addition, a time trend has been included to capture the impact of other variables not already included in the model.

In equation (8), both wages and output are expressed in expectational form. In the absence of any data on expectations, we are thus compelled to construct a model of expectation formation.

7.3 Modelling Wage and Output Expectations:

In this section, we consider three general processes of expectation formation: a first order autoregressive scheme; a univariate time series forecast; and rational expectations forecasts.

In the first expectations scheme, we assume that one step ahead forecasts are generated by a first order autoregressive process. For wages, a series of expectations was derived from the fitted values of the model:

$$(9) \quad \Delta w^e_t = \underset{(4.58)}{0.024} + \underset{(3.7)}{0.221} \ \Delta w_{t-1}$$

Sample: 1965:1 - 1983:4 : OLS

$\sigma = 0.029$; $Q_{20} = 22.4$; LM (4) = 9.51

[Note: t-statistics are shown in paranthesis, Q_{20} is the Box Pierce Q statistic for a random correlogram of residual, and LM (4) is the Lagrange Multiplier test for fourth order autocorrelation.].

The model can arguably be regarded as the empirical counterpart of a simple process in which the expected change in wages equals a fraction of the change in the previous quarter. The series generated from (9) will hereafter be referred to as the "naive expectations scheme".

In addition, we consider a more general extrapolative scheme, based on the univariate time series properties of the variable under consideration. The parameters of the model were identified and estimated using the techniques pioneered by Box and Jenkins (1976). Accordingly, wages were found to be described by an integrated AR (4) scheme. Thus our second series for wage expectations are based on the fitted values of the following model:

$$(10) \quad \Delta w^e_t = \underset{(2.01)}{0.29}\, \Delta w_{t-1} + \underset{(1.86)}{0.17}\, \Delta w_{t-2} + \underset{(2.43)}{0.19}\, \Delta w_{t-3} + \underset{(2.003)}{0.23}\, \Delta w_{t-4}$$

Sample 1965:1 - 1983:4 (Max. Likelihood)

$\sigma = .021$; $Q_{20} = 19.1$; $LM(4) = 4.28$

It is well established that any linear rational expectations model in which the exogenous variables follow a stationary process, can be expressed in terms of a univariate time series model (see Wallis (1980)). Thus equation (10) can be regarded as the extrapolative representation of a rational expectations predictor. However, Wallis (1980) has shown that an extrapolative predictor such as (10) is in general inferior to a rational forecast because it collapses separate information about the structure of the model into a single parameter. Thus, the forecast error of the extrapolative predictor is greater than that of a rational expectations forecast. Hence, following Wickens (1982), predictions such as these which are based on a subset of all available information will be referred to as "weakly rational expectations".

A similar procedure was employed to derive a univariate time series model for output. However, it was discovered that the series for manufacturing output followed a random walk with drift. Attempts to identify a subset of the observations by truncating the model, and splitting the observations into pre and post floating exchange rate periods, or using the "oil shock" as the demarcation line, made little different to this disturbing result. Clearly, in a univariate time series model the best prediction of a random walk is its past value, and hence the "weakly rational expectations" forecasts for output are identical to the "naive expectations" scheme. The time series model for output is given by:

$$(11) \quad q^e_t = 0.18 + \underset{(2.40)}{} \; 0.96 \; q_{t-1}$$

(2.40) (2.86)

Sample: 1965:1 - 1983:4 (Max. Likelihood)

$\sigma = 0.072$; $Q_{20} = 16.2$; $LM(4) = 3.19$

7.4 Rational Expectations:

The expectational schemes described above are based on mechanistic extrapolative rules which take no account of other factors which might influence wages and output. They therefore have the disturbing implication that individuals make systematic forecasting errors. Consider, for example, the output equation; it seems not unreasonable to suggest that in forming expectations, firms take some account of the impact of demand, competition, and exchange rates on output. Extrapolative schemes ignore these factors and hence persistently under (over) predict increases (decreases) in a series, and fail to track sudden changes and turning points.

An alternative approach is offered by the rational expectations hypothesis (REH hereafter) which asserts that expectations are "... informed predictions of future events .. ... and hence depend ... on the structure of the relevant system describing the economy" Muth (1961). Thus, according to the REH agents in forming their expectations take full account of all the available information, and the interrelationships among variables described by the appropriate economic theory. The potential advantages of RE over the mechanistic rules are clear; the process of expectations formation is endogenous to the model, and the forecasts are efficient and unbiased.

We therefore examine the implications of introducing RE forecasts of wage and output in the mark-up equation. It is possible that RE may improve our ability to derive a robust model, and yield results which differ substantially from those of the other expectations schemes.

However, before describing the estimation procedures, it seems vital to distinguish between the REH *per-se* and the model to which it is applied. The REH is typically used in models which embody strictly neoclassical assumptions (i.e. flexible prices and perfect markets). The hypothesis has therefore been used to attack "Keynesian" models which give effective demand the leading role in determining output. Recall that for output to be demand determined, it must be assumed that some markets do not clear. This does not, however, necessarily imply that expectations are formed adaptively. Price rigidities and involuntary unemployment may derive from a number of sources such as imperfect competition (as in Kalecki (1971) or Wietzman (1985)), fixed training costs (Oi (1962)), or increasing returns (Kaldor (1964)). None of these situations presupposes any form of "irrationality" or extrapolative expectations schemes. There is therefore no necessary contradiction in using the REH in a model which embodies "Keynesian" features. The present study does not seek to adjudicate on the macro policy implications or validity of the REH. Rather, concern here is restricted to the narrow question of assessing the effect of R.E on the mark-up equation, and the property tax coefficient.

Estimation Procedures:

In his seminal article Muth (1961) defined RE as being " . . essentially the same as the predictions from the relevant economic theory". Formally this implies that the RE of a variable (say Y) is given by its mathematical expectation conditional upon the available information:

(12) $Y^e_t = E(Y_t \mid \Omega_{t-1})$

and

$\Omega_{t-1} = (Z, \theta)$

where: Y^e_t = rational expectation of Y in period t

Ω_{t-1} = information set dated t-1

Z = variables in the information set

θ = structural coefficients of these variables in the information set.

The information set Ω includes the structure of the relevant model, as well as realisations of all relevant exogenous variables. It follows that to obtain rational forecasts of (say) wages, it becomes necessary to model the wage-price subsystem in the manufacturing sector. If we assume that agents are in possession of this subsystem, then we have the problem of estimating a model in which expectations are determined endogenously. With RE, computational considerations are of greater importance than in conventional model estimation. Hence it would seem appropriate to describe the estimation procedures used in the present study. In what follows, we ignore problems arising from learning mechanisms, and time varying parameters.

Consider the following n equation stable linear system:

(13) $Y_{1t}B_1 + Y^e_{1t}B_2 + Y_{2t}B_3 + X_{1t}C = U_t$

where: Y_{1t} and Y_{2t} = vectors of endogenous variables of size n_1 and n_2 respectively.

Y_t = $[Y_{1t} \; Y_{2t}]$ = size $(n_1 + n_2)$ vector

Y_{1t} = rational expectation of Y_{1t}

X = vector of exogenous variables of size q

U = disturbance term

Rationality implies that:

(14) $Y_{1t} = Y_{1t}^{e} + \eta_t$

where: η_t = random disturbance term

We assume that the exogenous variables X_t are described by the time series process:

(15) $\Theta(L) X_t = \Psi(L) \mathcal{E}_t$

where: $\mathcal{E}_t$ = white noise

$\Theta(L)$ and $\Psi(L)$ = lag polynomials of finite length

Substituting (14) into (13) we obtain:

(16) $Y_t B + X_t C = U_t + \eta_t B_2$

where: $B^T = [B_1^T + B_2^T : B_3^T]$

Rearranging (16):

(17) $Y_t = [-X_tC + U_t + \eta_t B_2] B^{-1}$

Taking expectations of (17) conditional upon Ω_{t-1}:

$$E(Y_t | \Omega_{t-1}) = -B^{-1} C \; E(X_t / \Omega_{t-1})$$

Writing $\hat{X}_t$ for $E(X_t / \Omega_{t-1})$ which is the optimal predictor for X given by the realisation in (15):

(18) $Y^e_{1t} = B^{-1} C \hat{X}_t$

That is, the RE of Y_{1t} is given by the predictions of the exogenous variables.

