A Methodology of Fiscal Incidence Using
A Social Accounting Matrix Framework and the Harberger Model

by

BORIS PLESKOVIC

Dipl. Eng. and Arch., University of Ljubljana
(1972)

M.A., Urban Design, Harvard University
(1978)

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Signature of Author ______________________
Department of Urban Studies and Planning
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Certified by ______________________
Karen R. Polenske
Dissertation Supervisor

Accepted by ______________________
Department Head

ABSTRACT

This study presents an overview of the planning techniques recently used in empirical income distribution studies. The principal tools reviewed are a Social Accounting Matrix (SAM) framework and the methodology of conventional empirical fiscal incidence studies. A new methodology for the improvement of empirical fiscal incidence studies is proposed. The proposed methodology consists of linking two different concepts: (1) a SAM data framework, and (2) the Harberger general equilibrium model of tax incidence. As demonstrated by the study, such an approach considerably improves the data base of empirical studies of fiscal incidence. The approach is also very useful in general on the modeling side, because it facilitates the explicit expression of the linkages between the accounting structure of the data base and the accounting structure of the Harberger model, including simultaneous relationships between prices, incomes, and the structure of production. In this way the data of empirical fiscal incidence studies are put into perspective, i.e., a SAM concept facilitates compilation, organization, reconciliation, and presentation of the data needed for tax incidence analysis. On the modeling side, a SAM framework facilitates a solution of the Harberger model, its extensions and modifications, as well as applications to the actual country data base.

This methodology is applied to a SAM for Egypt. The results of the SAM model provide some insights into the distributional implications that would arise from various changes in domestic commodity taxes and subsidies in Egypt. Recommendations for future research include modifications of some of the basic assumptions of the model (such as treatment of foreign trade, consumption, and intrasectoral distribution) and various possible disaggregations of a SAM data framework. The approach developed in this study deals only with the analysis of tax incidence of domestic taxes. An approach dealing with foreign trade and taxation is contained within the effective protection literature. This study recommends that ideally the best solution to the absence of foreign taxes in the conventional tax incidence analysis requires a combination of these two different approaches. In this respect, the approach developed in this study establishes the groundwork necessary to achieve such a synthesis.

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1/ Karen R. Polenske (1980). The U.S. Multiregional Input-Output Accounts and Model. Lexington, Massachusetts: Lexington Books.

To my parents

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CHAPTER I

INTRODUCTION

The starting point of this study is a concern with income redistribution in developing countries. There are many ways in which income distribution can be altered. One of these, probably the most important, is through government fiscal policies, i.e., through taxation and public spending. However, an immediate question that arises is how to measure the income redistribution through public finance, and what data and techniques (tools) are available to analysts and to policymakers for policy analysis and recommendations. As it appears in the development literature, an important technique that has been widely used recently in income distribution studies for data compilation, organization and reconciliation, and also for economic modeling purposes, is a Social Accounting Matrix (SAM). The SAM framework has several uses, one of which is a recent emphasis on commodity disaggregations, that allows the gathering, organization, and presentation, in a consistent manner, of a data base on taxation. It has been this recent focus of the SAM framework and an initial attempt to evaluate tax incidence using a SAM by Pyatt (1981a) and Newlyn (1980), that also initiated this study.

However, in order to carry out a study that could expand the SAM framework for tax incidence analysis, two basic prerequisites are necessary. One of these is a basic understanding and knowledge about the present uses and the conceptual potential of a SAM framework as a tool for data organization and economic analysis. On the other hand, it is necessary to know the most common techniques and concepts used for fiscal incidence analysis, that could be linked to the SAM framework and used for an emirical analysis of fiscal incidence. For these reasons, this study proceeded from two different angles. One of these is a review and analysis of the basic concepts of the SAM, and the other is a review of the conventional empirical studies of fiscal incidence. However, because the SAM concept has not been used explicitly in the past for fiscal incidence analysis, and because there is no single tool (that does not have several shortcomings) in the conventional fiscal incidence literature, a new approach has been developed in this study for empirical tax incidence analysis. In essence, this approach consists of linking together two different concepts, i.e., the SAM framework and a modified Harberger general equilibrium model of tax incidence. The approach is outlined at the end of this chapter, and is developed in more detail in subsequent chapters. An application of this approach to a SAM for Egypt is presented in Chapter V. The next two sections present a brief introduction to the SAM concept, and a short review of the basic concepts and limitations of the conventional empirical fiscal incidence studies.

An Introduction to the SAM Framework

In the last decade, the major international institutions--the I.L.O., the U.N., and the World Bank--have been supporting improvements of national accounting systems and/or modeling efforts to study policies for income distribution and employment in developing countries. Several large-scale models evolved that deal explicitly with income distribution issues. A common denominator to these economic models is the social accounting matrix (SAM). Pyatt et al. (1972) developed a model for Iran where income and factor payments are endogenous. Pyatt and Roe (1977) produced a social accounting matrix for Sri Lanka, and Pyatt and Thorbecke (1976) described the conceptual framework. Other recent work in this area, which is explicitly or implicitly based on a SAM, includes the computable general equilibrium (CGE) models of Adelman and Robinson (1978) on Korea, Lysy and Taylor (1978) on Brazil, Eckaus et al. (1981) on Egypt, the macroeconomic model of Drud et al. (1982) on Thailand, and work by Dervis et al. (1982).

The case for a social accounting matrix (SAM) approach to macroeconomic data systems has been set out by the United Nations in UNSO (1968). Recent adaptations of this system of national accounts (extensions of the input-output framework) in developing countries were conceived as an initial step towards understanding income distribution, and social accounting matrices have been developed in parallel with work on planning models. In essence, a social accounting matrix is a consistent data system that provides comprehensive base-year information on such variables as: (a) the structure, composition and level of production; (b) the factoral value added; and (c) the distribution of income among household groups. Typically, a SAM is structured around an input-output table, and includes summary statistics on consumption and production patterns, exports, imports, investment, and savings. Depending on the particular issues of interest and the data available, a SAM may include more detailed information on income distribution, tax structure, and monetary variables. The most important feature of a social accounting matrix is that it provides a consistent and convenient approach to organizing economic data for a country, and it can provide a basis and a starting point for improving modeling efforts in order to answer various economic policy questions.