There are two procedures commonly used to estimate RE models: the substitution method, and the errors in variables method. In the substitution method, the rational expectations (Y^e_{1t}) are replaced by the actual forecasts of the variable. More formally, in the substitution method, we first obtain the form of the RE in terms of the unknown structural coefficients (i.e. equation (18)), and substitute this into (13) to obtain the observable system.

(19) $Y_{1t}B_1 + Y_{2t}B_3 + X_t\bar{C} = \bar{U}$

where: $\bar{C} = C[I - B^{-1}]$

$\bar{U} = U_t + \varepsilon_t$

Since (19) is non-linear in B and C, efficient estimation requires the use of a highly non-linear systems estimator. One method of circumventing this difficulty is to replace Y^e_{1t} with its forecasts from (18) which are then treated as exogenous variables. This however may lead to the well known errors of two-stage procedures (see Wallis (1980)).

In contrast, the errors in variables method replaces the expected variables with their *ex-post* realisations. Thus in terms of equation (13), by substituting (14) for Y^e_{1t} we create errors in variables of η_t:

$$(20) \quad Y_t B + X_t C = (U_t + \eta_t B2)$$

Clearly, both Y_t and X_t are now correlated with the augmented disturbance term through η_t B2. We therefore have more jointly dependent variables than equations. However, Wickens (1982) has shown that asymptotically efficient estimates can be obtained by estimating (20) with Z_t (the variables in the information set) jointly using FIML. Since the errors in variables procedure is easier to implement, it has been used, where possible, to derive rational expectations.[5]

Wage Expectations under the REH:

Under R.E., we assume that agents are in possession of the complete model. Hence, to obtain rational forecasts of wages, it becomes necessary to model the wage-price system. Considerable controversy surrounds the specification of the appropriate model of wage determination. However, for the purposes of this study, we merely require a sufficiently general equation which has a reasonable empirical performance. A wage-price subsystem which has been widely used in past research is of the form:

$$(21) \quad \Delta w_t = \alpha o + \sum_{i=0}^{n} \alpha_{i1} \Delta p_r^e + \sum_{i=0}^{n} \alpha_{i2} \; \Delta. r.r._{t-i} + \sum_{i=0}^{n} \alpha_{i3} \; \Delta. (w-p_r)_{t-i}$$

$$+ \sum_{i=0}^{n} \alpha_{i4} \; d_{t-i} + \sum_{i=0}^{n} \alpha_{i5} \; X_{t-i}$$

$$(22) \quad \Delta P_r = \beta o + \sum_{i=0}^{m} \beta_{i1} \Delta m_{t-i} + \sum_{i=0}^{m} \beta_{i2} \Delta w_{t-i} + \sum_{i=0}^{m} \beta_{i3} \; i t_{t-i}$$

$$+ \sum_{i=0}^{m} \beta_{i4} \; \Delta t^A_{t-i} + \sum_{i=0}^{m} \beta_{i5} \; d_{t-i}$$

where: p_r = consumer price index

r.r = retention ratio

d = measure of demand

m = import prices

i.t = indirect taxes NET of property taxes

t^A = non-domestic property taxes paid by all services and industries

X = vector of other exogenous variables

The wage equation described in equation (21) has received a reasonable degree of empirical support, and is used in both the National Institute and Treasury macro models. However, its precise theoretical interpretation remains somewhat ambiguous. Thus, the National Institute modellers suggest that equations such as (21) represent workers demands for wages. Wage demands are seen to depend on net earnings (i.e. the retention ratio r.r), real wages ($w-p_r$) expected inflation (Δp_r) and other variables included in X which reflect workers' desired or target real wage path. In contrast, other authors such as Sargan (1980b) and H.M. Treasury modellers treat the wage equation as the outcome of a wage bargain. In this view, the real wage ($w-p_r$) and retention ratio (r.r.) are seen to determine the supply of labour, while the other terms reflect the demand for labour. On this interpretation, the variables included in X_t attempt to measure employers' willingness to concede higher wage claims. In the present study variables such as a time trend, indirect taxes, strike activity and union density were included in X_t, and it was found that only the union density variable was statistically significant. In addition, we experimented with three measures of demand in the wage equation: the excess of unemployment over vacancies, unemployment and vacancies. It was discovered that ony lagged uemployment was statistically significant.

The price equation in (22) is of the familiar cost-based pedigree, which have been widely used in single equation studies and the main macro-econometric models of the UK. The interpretation of equations such as these has been discussed in Section 7.1. However, it is perhaps worth noting paranthetically that there is no necessary contradiction between modelling prices in terms of costs, and allowing the money supply a role in the inflationary process. The cost-based price equation can be viewed as the mechanism through which changes in costs feed into prices.

The system was initially estimated using single equation techniques. This general procedure of moving from single to systems estimators is commonly applied, recent examples being Sargan (1980b) and Henry and Ormerod (1982). Thus, the dynamic specification of each equation was tested using the general-to-specific approach described in Chapter 6. We report below our preferred parsimonious specification:

(23) $\Delta w_t = c + \alpha_1 \Delta (w - p_r)_{t-1} + \alpha_2 \Delta r.r. + \alpha_3 \Delta u.d._{t-4}$

$+ \alpha_5 u._{t-6} + \alpha_6 r.r._{t-1} + \alpha_7 \Delta p_r^e$

D.W. = 1.95; $\sigma = 0.025$; $Q_{20} = 17.0$ U = 0.32

(24) $\Delta p_r = C + \beta_1 \Delta m_{t-1} + \beta_2 \Delta w_{t-1} + \beta_3 \Delta t^A + \beta_4 (p_r - w)_{t-1}$

D.W. = 1.86; $\sigma = 0.017$; $Q_{20} = 20.8$; U = 0.165

where: u.d = union density

u = unemployment

(Note: D.W. = Durban Watson statistic; U = Theil's Inequality coefficient)

Finally, these equations were estimated jointly using FIML in order to obtain rational asymptotically efficient estimates of price expectations (p_r^e).

The FIML estimates are given by:

$$(25)\quad \Delta w_t = \underset{(1.98)}{0.8} - \underset{(2.1)}{0.3}\,\Delta(w-pr)_{t-1} - \underset{(-2.5)}{0.92}\,\Delta r.r. + \underset{(3.16)}{0.24}\,\Delta u.d._{t-4}$$

$$+ \underset{(1.99)}{0.16}\,u_{t-6} - \underset{(-2.71)}{0.33}\,r.r_{t-1} + \underset{(2.18)}{0.47}\,p_r^e$$

RSS = 0.027; σ = 0.021; DW = 1.95; LM (4) = 5.32; U = 0.068

$$(26)\quad \Delta p_r = \underset{(-1.82)}{-0.003} + \underset{(3.05)}{0.104}\,\Delta m_{t-1} + \underset{(1.9)}{0.157}\,\Delta w_{t-1} + \underset{(3.48)}{0.22}\,\Delta t^A$$

$$\underset{(-2.1)}{-0.33}\,(pr-w)_{t-1}$$

RSS = 0.0062; σ = 0.0162; DW = 2.48; LM(4) = 4.08; U = 0.00527

In general, the model appears to be well specified. The expected rate of inflation coefficient has a plausible value of 0.47 and is well determined. While concern here is focused on the manufacturing sector, it is worth noting the size and sign of the coefficient of the property tax variable. Equation (26) reveals that 22% of any increase in property taxes is shifted forward into prices. Finally, the predictions based on the reduced form of this sytem were used to generate one step-ahead rational expectations of wages. The predictions closely track the actual change in wages, and this is reflected in the Theil's Inequality Coefficient between actual and predicted values of 0.00527. This would appear to suggest that the model is well specified.

Output under the REH:

The model used to derive expected output draws on the work of Wren Lewis (1983) and Nickell (1981). The model is based on the observation that variations in the output of a firm that is on its supply curve may either derive from (a) shifts in the demand curve, or (b) movements along the demand curve. In the former situation, output is exogenous to the firm, being determined primarily by demand factors. On the other hand, changes in output resulting from movements along the demand curve are induced by variations in real factor costs. In this case, output is a choice variable of the firm, as in a neoclassical world of perfect competition.

To contrast these two possibilities, we estimated a general 'reduced form' type of output equation based on both real wage costs, and variables related to government policy and demand factors. The general model is given by:

$$(27) \quad q_t = \beta_0 + \sum_{i=1}^{n} \beta_{i1} q_{t-i} + \sum_{i=0}^{n} \beta_{2i} (w-p)_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_{3i}\, b.d_{t-i} + \beta_4 C + Time + \sum_{i=0}^{n} \beta_5 t_{t-i} + \beta_6 D$$

where: q_t = output in manufacturing

b.d = measure of fiscal policy/demand

c = measure of competitiveness

D = exchange rate dummy variable

t = property taxes in the manufacturing sector

The budget deficit (b.d.) was included in the above equation to capture variations in output which derive from demand factors. We experimented with four measures: M3, £ M3, the unadjusted budget deficit, and the cyclically adjusted weighted deficit (CAWD hereafter). Both M3 and £ M3 were included on the assumption that the influence of government policy can be adequately captured by some broad measure of the money supply. The argument is based on the monetarist contention that fiscal policy is effective only if accompanied by increases in the money supply. However, both measures of the money supply were found to be statistically insignificant, and were therefore excluded from the equation. It may be argued that this result stems from the fact that certain monetary policies (such as the removal of the 'corset') have served to distort existing measures of the money supply. Thus the absence of a link may reflect the inadequacies of M3 and £ M3 as a broad measure of money, rather than the ineffectiveness of monetary policies. The unadjusted budget deficit was also found to be statistically insignificant and frequently had the wrong sign. This result is not surprising for their exists a reciprocal causation between the budget deficit and aggregate demand. While increases in the deficit raise demand; increases in aggregate demand in turn tend to lower expenditures and raise taxes thereby reducing the deficit. These so called 'automatic stabilisation' properties of the deficit have long been recognised, and have led to corrections in an attempt to extract the influence of the cycle on the deficit. Thus a measure of the cyclically adjusted weighted deficit (CAWD) was used. The statistics were obtained from the National Institute (Savage (1982), and Biswas et al (1985)). This measure is based on the variations in the deficit that would have occurred if output had grown at a specified trend. The trend for output from 1963 to 1973 was assumed to equal its *ex post* rate of 2.8% and after 1974 to equal 2%. Thus the CAWD seeks to measure the overall fiscal stance of the authorities. As noted below, this variable performed well in the equations and was robust to changes in specification.

The measure of competitiveness is defined as the ratio of wholesale prices to world export prices. The precise role of this variable in the output equation seems somewhat difficult to interpret in the floating exchange rate period. Under fixed exchange rates, it is clear that this measure captures both the authorities exchange rate policies and movements in foreign prices. The variable can therefore be viewed as a proxy for the world demand for domestic products. However, under floating exchange rates, this measure might well be influenced by interest rates if they lead to movements in the exchange rate, and hence the measure of competitiveness. There is consequently an *a priori* reason for either including a dummy variable to account for the transition from fixed to floating exchange rates, or estimating different equations for the two periods. On the basis of the forecasting performance of the equation, an exchange rate dummy variable was included.

The behaviour of lagged real labout costs in the equation was somewhat ambiguous, and highly sensitive to changes in specification. *Ceteris paribus* real wages should exert a negative impact on output. However, the lagged variables were frequently insignificant and alternated in sign. An attempt was made to improve the performance of the equation by excluding the insignificant lags, with the wrong sign. In addition, we experimented with Almon polynomial lags, using the tests described by Sargan (1980a) to determine the optimal degree and length of the lags. However, with real wages included in the equation, the forecasts failed completely to track the major turning points in the series (in particular the 1980 recession). Consequently on the basis of the predictive performance of the model, real wages were excluded from the preferred parsimonous specification.

Finally, we include a measure of property taxes in the manufacturing sector. In all versions of the model, this variable was found to be statistically insignificant. This result is not surprising, for as noted in earlier chapters, the link (if any) between property taxes and output is likely to be highly complex and indirect. It will be recalled that in general equilibrium theory, differentially higher property taxes induce firms to migrate to lower taxed sectors, thereby causing distoritions in the economy and lowering the level of output. Thus by this interpretation, lagged values of the property tax variable should have a negative sign. In contrast, Post-Keynesian theory suggests that equivalent property tax and government expenditure increases augment aggregate demand and raise output. Property taxes are therefore seen to have a positive impact on output.

At a high level of aggregation, it is difficult to reliably test these conflicting theoretical conclusions. In part, the difficulty stems from the fact that a change in any broad based fiscal instrument (such as the property tax) will typically be accompanied by a change in some other policy variable (e.g. government expenditure, alternative taxes, the money supply). Thus, a broad based tax only has an incidence relative to some other public finance instrument which should also be included in the model. In Equation (27), the CAWD is included to capture the overall fiscal stance of the authorities, and hence provides a summary measure of changes in policy variables. However, if these variables are related to the property tax, its impact will be subsumed within the CAWD. It may therefore be argued that our result stems from the failure to isolate the property tax effects from those of the other fiscal variables included in the CAWD.

The equation used to generate one-step-ahead forecasts of output is given by:

$$(28)\quad q_t = \underset{(2.92)}{1.576} + \underset{(9.81)}{0.813}\, q_{t-1} + \underset{(1.91)}{0.005}\, b.d. - \underset{(-3.52)}{0.147}\, c + \underset{(2.27)}{0.0007}\, D$$

$DW = 1.98$; $RSS = 0.006$; $\sigma = 0.062$; $Q_{20} = 8.91$; $U = 0.094$;

$LM(4) = 4.67$

Despite the forecasting ability of this equation, as reflected in the U statistic, it is worth noting the relative size of the coefficients. Clearly, the lagged dependent variable plays a dominant role in this equation, and this stems from the difficulties encountered in modelling a series which follows a random walk. The best prediction of a random walk is its past value, and hence the coefficient of output is close to unity. The one period forecasts from this model were used to generate a series of rational expectations of output.

7.5 The Mark-Up Equation:

Having derived the three expectations schemes, it is now possible to estimate the mark-up equation (8). The dynamics of equation (8) were subjected to a data based simplification search using the general-to-specific procedures. The naive expectations and weakly rational expectations (WRE hereafter) versions were estimated by substituting the appropriate one period forecasts into the mark-up equation. Estimation of the RE version is however more complex and therefore warrants further discussion.

In the previous section RE of wages were obtained using the computationally simpler errors in variables method. However, this procedure cannot be used in the mark-up equation, for the dependent variable is defined as $(p\text{-}w^e)$. To use the errors in variables FIML estimation method described by Wickens (1982), the dependent variable would have to be defined as $(p\text{-}w)^e$. In the mark-up equation only a component of the dependent variable (i.e. wages) is defined in expectational form. Hence, the

Wickens procedure does not yield rational asymptotically efficient, unbiased estimates. We have consequently used an iterative approximation of the substitution method described by Henry and Ormerod (1982). In the first step of the estimation procedure, a data series on Δw^e and q^e was obtained from the forecasts of the Δw and q equations. The model was then jointly estimated by 3SLS, and the Δw^e and q^e series were revised, being based on the fitted values of the 3SLS estimates of the Δw and q equations. The model was re-estimated with these new series. The process was continued until the estimated coefficients in the model remained constant between iterations, to the third decimal place. The estimates thus obtained are consistent, though not asymptotically efficient.