Empirical Studies of Fiscal Incidence

A number of empirical studies for different countries have been carried out in recent years which estimate tax burden and expenditure benefits by household groups. Two countries where studies of income redistribution through public finance have been most frequently undertaken since the Second World War are the United Kingdom and the United States of America (Ruggles and O'Higgins 1981). In the United Kingdom, the Government Central Statistical Office (CSO) has carried out such studies annually for the past twenty years, and its analyses and related papers constitute almost the entire body of empirical work on this subject in the United Kingdom (Nicholson 1974, 1977; O'Higgins and Ruggles 1981). The same type of studies, although academic rather than governmental, have been nearly as frequent in the United States (Colm and Tarasov 1941; Musgrave et al. 1951, 1974; Gillespe 1965; Pechman and Okner 1974; Ruggles 1980; Okner 1980). Among the less developed countries the most represented region in this respect is Latin America, with over 25 studies being conducted in twelve countries (Bird and De Wulf 1973).

A common denominator to these studies is their basic methodology, i.e., the differential incidence approach, which, although it has changed over the years, has not advanced considerably. The changes reflect more the increased availability of data coverage, changes made with respect to basic assumptions about allocation of taxes, and the greater emphasis on redistributional government policies, rather than improvement in the theoretical underpinnings of these studies.

It should be made clear initially that no study in any country has attempted the probably impossible task of tracing the total effects of government finance on the economy, or on the distribution of income in the economy among different subgroups. Instead, most studies, in essence, compare the observed incomes net of taxes under the existing tax system with those that, it is assumed, would prevail if the same revenue were collected through a proportional tax. This "differential incidence" approach was employed because taxes cannot simply be subtracted from the income in order to yield an estimate of after-tax incomes, and a proportional tax is assumed to be the most neutral alternative means to finance government expenditure. Musgrave and Musgrave (1980) define this "differential incidence" as distributional changes that result if one tax is substituted for another while total revenue and expenditures are held constant. The resulting total change in the state of distribution is referred to as differential incidence. In other words, substitution of one tax for another will improve the position of some households and worsen that of the others. Changes in the position of any one household may be measured in terms of the resulting change in its real income.

Early studies in the United States concentrated on the tax side, reflecting the greater difficulties encountered when dealing with public expenditures, but Gillespe's 1965 study made clear the extent to which it is possible to allocate expenditures (using alternative assumptions where necessary), and thus to assess the redistributive impacts of both parts of the public finance system. Basic differences between the recent studies are the variations made in the assumptions of allocating taxes and expenditure benefits, and the quality and scope of coverage of their data base.

Limitations of Redistributional Studies

There are several problems with the methodology of conventional empirical studies that attempt to measure income redistribution through public finance. The first weakness of these empirical studies is that in these studies, analysts allocate the total tax burden by income groups under assumptions that ignore many findings developed in the theoretical literature of tax incidence. The second major weakness of these studies is a lack of sufficient and reliable data, especially for developing countries. The data of these studies are weak, especially with respect to income distribution.

The first weakness of the conventional empirical studies is caused by the fact that there is a wide gap between theoretical and empirical tax incidence studies. On the one hand, the empirical work has yet to incorporate many of the concerns that arise in the theoretical literature. On the other hand, many of the theoretical models are far removed from being empirically implementable (Atkinson and Stiglitz 1980). However, so far no alternative to these conventional empirical studies of the incidence of all direct and indirect taxes has been proposed.

Approached in rigorous terms, the problem involves full-fledged general equilibrium analysis with all its difficulties. However, most of the existing theoretical general equilibrium models, although they give useful insights into the distributional impact of (tax) policy measures, are very aggregate, rely on simplifying assumptions, and thus give approximate results. No detailed, highly disaggregated economy-wide general equilibrium model that could take into account all the available statistical data on taxation for an economy and closely approximate behavioral relationships (e.g., functioning of markets and behavior of firms) has been built so far. And nonavailability of detailed and appropriate data precluded any extensive econometric work in this area (Boskin 1976). Therefore, the limitations of tax incidence studies apply to both empirical studies and theoretical general equilibrium models, i.e., to the methodology of redistributional studies in general.

The second weakness of empirical fiscal incidence studies is the organization, presentation, and reconciliation of the statistical data used. These studies require substantial time to implement, and do not have a common organizational framework that could improve clarity of presentation of their basic data, their results, as well as facilitate a comparison over years (time) and among the studies themselves. On the data side, the major problem of these studies is with income distribution estimates. The studies deal with the redistributive effects of government revenues, and the most common approach is to attempt to distribute the tax burden by income size classes or household groups. Because of the lack of data on income distribution in developing countries, most analysts have used any available size classification that seemed halfway reliable (Bird and De Wulf 1973). For example, in Latin America, where most of these studies were conducted, a number of techniques have been used to estimate the income distribution in particular countries. These vary from specially constructed income distribution series (McLure 1971) to the simple assumption that the income distribution of Venezuela is a good enough approximation to the income distribution of other Latin American countries to permit the study of tax incidence for these countries on the basis of the Venezuelan income distribution (Musgrave 1965). This latter assumption is obviously crude, as illustrated by Hunt (1971) for Peru, where a substantial change in the structure of effective tax rates resulted when the Colombian income distribution was used instead of the Venezuelan one. Some analysts are aware of low reliability of their results, for example, as stated by McLure (1971, pp. 239-40):

> It must be recognized at the outset that because of the difficulty of obtaining data on income distribution, the estimates ... can give no more than rough indications of the true patterns. Thus, these should be interpreted with extreme caution.

Besides problems with income distribution data, these studies have to deal with numerous and various sources that do not agree with each other. For example, different sources of data such as national accounts, household income and expenditure surveys, population census, taxation data, and various other sources that constitute a basis for these empirical studies, have to be adjusted each time in order to achieve consistency. Presently, these adjustments depend on the inventiveness of the investigator. No technique or framework has been used to improve consistency of data, or to allow for use of statistical techniques for reconciliation. All of these would, however, help to provide a common procedure.