The results are presented in Table 7.1 overleaf. There are a number of points of interest sugested by these results. First, in all three models, the measure of competitiveness, the revaluation dummy variable, and the time trend were found to be statistically insignificant. Furthermore, all three equations have a reasonable degree of explanatory power, and are well specified in terms of white noise residuals. Now, clearly the naive expectations model is a special case of the WRE equation. Hence the relative performance of these models can be formally tested by means of the usual likelihood ratio test. The test revealed that naive model can be unambiguously rejected in favour of the WRE model. A comparison of the RE and WRE model is, however, somewhat more difficult for there appears no

TABLE 7.1

The Mark-Up Equation
Sample 1965:1 - 1980:2

VARIABLE	Rational Expectations	Weakly Rational Expectations	Naive Expectations
Constant	-1.225	-0.6517	-0.168
	(2.91)	(3.7)	(1.38)
$\Delta(p - w^e)_{t-1}$	+0.216	+0.403	+0.361
	(1.93)	(3.34)	(3.23)
$\Delta(t - q^e)_t$	+0.137	+0.124	+0.125
	(2.95)	(2.47)	(2.59)
Δr_{t-1}	+0.176	+0.109	+0.158
	(3.75)	(2.52)	(3.69)
d_t	+0.047	+0.04	+0.0003
	(2.89)	(2.07)	(1.051)
d_{t-1}	+0.051	+0.034	+0.106
	(2.41)	(4.82)	(2.83)
d_{t-2}	+0.053	+0.028	-
	(3.19)	(1.29)	
d_{t-3}	+0.056	+0.022	-
	(2.05)	(1.82)	
d_{t-4}	+0.043	+0.016	-
	(1.98)	(2.13)	
R.S.S.	0.0086	0.0071	0.018
σ	0.0205	0.0183	0.0371
LM(4)	5.3	2.84	7.09
Q_{20}	12.5	9.6	10.34
Z (4)	9.26	5.35	19.1

Note: Z (4) is an asymptotic approximation of the Chow Test, see Hendry (1980) obvious way of nesting the two hypotheses into a composite model. Hence, we assume here that the two models are non-nested and use the familiar Cox test to obtain a preferred model.[6] The Cox procedure treats each hypothesis as the null and compares the observed likelihood functions with an estimate of the likelihood functions if the null hypothesis were true. If the alternative fits better than it should if the null were true, then we can clearly reject the null. The Cox test statistic is of the form:

$$T_0 = L(\hat{\theta}_0) - L(\hat{\theta}_1) - T\left[\operatorname*{Plim}_{T\to\infty} \frac{1}{T} \{L(\hat{\theta}_0) - L(\hat{\theta}_1)\}\right]_{\theta_0 = \hat{\theta}_0}$$

where: $L(\hat{\theta}_0)$ = log likelihood function under the null hypothesis

$L(\hat{\theta}_1)$ = log likelihood function under the alternative hypothesis

T = number of observations

The advantages of the Cox test over other selection criterion are clear. Firstly, the test makes use of the information contained in the alternative. In addition, the test may reveal either that one model can be rejected, or that neither can be rejected or that both models can be rejected. Hence, the Cox procedure provides an additional test of model specification. The Cox statistics of the models are:

Null Hypothesis	Alternative Hypothesis	
	Rational Expectations	Weakly Rational Expectations
Rational Expectations	-	- 3.458
Weakly Rational Expectations	+ 1.362	-

The Cox statistic is asymptotically normally distributed with a critical value of ± 1.96 at the 5% level. Hence, we can clearly reject the RE model in favour of the WRE version.

However, which ever model is in fact deemed to be preferable, the most striking result in the Table 7.1 derives from the coefficient of the property tax term. This variable is clearly robust to changes in specification and varies from an upper limit of 0.137 in the RE model to a low of 0.124 in the WRE version. Lagged values of the property tax variable were found to be insignificant in all versions of the equation. This therefore implies that what little effect the property tax has on the mark-up is both direct and immediate. More specifically, the estimates suggest that much of the property tax burden falls on firms with less than 14% being shifted into the mark-up.

Table 7.1 further reveals that demand lagged over four quarters exerts a positive and significant efect on the mark-up. It will be recalled that demand is measured by the Wharton index of capacity utilisation. The coefficient is clearly sensitive to the assumed process of expectation formation; with the cumulative impact in the RE version being greater than in the rival models.

One possible explanation for this result is that the short run tax shifting coefficient merely represents the adjustment process by which firms vary prices in response to changes in excess demand. Stated differently, it may be argued that the model fails to separate out the tax and expenditure effects and hence the positive coefficient merely reflects changes in demand rather than forward tax shifting. By this line of reasoning, in the long run the mark-up responds to changes in excess-demand alone and not demand in addition to cost and tax changes. Thus, as in neoclassical pricing theory, demand may be viewed as a generic factor that sums up all the forces acting to bring about changes in price. To investigate this possibility, we estimated the long run equilibrium coefficients directly using a procedure suggested by Bewley (1979). Bewley outlines an algebraic method of reparameterising short run adjustment models in a manner that permits direct estimation of the long run equilibrium coefficients. The procedure is briefly described in Appendix 3 and the estimates are presented in Table 7.2

TABLE 7.2

THE LONG RUN COEFFICIENTS

Sample 1965:1 - 1980:2

VARIABLE	Rational Expectations	Weakly Rational Expectations
$\Delta (t - q^e)_t$	0.1448	0.1163
	(3.72)	(3.55)
$\Delta\ r_t$	0.1577	0.062
	(3.12)	(1.15)
d_t	0.992	1.28
	(3.77)	(2.72)

The results reveal that both demand and property taxes exert a powerful influence on the mark-up in long run equilibrium. Raw material costs, however, are found to be insiginifcant in the WRE model. In addition, the long run coefficient of demand is close to unity in the RE and WRE versions, thereby implying that in the long run changes in demand lead to equiproportionate changes in the mark-up.

However, at the same time, property taxes exert an influence on the mark-up with the coefficient being largely unaffected by the assumed form of expectations. This therefore suggests that property taxes exert a positive impact on the mark-up *independently* of demand.

7.6 Theoretical Implications of the Empirical Results:

It is instructive to consider the theoretical implications of these results. The estimates presented in Table 7.1 revealed that less than 14% of the property tax burden is shifted forward into the mark-up thereby implying that the tax burden falls mainly on firms in the short run. It may therefore be argued that the results validate neoclassical incidence theories which predict that the property tax burden is borne wholly by firms in the short run. Moreover, the finding that the mark-up is sensitive to demand appears to support the assumption of general equilibrium theory that firms maximise profits and prices respond to excess demand. By this interpretation, the long run forward shifting coefficients may be taken to represent the "excise effects" of the property tax which result from the outmigration of firms from higher taxed sectors.

However, the argument appears to be somewhat misleading, for general equilibrium theory asserts that none of the burden of the property tax can be shifted forward in the short run. This result stems from the assumption that firms maximise profits in perfectly competitive markets. Any attempt by a firm at its optimum price - output configuration, to raise prices can lead only to a decline in profits. It follows that in the short run the tax burden must be borne wholly by firms. Thus despite the apparent similarity of the empirical results, with the predictions of general equilibrium theory, it is evident that any degree of forward shifting (however small), is incompatible with the behavioural assumptions and conclusions of general equilibrium theory.

In contrast, Post-Keynesian analysis suggests that none of the burden of a uniform property tax falls on profits in the short run. In the competitive version of the model, prices are assumed to be flexible, and hence the expansionary demand effects of balanced property tax and government expenditure increases, raise prices and profits. This implies that the property tax variable will have a coefficient close to unity in the mark-up equation. In contrast, our results suggest that there is little forward shifting into prices. In the non-competitive version of the Post-Keynesian model, prices are assumed to be rigid, and hence a balanced property tax and government expenditure increase raises output, employment and profits. This suggests that property taxes exert a significant and powerful impact on output. However, in the output equation which was used to derive rational expectations, property taxes were found to be statistically insignificant. This result, it was argued, may reflect the fact that the demand effects of the tax (if any), are likely to be captured within the measure of the budget deficit. The difficulty encountered here is similar to that described in the discussion of budget and differential incidence in Chapter 6. Given the interrelations between policy variables it is often difficult, if not impossible, to isolate the impact of any one tax. At a high level of aggregation, there appears to be no obvious alternative way of testing this conclusion.

In the Post-Keynesian world, differential property taxes are shifted into prices by those firms which enjoy a sufficient amount of market power as measured by the degree of monopoly. Thus it may be argued that the coefficient of the property tax variable in the mark-up equation merely reflects forward shifting of the differential component by firms who enjoy a sufficient amount of market power. However, since this conclusion relies on the unverified expansionary output effects of the property tax, and depends on factors such as the degree of monopoly which can only be tested at a higher level of disaggregation, it would seem inappropriate to uncritically endorse this interpretation of the property tax coefficient. Furthermore, in the non-competitive model, prices are rigid and unaffected by demand. In contrast, our results reveal that demand exerts a statistically significant effect in the short run, and a powerful impact in the long run equilibrium.

The estimates presented here are therefore neither wholly compatible with the conclusions of neoclassical theory or Post-Keynesian analysis. However, the results do appear to be consistent with the predictions of Davidson and Martin's (1985) general equilibrium model with an oligopolistic sector (see Chapter 2). It will be recalled that in the Davidson-Martin model, firm behaviour in the oligopolistic sector is governed by non-Cournot tacit collusion in the form of output quotas. The analysis is based on an infinite period supergame, in which it is assumed that firms adhere to a cartel only if there is no cheating. If any firm cheats the cartel is abandoned and output reverts back to its Nash level. Hence, a potential cheat compares the higher profits from cheating with the discounted future lower profits resulting from the dissolution of the cartel. An optimising firm will use the net returns to capital as the rate at which to discount future profits and losses. Thus property taxes which lower the returns to capital, serve to increase the present value of future losses from cheating. This permits the cartel to further restrict output and increase prices and profits. Hence the coefficient of the property tax variable in the mark-up equation may be interpreted as a measure of the aggregate "cartel effect". Furthermore, within this framework the mark-up remains sensitive to demand. Thus, the results presented in Tables 7.2 and 7.3 appear to accord with the conclusions of the Davidson

Martin model. This suggests that firm behaviour in the manufacturing sector is best described by a model of oligopoly thereby implying that future theoretical research should integrate alternative forms of collusive and non-collusive strategies within the general equilibrium system, and perhaps incorporate the demand effects of taxation.

APPENDIX 1

INTERPOLATION OF THE NON-DOMESTIC PROPERTY TAX SERIES

In the UK, non-domestic property taxes are levied annually, though they are typically paid in advance by firms either quarterly or half yearly.[7] Interpolation of the annual series is therefore not a purely statistical exercise, and arguably bears some relation to the flow of property tax payments through the accounting year.

Since only annual totals are available, but we require quarterly data, no assumption can be made about the seasonal (i.e. quarterly) pattern of fluctuations. The various interpolation techniques discussed here are based on different statistical criteria which the quarterly series are required to satisfy.

Thus, the procedure described by Lisman and Sandee (1964) (L-S hereafter) assumes that the unknown quarterly figures lie on a smooth trend between the annual observations. Interpolating this trend is, however, problematic because the trend underlying an annual series may differ from that of quarterly observations. To circumvent this difficulty L-S propose that the derived quarterly series should meet four statistical criteria of "reasonableness":

(i) The sum of the quarterly figures must equal the annual totals

(ii) Symmetry in a series requires that if the annual totals for years 1, 2 and 3 are y_1, y_2, y_3 respectively, then the quarterly figures for year 2 will be in reverse order from what they would have been had the yearly totals been y_3, y_2, y_1.

(iii) Trend considerations dictate that if yearly totals increase in equal amounts (i.e. $y_2 - y_1 = y_2 - y_3$) then the quarterly figures must also rise in equal steps.

(iv) If the annual series follows a cycle such that $y_2 - y_1 = y_2 - y_3$ then the quarterly series in year 2 must lie on a sinusoid. This is the "cycle" requirement.

More formally, let y_1 $(i = 1, \ldots, n)$ denote the annual observations and x_j $(J = 1, \ldots, p)$ be the quarterly figures. Now, from conditions (ii) to (iv) it follows that the quarterly series (x_j) will be the weighted sum of the annual figures y_i.

(1)

i.e.

$$\begin{bmatrix} x_5 \\ x_6 \\ x7 \\ x8 \end{bmatrix} = \begin{bmatrix} a & e & d \\ b & f & c \\ c & f & b \\ d & e & a \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

where: x_5 to x_8 = quarterly figures in year 2

Y_1 to Y_3 = annual figures in years 1, 2, and 3

Furthermore, from condition (i) we have:

(2) $\sum_{j=5}^{8} x_j = Y_2$

L - S then show that:

(3) $2\ (e + f) = 4$ and

(4) $a + b + c + d = 0$

Solving the system leads uniquely to the result:

(5) $$\begin{bmatrix} x_5 \\ x_6 \\ x_7 \\ x_8 \end{bmatrix} \begin{bmatrix} 0.073 & 0.198 & -0.021 \\ -0.010 & 0.302 & -0.042 \\ -0.042 & 0.302 & -0.010 \\ -0.021 & 0.198 & 0.073 \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

Thus to obtain a quarterly series we merely substitute values for Y_i in equation (5). Despite its simplicity, the L-S procedure has a number of disadvantages. First, no quarterly values can be inferred for the first and last year. Second, the four criteria of 'reasonableness' are arbitrary in the sense that they are not based on any form of optimising conditions.

An alternative method described by Boot et al (1967) minimises the sum of squares of the differences between successive quarterly values.

subject to the constraint that the quarterly figures sum to the annual totals.

Thus:

(6) $\text{Min.} \sum_{i=2}^{4} (x_i - x_{i-1})^2$

subject to:

(7) $\sum_{i=4k-3}^{4k} x_i = y_k \quad (k = 1, 2, \ldots, J)$

The Langrangean function is then given by:

(8) $\sum_{i=2}^{4J} (x_i - x_{i-1})^2 - \sum_{k=1}^{J} \lambda_k \left(\sum_{i=4k-3}^{4k} (x_i - y_k) \right.$

Solving (8), we obtain the system:

(9) $$\begin{bmatrix} B & -J^T \\ J & 0 \end{bmatrix} \begin{bmatrix} x \\ l \end{bmatrix} = \begin{bmatrix} 0 \\ y^T \end{bmatrix}$$

where:

$$B = \begin{bmatrix} 2 & -2 & & & & & \\ -2 & 4 & -2 & & & & \\ & -2 & 4 & -2 & -2 & 4 & 2 \\ & & & & & -2 & 2 \end{bmatrix}$$

and

$$J = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \end{bmatrix}$$

$$l^T = \begin{bmatrix} \lambda_1, & \lambda_2, & \ldots & , \lambda_J \end{bmatrix}$$

A second quarterly series was derived from Equation (9). Solution of the system require the inversion of the matrix $\begin{bmatrix} B & - & J^T \\ J & - & 0 \end{bmatrix}$ of order 5_J x 5_J, and this was done using a FORTRAN programme.