The primary purpose and premise for the continuous and large number of conventional empirical tax incidence studies that have been undertaken has been that even "approximate" information is better than a random choice (Musgrave et al. 1974). Thus, although these empirical studies have several limitations (common also for most theoretical studies) because they are based on simplifying assumptions and a methodology that falls short of a full general equilibrium approach, the studies have nevertheless been important as a contribution for policy information. Policymakers make assumptions every day regarding the distribution burden of various taxes, and the question for the tax expert or economist is whether and how to help in formulating the assumptions.

Therefore, the question is not whether one can wait until the science progresses enough to give a "definite" answer to some of the difficult aspects of fiscal incidence, but rather whether the existing methodology of tax incidence (including empirical studies) can be improved so as to be able, at least partially, to close the gap between theoretical and empirical findings and to provide policymakers with improved tools of analysis of fiscal incidence. The basic point with respect to the issues raised above is simply that "scientific information" is only acquired at the intersection of theoretical and empirical research. There are three ways in which knowledge can be improved: (1) new and better theoretical insights may be developed;

(2) more and improved data may be obtained, or both; and (3) superior methods by which to analyze data may be developed. The following section will outline the ways in which empirical fiscal studies could be improved along these lines.

Suggestions for Improvement of Redistributional Studies

As it appears, there is a need for: (1) an organizational framework to bring the data of fiscal incidence studies under one single organizational concept, and (2) a need for a technique that could easily translate these adjusted and reconciled data into a picture of tax incidence and expenditure benefits for a particular country, i.e., to develop superior methods by which to analyze the data.

An organizational framework for the data base would prove especially useful for the developing counries where the scarcity of data require the best use of available information, and where such a framework can be the most helpful to bridge the gaps in the data, either by clearly stated and documented assumptions on the basis of well-documented secondary sources, or by using available statistical techniques. There is also a need to facilitate updating of such empirical studies in order to compare them over time.

Another area for potential improvement of these empirical studies is to show clearly the relationship between the alternative assumptions made about incidence of different taxes (tax shifting) and the sensitivity of the final results obtained. As Atkinson and Stiglitz (1980) note, any future investigation of empirical studies is likely to lead to results conditional on a range of alternative assumptions. For linking together theoretical considerations and empirical studies, they propose that the standard incidence assumptions of empirical studies should be related to the simple fixed-factor, two-sector models developed in theoretical literature. Thus, these models could be used to evaluate the possible consequences of alternative assumptions and to suggest different approaches. This could be accomplished by presenting the basic features of simple general equilibrium models for a particular tax in relation to the data concept, i.e., by presenting both the models and the data within the same accounting framework.

Organizational Concept -- Data Framework

A data system that is potentially the most promising to bring together an improved solution to some of the problems of empirical studies presented above is a Social Accounting Matrix (SAM).1/ Recently, social accounting has been increasingly and widely used for both (1) data organization and reconciliation, and (2) modeling on the basis of the accounting structure of a SAM. The social accounting matrix is focussed on detailed disaggregation of factor and households accounts and income distribution (as well as production structure)--implying its usefulness for fiscal incidence studies on two grounds. First, a SAM organizes income and expenditure data, which are a primary basis for empirical incidence studies, in a consistent manner. The social accounting matrix closely approximates the final form of data used in empirical incidence studies, with an advantage that it provides a consistent but flexible framework as opposed to tabular and "ad hoc" organization of the data base in the fiscal incidence studies. Second, its focus on income distribution coincides with the focus of fiscal incidence studies, since the major questions confronting public finance and fiscal studies have always been distributional in nature. In this respect, a

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1/ For references to the SAM literature, see Pyatt and Thorbecke (1976), and Pyatt et al. (1977).

methodology that would allow empirical studies of fiscal incidence to be undertaken within a context of a SAM can improve the scope for which the SAMs can be used. Considering the increasing number of SAMs being built for different countries and their recent emphasis on commodity accounts (which permit explicit treatment of indirect taxes and subsidies), a methodology that could translate the data of these SAMs into a picture of fiscal incidence would be an important extension of the present scope of analysis undertaken on the basis of SAMs. It should be noted that an attempt at using the SAM framework for tax incidence analysis has been made by Pyatt (1981a). However, as it appears, his method of "collapsing SAMs" is useful only for apportioning general commodity taxes to household groups (in a static sense), and for reducing the size of a SAM.

On the other hand, the methodology of empirical fiscal incidence can be improved by using the SAM framework because of the following advantages. First, existing or future SAMs provide a ready information on income distribution and taxation. Second, the SAM framework guarantees consistency of the accounting framework. and is well suited for use of statistical techniques for data reconciliation. And finally, SAMs can be used as a basis for modeling purposes.

A Methodology Used in This Study

While the conventional empirical studies of tax incidence are a standard tool for statistical calculations of tax burdens, the Harberger (1962) two-sector general equilibrium model of tax incidence is a technique most often used in the theoretical literature. As noted by McLure (1975) and Nizar (1979), this model, with various modifications and extensions, has become the standard tool of incidence analysis in situations requiring a general equilibrium framework. Although the conventional empirical studies of tax incidence would ideally require a general equilibrium framework, they are actually dealing only with partial equilibrium static analysis of tax incidence, as discussed in the following chapters.

The attempt of this study is to narrow the gap between theoretical and empirical tax incidence studies, and to integrate the advantages of the SAM data framework with some of the theoretical findings developed in the field of tax incidence. For this purpose, the Harberger (1962) general equilibrium model is used in the context of a SAM data framework. Because of the flexibility (Pyatt 1981b) and conceptual features of the SAM data system, the incorporation of the Harberger model into the accounting structure of the SAM, in the first instance, allows the exact correspondence of the algebraic formulation of the Harberger general equilibrium model to be clearly shown within the accounting structure of the data base. Second, as demonstrated in the following chapters, such an approach facilitates the solution of the model, its extensions and modifications, as well as applications to the actual country data base needed for tax incidence analysis. A detailed methodology incorporating the outlines suggested above will be developed in subsequent chapters.

The previous research in the field of empirical studies of fiscal incidence is reviewed in the next chapter. The methodology used in this study is discussed in detail in Chapter III, and it is compared with the methodology of the previous empirical research. This methodology is extended in Chapter IV, where the standard Harberger model written in a SAM framework is modified in order to include preexisting taxes and interindustry transactions, both of which are a part of the SAM framework. The empirical application of the methodology developed in this study to the SAM for Egypt, 1979, is presented in Chapter V. The results and policy implications of this methodology, including recommendations for future research, are discussed in Chapter VI.

References

Adelman, I. and S. Robinson (1978). Income Distribution Policy in Developing Countries: A Case Study of Korea. Stanford University Press and the World Bank.

Atkinson, A. B., and Stiglitz J. E. (1980). Lectures on Public Economics. New York: McGraw-Hill Book Company.

Bird, R. M., and De Wulf, L. H. (1973). "Taxation and Income Distribution in Latin America: A Critical Review of Empirical Studies." International Monetary Fund Staff Papers (January).

Boskin, M. J. (1976). "On Some Recent Econometric Research in Public Finance." American Economic Review (May).

Colm, G., and Tarasov, H. (1941). "Who Pays the Taxes." Temporary National Economic Committee, Monograph No. 3, Washington, D.C.

Dervis, K., J. de Melo, and S. Robinson (1982). General Equilibrium Models for Development Policy. Cambridge University Press, Cambridge.

Drud, A., W. Grais and D. Vujovic (1982). "Thailand: An Analysis of Structural and Non-Structural Adjustments." World Bank Staff Working Paper No. 513, The World Bank, Washington, D.C.

Eckaus, R. S., F. D. McCarthy, and Amir Mohie-Eldin (1981). "A Social Accounting Matrix for Egypt, 1976." Journal of Development Economics, Vol. 9, No. 2, pp. 183-204.

Gillespe, W. I. (1965). "The Effect of Public Expenditures on the Distribution of Income." In R. A. Musgrave (ed.), Essays in Fiscal Federalism, Brookings Institution, Washington, D.C.

Harberger, A. C. (1962). "The Incidence of the Corporation Income Tax." Journal of Political Economy, No. 3, pp. 215-40.

Hunt, S. (1971). "Distribution, Growth, and Government Economic Behavior in Peru." Chapter 11 in G. Ranis (ed.), Government and Economic Development, Yale University Press, pp. 374-416.

Lysy, F., and L. Taylor (1978). "A Computable General Equilibrium Model for the Functional Income Distribution: Experiments for Brazil 1951-1971." The World Bank, Development Research Center, mimeographed.

McLure, C. E., Jr. (1971). "The Incidence of Taxation in Colombia." In Malcolm Gillis (ed.), Fiscal Reform for Colombia: Final Report and Staff Papers of the Colombian Commission on Tax Reform, Harvard University, pp. 239-66.

McLure, C. E., Jr. (1975). "General Equilibrium Incidence Analysis: The Harberger Model After Ten Years." Journal of Public Economics, 4, pp. 125-161.

Musgrave, R. A., Carroll, J. J., Cook, L. D., and Frane, L. (1951). "Distribution of Tax Payments by Income Groups: A Case Study for 1948." National Tax Journal, 4, pp. 1-54.

Musgrave, R. A. (1965). "Estimating the Distribution of the Tax Burden." Chapter 2 in Problems of Tax Administration in Latin America: Papers and Proceedings of a Conference held in Buenos Aires, Argentina.

Musgrave, R. A., Case, K. E., and Leonard, H. (1974). "The Distribution of Fiscal Burdens and Benefits." Public Finance Quarterly (July).

Musgrave, R. A., and Musgrave, P. B. (1980). Public Finance in Theory and Practice. New York: McGraw-Hill Book Company.

Newlyn, W. (1980). "The Effects of Financial Management on Household Income Distribution, West Malaysia 1969-1978." Economic Planning Unit, Kuala Lumpur, mimeographed.

Nicholson, J. L. (1974). "The Distribution and Redistribution of Income in the United Kingdom." In D. Wedderburn (ed.), Poverty, Inequality and Class Structure, Cambridge University Press, London.

Nicholson, J. L. (1977). "How Should Indirect Taxes be Allocated when Estimating the Redistribution of Income?" In A. J. Culyer, and J. Wiseman (eds.), Public Economics and Human Resources, Paris.

Nizar, J. (1979). "Recent Theoretical Developments in Public Finance." Bulletin for International Fiscal Documentation, Vol. 33, No. 7, pp. 321-24.

O'Higgins, M., and Ruggles, P. (1981). "The Distribution of Public Expenditures and Taxes among Households in the United Kingdom." Review of Income and Wealth, No. 3.

Okner, B. A. (1980). "Total U.S. Taxes and Their Effect on the Distribution of Family Income in 1966 and 1970." In H. D. Aaron, and M. J. Boskin (eds.), The Economics of Taxation, Brookings Institution, Washington, D.C.

Pechman, J. A., and Okner, B. A. (1974). Who Bears the Tax Burden?. Brookings Institution, Washington, D.C.

Pyatt, G., et al. (1972). "Employment and Income Policies for Iran." International Labour Office, Geneva.

Pyatt, G., and Thorbecke, E. (1976). Planning Techniques for a Better Future. International Labour Office, Geneva.

Pyatt, G., and A. R. Roe (1977). Social Accounting for Development Planning with Special Reference to Sri Lanka. Cambridge University Press, Cambridge.

Pyatt, G. (1981a). "Collapsing SAMs: A Technique with Particular Relevance for the Computation of Tax Incidence." The World Bank, Development Research Center, mimeographed.

Pyatt, G. (1981b). "A Lecture on Social Accounting Matrices Presented at MIT." The World Bank, Development Research Center, mimeographed (April).