This procedure circumvents the problems associated with the L-S technique, but has been shown to produce an "S" shaped quarterly series when the annual trend is rising continuously. This is clearly an undesirable result, for it seems "reasonable" to require the quarterly figures of a monotonically increasing annual series to lie on a positively sloped straight line.

Thus Lesser (1961) suggests that quarterly figures should be inferred by minimising the sum of squares of the second differences between successive quarterly values:

(10) $Min \sum_{i=2}^{4J} (\Delta\ x_i - \Delta\ x_{i-1})^2$

where:

$\Delta\ x_i = \Delta\ x_{i+1} - x_i$

subject to:

(11) $\sum_{i=}^{4} x_i = y_J$

Forming the Langrangean function and solving:

(12) $$\begin{bmatrix} C & - J \\ J & 0 \end{bmatrix} \begin{bmatrix} x \\ l \end{bmatrix} = \begin{bmatrix} 0 \\ t \end{bmatrix}$$

where:

$$C = \begin{bmatrix} 2 & -4 & 2 & & & & \\ -4 & 10 & -8 & 2 & & & \\ 2 & -8 & 12 & 12 & & & \\ & 2 & -8 & -8 & & & \\ & & & -2 & 8 & 10 & -4 \\ & & & & 2 & 4 & -2 \end{bmatrix}$$

This procedure satisfies the summation condition that $\Sigma \; x_i = y_t$. Furthermore, there is symmetry in the sense of L-S, and the cycle requirements are satisfied. In addition, if yearly totals increase in equal amounts, the quarterly figures lie on a straight line trend. It would therefore appear that the Lesser interpolation technique is theoretically superior to the L-S and Boot et al procedures.

However, having obtained quarterly figures using all three techniques, these were substituted into the price equation (22), output equation (27), and the mark-up equation (8). The estimates thus obtained were compared with the results of regressions using annual data. It was discovered that only the L-S series yielded results which were consistent with the annual estimates. Thus the estimates reported in the study are all based on the L-S series.

APPENDIX 2

DIRECT ESTIMATION OF THE EQUILIBRIUM RESPONSE: THE REPARAMETERISATION PROCEDURE

Bewley (1979) has described a simple algebraic procedure for reparameterising linear dynamic models in a form which enables the equilibrium coefficients to be estimated directly. For expository convenience, we describe here the procedure for a static partial adjustment model. The technique can readily be extended to more complex dynamic systems.

Consider the equilibrium relation:

(1) $Y^*_t = B X_t$

where:

Y^*_t = n x 1 vector of the equilibrium value of Y

X_t = k x 1 vector of exogenous variables

B = n x k matrix of unknown equilibrium parameters

Assume that in the short run agents adjust to Y^* by means of the familiar partial adjustment model:

(2) $\Delta Y_t = A(Y^*_t - Y_{t-1}) + u_t$

where:

A = n x n matrix of adjustment parameters

u = vector of disturbances with $E(u_t) = 0$ and $E(u_t u_s) = 0, t \neq s$.

Substituting (1) into (2) we obtain the short run disequilibrium regression equation:

(3) $\Delta Y_t = C X_t - A Y_{t-1} + u_t$

where:

$C = A B$

The usual regression coefficients in short run disequilibrium models are based on C (= A B). However, concern here is focused on the long run coefficients in B. Since C and B are non-linearly related, direct estimation of A in Equation (3) is clearly difficult.

Bewley (1979) therefore suggests the following reparameterisation:

Premultiply (3) by A^{-1}

(4) $A^{-1} \Delta Y_t = B X_t - Y_{t-1} + A^{-1} u_t$

Let $A^{-1} = (I - P)$, so that rearranging (4) we obtain:

(5) $Y_t = P \Delta Y_t + B X_t + v_t$

where: $v_t = A^{-1} u_t$, $E(v_t) = 0$ and $E(v_t, v_s) = 0$, $t \neq s$.

We can directly estimate (5) and hence obtain the equilibrium responses in matrix B. The results reported in Table 7.2 are based on this reparameterisation procedure extended to take account of dynamic responses.

APPENDIX 3

DATA SOURCES

c = International Competitiveness from Economic Trends

d = Demand = Wharton Capacity Index based on output from Economic trends.

b.d = Budget Deficit from Economic Trends and Savage (1982) and Biswas et al (1985).

p = Price of value added in manufacturing derived from Economic Trends and/or National Income and Expenditure

w = Wage Costs derived from Economic Trends and National Income and Expenditure.

pr = Consumer price Index derived from Economic Trends

r = Raw Material Costs derived from Economic Trends

r.r = Retention Ratio from Tarling and Wilkonson (1979) and Economic Trends.

m = Import Prices derived from Economic Trends

q = Manufacturing Output obtained from Economic Trends

i t = Indirect Taxes = (GDP Nominal - GDP Real - Business Rates) GDP Nominal and GDP Real from Economic Trends

t = Rates in the Manufacturing Sector from CIPFA Statistics Scotland; CIPFA Statistics England and Wales and National Income and Expenditure.

t_A = Total Business Rates from CIPFA Statistics Scotland, and CIPFA Statistics England and Wales

u = Unemployment from Economic Trends.

v = Vacancies from Economic Trends.

M3 from Economic Trends.

£M3 from Economic Trends.

NOTES TO CHAPTER SEVEN

1. Stated differently our assumption implies that the objectives are perfect complements. Thus increased "consumption" of one objective is accompanied by higher "consumption" of the other.

2. We require this assumption to circumvent the logical shortcomings of the perfect competititon model noted by Arrow (1959): If all producers and consumers are price takers, then prices can never be changed.

3. The linearisation procedure is based on Beath (1979) and is as follows.

   We have:

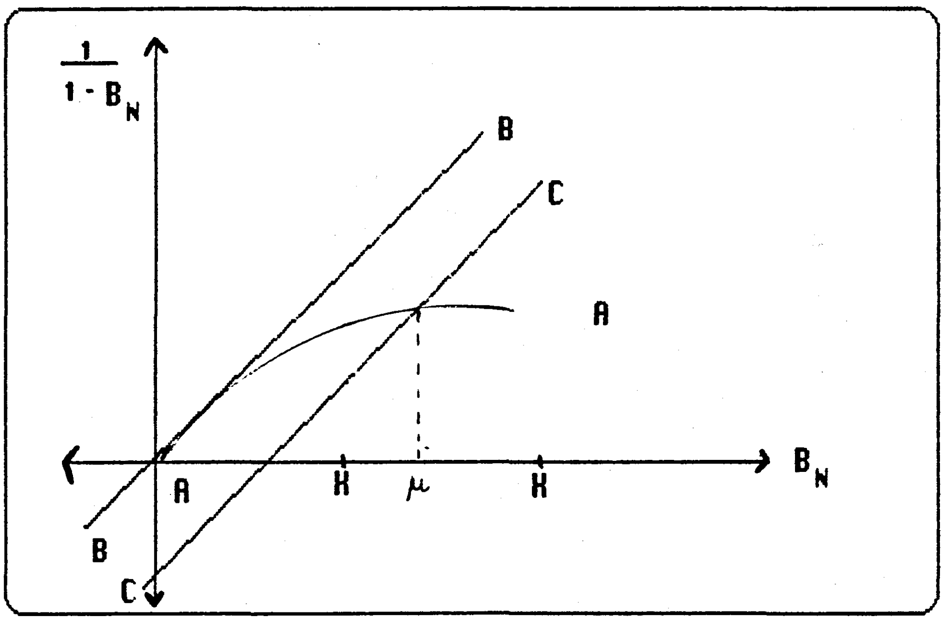
$$P^* = \left[\frac{1}{1 - B_N}\right] \left[\frac{T}{Q^e} + w^e\right]$$

Taking logs and rearranging:

$$\text{In}\,P - \text{In}\,w^e = C + B_N\,\text{In}\,(\frac{T}{Q^e})$$

$$\text{where: } C = .\text{In}\,\frac{1}{1 - B_N} + B_N^2\,\text{In}\,\frac{T}{Q^e} + B_N^3\,\text{In}\,\frac{T}{Q^e} + \ldots.$$

Since C approximates all the higher order terms in the expansion $\frac{1}{1 - B_N}$ we would expect it to be negative. Thus consider the diagram below which depicts the relationship between our approximation B_N and the actual coefficient $\frac{1}{1 - B_N}$. Let AA denote the true relationship, and B B our linear approximation. Clearly, $\frac{1}{1 - B_N} = B_N$ only at the origin. Hence at the origin, we get an accurate estimate of the mark-up.