Ruggles, P. (1980). "The Allocation of Taxes and Government Expenditures among Households in the United States." Unpublished Ph.D. dissertation, Harvard University.

Ruggles, P., and O'Higgins, M. (1981). "The Distribution of Public Expenditure among Households in the United States." Review of Income and Wealth, No. 2.

United Nations Statistical Office (1968). A System of National Accounts, Studies and Methods. Series F, No. 2, Rev. 3, New York.

CHAPTER II

METHODOLOGY OF FISCAL INCIDENCE IN EMPIRICAL STUDIES

Purpose of Analysis and Underlying Theory

Increasing concern with income distribution in recent years has initiated numerous empirical studies that attempt to estimate the incidence of different aspects of public activity. Traditionally, the focus of these studies has been on tax incidence. Recently, there have been numerous estimates of the incidence of total public expenditures (Musgrave, et al., 1974; Ruggles 1980; Meerman 1979). Some studies combined the two types of incidence into fiscal or budget incidence. The following chapter will review the purpose and underlying theory of all three types of empirical incidence studies: (1) tax incidence, (2) expenditure incidence, and (3) budget incidence. The review of the previous research will include definitions, concepts of measurement procedures, methodology used in these studies as well as their limitations. It should be noted that this review covers only empirical studies of the redistributive impact of the government budget, and the major theoretical issues related to these studies. This includes a review of the major theoretical features of the Harberger model of tax incidence.

Purpose of Studies

The main purpose of fiscal incidence studies has been to derive policy judgements regarding the distributional effects of various taxes and expenditure benefits among household groups. A policy-relevant question asked in tax incidence or tax burden empirical studies is whether the burden of taxes (paid in a particular country) is distributed fairly by income class or among persons with substantially equal incomes. Thus, the concern of empirical studies is with the vertical equity of the tax system, that is, with the distribution of tax burdens among different income classes, and with horizontal equity, that is, the distribution of tax burdens among household groups with similar incomes, and sometimes with both. One issue in most studies is whether a tax is regressive or progressive. A tax is regressive when the ratio of tax to income falls as incomes rise: a tax is proportional when the ratio of tax to income is the same for all income classes; and a tax is progressive when the ratio of tax to income rises as income rise. The results of tax incidence studies are usually presented by Lorenz curves or Gini coefficients summarizing the before- and after-tax income distribution.

Two categories of fiscal incidence studies can be distinguished. One is concerned with vertical equity while the other category deals with horizontal equity. The first group of studies is concerned with vertical equity, analyzing the redistribution of income through the fiscal system (Snodgrass 1974; McLure 1974a) and concentrating on the effects of taxes, or expenditures, or both, on different income-size classes of the population. A second group of incidence studies is concerned with horizontal equity and development strategy concentrating on the differential tax burden between different groups of the population. The horizontal equity, as treated in these studies, ranges between urban and rural sectors, between various geographical areas, or between various ethnic components of the population. Most of the studies conducted in India concentrate on the differential tax burden between rural and urban sectors, and on the transfer of resources between these two sectors (Gandhi 1966, De Wulf 1975). Tax incidence studies in India attempt to estimate the "formal incidence" of the Indian tax system. Formal incidence estimates are a quantification of the presumed intentions of the fiscal authorities. Most Indian studies avoid the problem of tax shifting. However, a distinctive feature of these studies is that they allocate the tax burden between the urban and the rural, or the agricultural and nonagricultural sectors of the economy. Indian tax incidence studies also estimate the tax content of expenditure for the various expenditure classes of the urban and rural sectors (Raj 1959, Mitra 1963).

Other studies are concerned with the horizontal equity between various geographical areas (Azfar 1972) or between various ethnic components of a country (Adler et al. 1952, Pechman and Okner 1974). The purpose of a now classic study in the field of fiscal incidence by Pechman and Okner (1974), for example, was to estimate the effect of all U.S. taxes on the distribution of income by size of income and by other characteristics (demographic and economic) of the population. The authors drew inferences from their results about the tax incidence in the United States. Their main conclusion is that the U.S. tax system is essentially proportional for most families and therefore has little effect on the distribution of income. The results, however, may vary with different taxes. For this reason, this study compared the distribution of tax burdens by income classes under eight sets of assumptions for corporate, property, and payroll taxes. The objectives of these statistical calculations, according to the authors were, first, to determine whether it is possible to arrive at any broad conclusions about the distribution of tax burdens in the United States, and second, to illustrate the differences implied by the major competing views among economists about the incidence of particular taxes.

There are three main purposes for conducting fiscal incidence studies. One main purpose is a concern with the effects of tax shifting on income distribution. The second purpose is a concern with the improvement of income distribution estimates. And the third purpose of these studies is a concern with the distributional implications of government spending. Musgrave et al. (1974) define the purpose of empirical fiscal incidence studies as an exploration of the sensitivity of the results to alternative assumptions about tax shifting. With respect to the limitations of the assumptions 1/ made in these studies, they argue that:

> As science proceeds, these assumptions will, hopefully. come to be replaced by firm evidence, but policy judgements regarding the distributional effects of various taxes must be made in the meantime. For this purpose, systematic exploration of the more reasonable hypotheses is surely better than random judgement.

The second main purpose, noted especially by Meerman (1972), and Bird and DeWulf (1973) for studying fiscal incidence is a need to improve income distribution studies. Most country studies on size distribution of income ignore tax effects, benefits of government expenditures, or both. A typical income concept in such studies comes close to that of factor payments before taxes. However, this failure to consider fiscal incidence is a serious shortcoming, since in many countries 15 to 20 percent of national income is channeled through the public sector. For example, in recent years, total public expenditures exceeded 25 percent of national income in Algeria, Chile, Guyana, Liberia, Yugoslavia and Zambia (World Bank 1980). These data suggest that in developing countries there is a substantial potential in the public sector for redistributing income. This also points to a need to assess the public sector impact when estimating the size-distribution of income.

1/ It should be noted that there is a great difference in opinion and absence of consensus among economists as to how some of the major taxes are shifted, especially with respect to corporate tax, property tax and payroll tax. For this reason, alternative incidence assumptions are usually explored and compared.

The third main purpose of fiscal incidence studies is a concern with the spending side of the government budget. Most fiscal incidence studies usually concentrate on the distributional effects arising from various tax changes, thus ignoring the effects that arise as a consequence of government spending patterns. However, the distributional effects of government spending may be as important as the distributional effects arising from taxes. Because governments directly allocate anywhere from an eighth to a third of total (final) output (Meerman 1974), a concern with income distribution carries with it, also, a concern for the incidence of public activity on the distribution of income. Consequently, the need to estimate such incidence is also increasing.

The potential usefulness to policy from studies on fiscal incidence and the redistributive role of a government budget can be presented by assuming that the rich pay all the taxes and the poor receive all the benefits. In such an "ideal" situation, considerable redistribution could be achieved. The real world is, however, far from such an "ideal" situation, because in reality, changes in tax policies are quite difficult to achieve politically in developing countries. For example, Adelman and Morris (1973) cast doubt on potential redistribution through government budgets in developing countries. On the other hand, in his survey of fiscal incidence studies in developing countries, De Wulf (1975), contrary to other similar studies, (Meerman 1973, OAS 1973) claims that budget incidence is progressive in most countries. Many governments in developing countries do claim that their objective or the goal of their present tax and expenditure system is to redistribute incomes. However, without an analysis of the existing situation, it is rather difficult to argue that budget expenditures are either propoor or prorich. More concretely, if the poor are to escape poverty through public expenditure, then measuring benefit incidence becomes an important policy input.

A useful policy approach to assist the poor requires knowledge of how well existing programs are functioning, in terms of which reach the poor and which do not, i.e., who pays the taxes and who receives the benefits of public expenditures. As noted by Meerman (1978), information concerning the distribution of public costs by the beneficiary gained through empirical expenditure incidence studies is a necessary first step in acquiring such knowledge: consequently whether or not the actual distribution is compared with an ex ante hypothetical distribution, knowledge concerning benefit incidence is valuable per se.

Most of the empirical fiscal incidence studies (e.g., Musgrave et al. 1974, Pechman and Okner 1974) are concerned with pure analytical questions, i.e., they attempt to estimate the burden of taxes and the benefit of public expenditures without giving any policy recommendations. Some other studies (Meerman 1973, 1979; Bird and de Wulf 1973), on the other hand, deal with both the analytical and the policy questions. The policy conclusion in most of these studies is that more progression is needed in the tax system in order to obtain a more equitable tax system and greater income redistribution.

In summary empirical fiscal incidence studies are potentially valuable in providing information about the functioning of the public sector (budget) in a particular country and for improving information on country size-income distributions. It is necessary, however, to consider carefully what questions should be asked and how they bear upon the definition of the relevant concepts of measurement procedures, assumptions, and limitations of the methodology used.

Theory and Concepts of Fiscal Incidence

Regardless of their purpose, empirical incidence studies are used to determine the incidence of a tax by following through its effects on the incomes of the producers of the taxed commodity or sector, and on the consumption expenditures of individual households. The burden of a tax on any household is the sum of the burdens borne by its members both as producers and as consumers. Thus, in the modern incidence theory, a distinction is made between tax incidence on the sources of income side of household budgets and incidence on the uses of income side. The sources of funds are the incomes received by the producers of the taxed commodity, and the uses of funds are the consumption expenditures of individual households. The fundamental concern of empirical incidence studies is to determine how the burdens of different taxes are distributed according to family income.

There are three ways in which the problem of incidence has been analysed: (1) absolute; (2) differential; and (3) budget incidence. In the absolute (or specific) tax incidence, the analyst attempts to examine the distributional effects of a particular tax while holding public expenditures constant. This concept of absolute incidence is generally agreed to be the least satisfactory of the three alternatives, because it deals with the distributional effects of a given tax change in isolation, not allowing for changes in expenditures, transfers, or other taxes to help counteract the effects of the given tax change on aggregate demand. For this reason, an absolute tax incidence approach is not widely used in the field (Break 1974), and is neglected in the remainder of this study.

The second approach, preferred by many economists at the conceptual level, is to calculate the differential incidence of two taxes yielding equal revenue or of two equally costly expenditure packages. In this approach, the analyst examines the distributional changes that result if one tax is substituted for another while total revenues and expenditures are held constant. An advantage of this concept is to avoid macro economic effects (changes in aggregate demand) that would follow if total revenues and expenditures were not held constant. Substitution of one tax for another (of equal yield) involves no new resource transfer to public use; it merely involves a redistribution among households (disregarding the issue of excess burden). The concept of differential incidence applies when alternative ways of raising or lowering revenue are compared. As noted by Musgrave and Musgrave (1980), this view of tax incidence is particularly useful because actual tax-policy decisions usually involve such issues.

Although this approach has been accepted as reasonable and applied in many empirical incidence studies, several shortcomings can be identified. The approach necessitates the comparison of the incidence of two taxes or of two expenditures between themselves, rather than calculation of the unique incidence of only one tax or one expenditure. Using this concept, it is thus impossible to specify a unique differential incidence pattern of any particular tax; only a comparison of its incidence with the incidence patterns of other taxes is possible (Break 1974). It should be noted that the term "differential incidence" as used in the traditional tax literature by Musgrave (1959) is not defined in terms of calculus. In this literature, differential incidence simply means comparison of two different taxes.

The third approach to incidence analysis avoids the problems of absolute or specific incidence analysis by examining the balanced-budget incidence of equal changes in taxes and expenditures. Using this concept, as defined by Musgrave and Musgrave (1980), an analyst considers the changes in household level of income that result if the combined effects of tax and expenditure changes are calculated and attempts to determine simultaneously "who pays the taxes?" and "who gets the benefits?" Most studies of the distributional effects of budgetary policy attempt to compare the distribution of real income among households, given the current budgetary practices, with what it would be in the absence of government.