However, the observations will lie somewhere along AA - say in the range XX with sample mean μ. Thus, *a priori* we would expect a negative constant. The final results presented in Table 7.1 confirm this.

4. See Chapter 6 for the definition of absolute differential and budget incidence effects.

5. The Wickens (1982) procedure cannot be used in the mark-up equation since the dependent variable is defined as $(p_t - w^e)$ rather than $(p_t - w_t)^e$, and hence is not in expectational form. This is discussed in detail in the following section.

6. It is recognised that the RE and WRE versions are not strictly non-nested equations. A set of equations are said to be non-nested if neither equation can be derived as a special case of the others. It will be recalled that Wallis (1980) showed that a linear RE model can be expressed in terms of a univariate time series equation (termed here WRE) However, the forecast error of the time series model is greater than that of an RE prediction. Hence, while the predictions of the RE and WRE versions differ, the two models are in fact algebraically related and therefore cannot be strictly defined as non-nested hypotheses. However, in so far as the Cox-test is merely a test of variances, the results of the procedure can be seen to yield approximate results.

7. Thus, published accounts of P.L.C.s frequently reveal that rates are paid in advance for either quarterly or half yearly. Further anecdotal evidence to support this assertion was obtained from a random sample of thirty firms audited by a large firm of chartered accountants. It was found that 14 paid their rate bills half yearly, 11 quarterly and the remainder annually. For reasons of confidentiality, the author is unable to reveal either the name of the auditors, or the Companies involved.

CHAPTER EIGHT

CONCLUSIONS:

The effective incidence of the non-domestic property tax is an issue which either by design or default has been consistently ignored in much of the literature on the rating system. Proposals for the reform of the system have consequently been based on the theoretically and empirically unsubstantiated assumption that the formal and effective incidence of the non-domestic property tax are identical. The present study has thus endeavoured to remedy this deficiency and infer the incidence of the non-domestic property tax. However, the analysis has not been concerned with detailed proposals for reform of the property tax, or the desirability of any particular change. The intention has been to provide further insight into the effective incidence, rather than answers to current policy problems. Consequently, much of the discussion has been concerned with theoretical issues, and in developing a coherent framework to empirically infer the incidence of the non-domestic property tax.

Incidence theory is a notoriously controversial issue, over which opposing schools of thought have long waged an intense but inconclusive battle. In part, the disagreements appear to arise because of the failure to trace the full consequences of a tax. Thus, in Chapter 2, it was argued that the main differences between the "traditional view" and the "new view" of the property tax arise from the secondary or general equilibrium effects which may offset the direct impact of the tax. The "traditional view" concluded that a tax on property is shifted forward into prices. This result stems from the fact that the analysis is confined to the effects of the tax on one market in isolation, hence the taxed factor (property) is assumed to be perfectly elastic in supply. In contrast, the "new view" analyses the impact of the property tax in an economy-wide context in which the supply of factors of production are fixed. It follows that the burden of a uniform property tax falls entirely on its legal base, i.e. property owners. In part, this conclusion derives from the plethora of stringent assumptions which are employed in general equilibrium theory. The models abstract from the aggregate demand effects of taxation, and assume that factors of production are fully employed and all markets are perfectly competitive. Given this entourage of assumptions, a tax can only be shifted by varying the supply of the taxed factor or product. In a closed economy, a uniform tax on land or capital is a clear case where the taxed factor cannot be decreased, hence the entire burden of the property tax is borne by the owners of land and property. In section 2.2, this conclusion was shown to endure the introduction of the public sector (Henderson (1985)), a variable supply of land (Sonstellie (1979)), and an endogenously determined intermediate product (termed capital) (Breuckner (1981)). This result is not surprising, for none of these extensions of the standard two-sector model alter the basic tax shifting mechanisms, or allow factor supplies to vary.

In contrast, the introduction of risk induced portfolio changes in a one sector neoclassical model revealed that if uniform property taxes are fully capitalised into lower land values, the riskiness of land vis-a-vis other assets declines. Thus the demand for land increases and land prices rise. That is, part of a uniform land tax is shifted to other factors of production.

Similarly, in the analysis of the dynamic incidence of the property tax, it was discovered that a uniform tax on capital may be fully shifted to labour. This result stems from the fact that in growth models labour is treated as a primary factor, while capital is assumed to depend on saving out of labour and capital income. Thus, a tax on capital lowers its net returns and decreases savings and the stock of capital. In turn, the reduced supply of capital raises its marginal product, and net returns increase. In the extreme case, where there are no savings out of wages, the decline in the capital stock is sufficient to ensure that the tax is fully shifted to labour. The analysis of the dynamic incidence of the tax therefore suggests that a uniform property tax which appears progressive in a static framework might, as a result of changes in factor supplies, be highly regressive.

The policy implications of this conclusion are apparent: The dynamic and secondary effects of the property tax may well offset the initial or direct impact. Hence, policy recommendations based on the formal incidence may well have the reverse of their intended effects. What is needed is a clear recognition of the general equilibrium repercussions of the property tax, and an adequate model in which to incorporate these. This, however, leads to a second major source of controversy in the incidence literature - the model which is to be used to describe the economy.

In general, there appears to be little disagreement over the need to analyse property tax incidence within a general equilibrium system. What is at issue is the nature of the model to be used, and in particular, the assumptions about the structure of markets within which firms operate. In section 2.3, we argued that the response of firms to the property tax depends crucially on the assumed form of competition. The analysis focused on the consequences of introducing monopolistic competition and oligopoly in the standard two sector general equilibrium model.

Under monopolistic competition, a uniform property tax once again falls wholly on its legal base. However, the number of firms, and hence market structure are affected by the tax. In contrast, under oligopoly, the assumed form of collusive behaviour and retaliatory actions provide an additional mechanism through which a uniform property tax may be shifted. Specifically, the model assumed that collusion takes the form of output quotas. If any firm cheats, the cartel is dissolved and output reverts back to its Nash level. Thus cheating is only profitable if the current higher profits from cheating exceed the discounted future lower profits from the dissolution of the cartel. Since profit maximising firms discount future profits and losses by the rate of return on capital. an increase in property taxes which initially lowers profits serves to raise the present value of future losses from cheating. Thus, cartel output can be further restricted thereby raising prices and profits.

The assumed form of competition has further implications for incidence theory. If the economy is dominated by price setting oligopolists, agents may transact at false (i.e. non-market clearing) prices. and hence effective and notional demands and supplies will diverge. In this situation, equivalent property tax and government expenditure changes will affect not only the distribution of income. but also its level. Thus in the amended Post-Keynesian non-competitive model, balanced property tax and government expenditure increases raise consumption flows which augment aggregate demand, thereby raising employment output and profits. It follows that in the short run, none of the burden of a uniform property tax falls on firms. In contrast, property tax differentials in the Post-Keynesian world may be shifted forward into prices if firms enjoy a sufficient amount of market power. However. unless the tax is fully shifted into prices, property tax differentials will lead to variations in net profits which will induce movements of capital between sectors and regions in the long run. By ignoring these tax induced supply side shifts. Post-Keynesian theory appears to be crucially incomplete.