The measurement of balanced-budget incidence is usually formulated in the following way:

$$\Delta Y = Y_1 + G_1 - Y_o$$

where:

ΔY is the change in the real income of the household;

Y_o is the estimated real income of the household in the absence of government activity (before tax income);

Y_1 is the corresponding actual real income of the household given the existence of government (after tax income);

G_1 measures the real income--equivalent of the public services (and transfers) enjoyed by households.

Effective tax and benefit rates can be calculated by comparing tax burdens and expenditure benefits in each household group with the group's total income. This means that the amount of taxes paid as a proportion of total household income is compared across different household groups. The comparison can be made either with Y_o or with $Y_1 + G_1$. Comparison with Y_o would indicate the percentage of zero-budget income, i.e., (taxes equal expenditures) taken by taxes and increased by expenditures. On the other hand, comparison with $Y_1 + G_1$ would indicate by what fraction real income would rise due to the elimination of taxes and fall because of the elimination of expenditures, if the government budget were to be removed. As noted by

Gillespie (1965), there are no grounds for preferring one or the other, because these are two different concepts. The former comparison measures the impact the government budget has on the distribution prevailing in a no-budget world, while the latter tells how the existing distribution would be changed by elimination of the government budget.

Because balanced-budget incidence studies attempt to compare an economy with the government budget with an economy without the budget, they overlook and simplify many important issues. These studies ignore the possibility that public provision of services may not be efficient; they also ignore the burden of public services, bureaucratic red tape, etc. As noted by McLure (1974b), strict interpretation of a zero budget case would entail the comparison of the existing state of the world with a state of total anarchy. This also means that the "rules of the game" under which an economy operates might be vastly different in the zero-government case. For example, the extent of monopolization and discrimination depends on the government regulatory role. Although all these issues are important, they are ignored in these studies, by assuming that the prevailing institutional framework would also exist in an economy without the government budget, and that there is no difference in efficiency between public and private sectors.

Balanced-budget incidence, as defined above, has to be decomposed into its basic elements in order to develop measurement procedures. Musgrave and Musgrave (1980) and McLure (1974b) define three distinct elements causing change in real income due to a government intervention: (1) the burden (and benefits) of taxes used to finance public activity; (2) the benefits of public services; and (3) the redistribution of income resulting from changes in relative factor rewards and product prices induced by the shift of purchasing power from the private to the public sector. These three effects can be referred to as tax, benefit, and expenditures incidence, respectively. Most of the studies on budget incidence identify tax and expenditures incidence with the change in real private income, i.e., $Y_1 - Y_o$ from the above equation, and benefit incidence with the income equivalent of government expenditures (G_1). This means that taxes are subtracted from the gross income of households and government expenditures (real income equivalent) are added to after-tax household incomes to measure the distributional implications of the government budget. In essence, this approach takes a static view of fiscal incidence, i.e., the distributional implications of the government budget are evaluated at a certain point in time, ignoring the above-discussed elements of budget incidence. These studies have been severely criticized, especially because of inadequate treatment of expenditures incidence. In the next section, expenditures incidence studies will be reviewed in more detail in order to clarify the limitations of balanced-budget incidence studies.

Benefit and Expenditures Incidence

Empirical studies of incidence on the spending side are less frequent than empirical studies of tax incidence. As noted by DeWulf (1975), among the studies in developing countries concerned with fiscal impact on income distribution, one-third have attempted to quantify expenditures incidence. Unlike tax incidence studies, which are widely accepted in spite of frequent criticism, there are neither well-developed general techniques nor theory for handling expenditures (Meerman 1978). And, as noted by McLure (1974b), "the methodology and theory of estimating benefit and expenditure incidence is largely undeveloped." Nevertheless, all researchers used an approach similar to that which has evolved in estimating tax incidence. This approach can probably be best illustrated by the Musgrave et al. (1974) study which covers both taxes and public spending. The tax incidence approach of the Musgrave et al. study will be described in the next section, while the approach to distribution of expenditure benefits will be reviewed in this section.

On the expenditure side of fiscal incidence, three classes of spending are identified. The first consists of goods and service expenditures where particular beneficiaries can (in theory) be identified, such as allocable expenditures or broadly publicly provided private goods (e.g., highways and education). The second group consists of transfer payments which by their nature lend themselves to allocation. And the third group consists of "public goods" that cannot be directly allocated to particular individuals (e.g., defence) (Gillespie 1965). For allocable goods, the procedure adopted by Musgrave et al. is similar to that for taxes. For example, unemployment insurance benefits are allocated according to receipts from that source (given in the MERGE file), education expenditures is allocated to the families of students, using data from the Census of Population. The second group of public goods are simply allocated using three assumptions: (1) in proportion to total income, (2) in proportion to taxes, and (3) equally to all persons. In making allocations of goods and services that are directly allocated, it is assumed that costs incurred on behalf of various groups reflect the value of benefits received (Musgrave and Musgrave 1980). Thus, in the case of highways, expenditures are divided in line with consumer and business use of facilities. The former are allocated according to household expenditures on automotive products, while the latter, by reducing business costs, are assumed to be passed forward to the consumer. Transfers are treated as negative taxes and are assumed to stay with the recipients. After all benefits are allocated to the household groups, a picture of total benefits is presented in three alternatives. The first alternative assumes that general benefits are distributed in line with total family income. The second variant allocates such benefits in line with tax burdens, and the third uses a per capita distribution. The use of the last alternative results in the most favorable pattern for the low-income groups. However, in all cases the overall benefit rate declines towards the upper end of income scale. The overall pattern of benefit distribution is, in all cases, much more pro-low income compared to the relative position of low incomes in the tax incidence distribution.

Empirical studies of expenditures incidence have several limitations. One of the major limitations of the approach is that it does not consider the effects on the distribution of earnings, due to government expenditures, i.e., which result as wages are paid to government employees or to construction workers employed by private firms building public highways. This procedure assumes that the pattern of earnings will not change in the process.