The second major component of this study is the empirical analysis in Chapters 4-7. In Chapter 4, we reviewed the existing empirical literature on the impact of the non-domestic property tax in the UK. Thus section 4.2 discussed the Crawford, Fotherfill and Monk (1985) (C.FM) and Gripaios and Brooks' (1984) studies on the effect of non-domestic property taxes on regional employment. It was suggested that the authors failed to distinguish between the final impact of the property tax on employment, and the mechanisms through which the tax may affect employment. Hence property taxes were found to be highly correlated with the main explanatory variables in the regression equations. It was further argued that CFM's estimation procedures were statistically flawed and their results theoretically incompatible. In contrast, Gripaios and Brooks' conclusions appeared to be consistent with a broadly Keynesian view of property taxation in which balanced tax and government expenditure increases raise aggregate demand and employment. In addition, Chapter 4 reviewed Bennett's (1986b) estimates of the effective property tax rates, and Mair's (1986) investigation of the impact of property taxes on prices. Both these studies appear to suggest that non-domestic property tax rate differentials between sectors are substantial, and hence the allocative impact of the tax is likely to be highly distortionary, with the incidence falling primarily on firms.

Thus in Chapter 5, we developed a hierarchical general equilibrium model to estimate the effective incidence of the non-domestic property tax.

The model attempted to extend Harberger's (1962) pioneering analysis by introducing a stylised production hierarchy based on the observed flows of intermediate goods in the UK economy. Employing the usual entourage of general equilibrium assumptions (i.e. perfect markets, full employment, fixed factors, etc.) it was shown that the spirit of Harberger's conclusions are unaffected by the introduction of a complex hierarchy. Furthermore, the model was used to discern the "differential" incidence of varying tax rates at various levels of the production hierarchy. Finally, estimates of the incidence of the property tax were derived from the algebraic solution of the model. However, in the absence of data on cross-elasticities of substitution in demand and supply, the magnitude of key parameters were assumed *a-priori* and varied in an attempt to assess the sensitivity of the results to a particular parameter. We further investigated the empirical consequences of introducing factor complementarity in the model. Overall, the simulations revealed that capital bears much of the burden of the non-domestic property tax.

However, the algebraic expression used to estimate the incidence contained a large number of elasticities, so that the robustness of the results to any single parameter may be of little significance. A further difficulty stems from the fact that the general equilibrium model merely imposes functional forms on the data, rather than empirically verifying the validity of the assumed restrictions. As noted earlier, there are several competing models in the literature and each yields a different algebraic solution and estimate of tax incidence. The general equilibrium method does not provide a means for discriminating between models, for no statistical testing is involved. Thus, conflicting theories cannot be empirically falsified within this framework.

These criticisms suggest that we require an alternative method to infer the incidence of property taxes. Hence, Chapter 6 reviewed the main quantitiative techniques used in public finance to measure the impact of taxes. It was argued that while the income distribution method is inappropriate for analysing the incidence of a broad based tax, the general equilibrium estimates depend crucially on unverified assumptions regarding the structure of the economy. In contrast, econometric procedures, while not perfect, provide a framework for refuting hypotheses and generating data coherent estimates. Chapter 6 thus discussed a procedure widely used in econometrics to estimate data admissible short run dynamic adjustment models.

These techniques were employed in Chapter 7 to derive estimates of the degree of forward shifting of the property tax in the manufacturing sector. In common with empirical studies on the incidence of the corporation tax, the estimates were based on a model of mark-up pricing. This class of models have obtained widespread empirical support, and appear to be increasingly accepted as an explanation of price determination in the manufacturing sector. The form of the mark-up equation was derived from a theoretical model of price setting behaviour, and was found to depend on expected costs. Thus, one of the questions investigated in the study was the process by which agents form expectations. We considered three processes of expectation formation: A first order autoregressive scheme, an extrapolative univariate time series predictor, and rational expectations. The expectations procedures were discussed in some detail, and on the basis of a likelihood ratio test, and a non-nested Cox test, it was discovered that the autoregressive scheme and rational expectations forecasts could be rejected in favour of the time series extrapolative predictions.

However, all three models revealed that less than 14% of the property tax is shifted forward into prices and that the mark-up is sensitive to demand (as measured by a Wharton capactiy index). Furthermore, the value of the estimated long run equilibrium parameters suggested that demand exerts an equiproportionate effect on prices, and that property taxes are shifted forward independently of any demand effects.

Chapter 7 further investigated the theoretical implications of these results. Since part of the property tax burden is shifted into prices in the short run and the mark-up was found to be responsive to demand, the results cannot be readily reconciled with either Post-Keynesian or neoclassical incidence theories. However, the results do appear to be consistent with the general equilibrium model which incorporates an oligopolistic sector. It will be recalled that within this framework an increase in property taxes initially lowers profits, thereby increasing the present value of future losses from cheating. This permits cartel output to be lowered and prices and profits rise. One may arguably view this conclusion as evidence in favour of oligopolistic behaviour in the manufacturing sector.

These results appear to present a number of immediate possibilities for further empirical and theoretical research. The present study has been undertaken at a high level of aggregation. In part, this reflects the paucity of regional and sectoral data on costs, prices and profits. However, it would clearly be useful to explore the impact of the property tax at a greater level of disaggregation. It will be recalled that we were unable to adequately test the Post-Keynesian assertion that equivalent property tax and govern ment expenditure increases raise output. In part, this resulted from the difficulties involved in separating the impact of the property tax from the effect of other fiscal instruments. At a more disaggregated level, these problems are likely to be less severe since most taxes are levied nationally.

The measure of tax shifting used in our econometric study was based on the mark-up. It was argued that the mark-up yields a reliable measure of the tax burden only if the capital stock is held constant. Consequently, the analysis focused on the short run impact of the property tax. The orientation once again reflects the lack of reliable data on capital. If sufficient information can be obtained, it is clearly important to infer the long run incidence, both in the aggregate and at the industry level.

The study suggests a number of areas for further theoretical research. Despite the burgeoning of incidence theories, there seem to be important deficiencies in the literature. It will be recalled that neoclassical general equilibrium models typically neutralise the aggregate demand effects of taxes and concentrate wholly on the supply side shifts (i.e. the "output" and "substitution" effects). In contrast, the Post-Keynesian model aggregates heterogeneous products into a single multipurpose good, thereby precluding short run supply variations. The analysis thus focuses on macro-relations and the aggregate demand effects of the property tax. However, in the Post-Keynesian world, differential property taxes are shifted forward only if firms enjoy sufficient market power. It follows that unless the differential component of the tax is fully shifted, net profits will vary thereby inducing capital flows between sectors and regions in the long run. Clearly, the final incidence of the property tax will depend on the combined impact of both demand and supply side changes. The separation of the two effects in the theoretical literature therefore appears difficult to justify. In other areas of economics (such as international trade) this gap has been narrowed considerably. There exists a substantial body of literature on disequilibrium macro theory which could readily be used in public finance; notable examples being Clower (1962) and Barro and Grossman (1976).

The empirical results further suggest that firm behaviour in the manufacturing sector is best described by a model of oligopoly. One may view this as implying that future research should attempt to further explore the consequences of oligopoly in general equilibrium tax incidence models. In particular it would seem useful to assess the consequences of introducing alternative collusive strategies and forms of retaliation in the standard two sector model. Despite its shortcomings, the general equilibrium method is firmly established in public finance and is therefore unlikely to be abandoned. As a tool for policy analysis, it appears to serve a potentially important purpose. However, the challenge lies in recognising its limitations and in interpreting the results with care.

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