The major problem of expenditures incidence studies seems to be that they attempt to estimate the value of all benefits from public expenditures to recipients while ignoring two different but important aspects of incidence on the spending side. These two aspects are that incidence has to be decomposed into two components in order to capture two different effects of government spending on income distribution. One component is defined as expenditures incidence, i.e., how government spending affects private incomes; and the other component is defined as benefit incidence, i.e., who receives government services (McLure 1974b). Most of the criticism of these studies arises in the literature because of confusion and lack of separation of the two components of spending incidence. Although in conventional studies of budget incidence, analysts claim that they attempt to solve tax incidence and expenditures incidence simultaneously, they are actually dealing only with partial equilibrium static analysis of tax incidence, as discussed in the next section. And on the other hand, these studies are dealing only with benefit incidence, thus ignoring expenditures incidence which is a consequence of changes in relative prices due to government spending.

Expenditures incidence can in other words be described in the following way. Government budget policies affect personal income indirectly by affecting the composition of output and hence changing both the relative and the absolute prices of final goods and services, and of factors of production. In general, expenditures incidence depends upon: (1) the changes in the distribution of income resulting from marginal differences in private and public spending, (2) the price elasticity of demand for various products, (3) the degree of complementarily or substitability of publicly and privately provided goods, (4) the supply elasticity of products, (5) differences in the average propensities of households to consume various goods, and (6) the differences in factor endowments of households. Theoretically, a study of expenditures incidence should take these effects into consideration. In the context of the budget incidence approach, this means that it would be necessary to calculate the level and distribution of personal incomes that would have existed in the absence of the activities of the public sector (government). However, as noted by Dodge (1975), this calculation is not feasible as the behavioral relationships on which such a calculation could be based are not available, nor in practice estimable. From the above discussion, it is clear that allocation procedures of conventional expenditures incidence studies do not deal with the expenditures incidence problem as outlined above, but actually attempt to estimate only benefit incidence.

However, there are several problems also with estimating benefit incidence as formulated in empirical studies. These studies require many simplifications and clearly stated assumptions in order to arrive at some meaningful results of the analysis. One major source of criticism of country studies of benefit incidence is their assumption that total costs of providing public goods equal total value to the recipients. The problem with this assumption is that the political process does not give such perfect results. It is usually impossible to measure empirically the value of benefits as perceived by particular households. As noted by Meerman (1978), even if households wanted to, it probably would be impossible for them to value consistently, i.e., decide what they would be willing to pay for a school year, or public clinic visit. Another problem in these studies arises if the assumption, implicit in these studies, that the public activity is carried out at the optimal level (disregarding the possibility of nonefficient output) is relaxed. In that case total costs no longer equal total benefits, except by chance, and there is no reason to expect total benefits attributed to exactly equal total budgetary costs.

As presented above, expenditures incidence studies have several limitations. Because these studies are a constituent part of balanced-budget analysis, the limitations of the expenditures incidence also apply to the balanced-budget incidence. Some of the major shortcomings of expenditures incidence studies are, on the other hand, of the same nature as the limitations of conventional tax incidence studies discussed in the next section.

The focus of this study is on tax incidence, specifically on the empirical implementation and extension of the Harberger (1962) model within the context of a social accounting framework. Expenditures incidence studies are reviewed here only because they are a part of some traditional tax incidence studies. As discussed above, the theory of expenditures incidence is largely underdeveloped, and empirical studies of expenditures and balanced-budget incidence have several limitations. The methodology and approach of this study deals with the expenditures side of the government budget only to a limited extent. The approach to this problem adopted in Chapters IV and V is that the tax revenues (indirect taxes) are allocated to the household groups as a part of their income (in the form of transfers) instead of to the government. This simple assumption avoids most of the problems found in the traditional incidence studies, and on the other hand, it allows measurement of changes in real incomes of households that arise from changes in tax revenues.

Tax Incidence

As discussed above, the basic concern of empirical tax incidence studies is with the distribution of income among different groups of the population. An obvious question to be addressed is whether there exists the most appropriate partitioning of the population. As it appears from the literature, the adequate partitioning depends on the policy question. Distributions that appear in most studies of tax incidence involve the distribution by income class, age-group, racial, and regional classification. Less frequently found are the urban-rural and agricultural-nonagricultural distributions. The reason for less interest in these distributions is probably due to the fact that most studies of tax incidence have been undertaken in developed countries or that their methodology has been applied in developing countries without questioning their policy relevance or usefulness. However, the urban-rural and agricultural-nonagricultural distributions would be indicative of the inequality in the size distributions in many developing countries, given the importance of economic dualism in explaining the size distributions (Adelman and Morris 1971). These distributions might be especially relevant in that particular expenditure policies might more easily be designed to benefit the rural poor than the urban poor, and are likely to affect urban and rural groups differently. For these reasons, the application of the methodology developed in the next chapters will focus on the distributional implications of tax incidence by partitioning the population into urban and rural groups.

There are three basic methods of theoretical analysis used in examining tax incidence: (1) partial equilibrium static analysis; (2) general equilibrium comparative static analysis; and (3) dynamic analysis. For some taxes, where it seems reasonable to abstract from most tax-induced market interactions, Marshallian partial equilibrium analysis is often used. However, for partial factor taxes, such as the corporation income tax, selective commodity taxes, and for industrial incentives tied to the use of one factor in one region or industry tax incidence cannot be analyzed satisfactorily without explicitly recognizing market interdependence. For these cases, a general equilibrium analysis is required. Most often, analysis similar to that used in the Harberger (1962) model is employed. In some cases, the examination of tax incidence cannot be performed adequately either with partial or general equilibrium comparative static analysis. If taxation affects the rates of capital accumulation and growth significantly (over some intermediate adjustment period), a dynamic analysis based on a growth model is needed (Krzyzaniak 1967). However, as the analysis is moved from comparative statics to dynamic analysis, it becomes more difficult to include a rich structure of market interdependence.

The focus of this study is on the improvement of the traditional tax incidence studies (Musgrave et al. 1974, Meerman 1978, Meerman and Shome 1980) extended by the use of the modified Harberger model and the social accounting framework. For this reason, the rest of this section will concentrate on these type of studies and on the theoretical structure, applications, and limitations of the Harberger model.

Traditional tax incidence studies

There have been a number of major studies of the redistributive impact of the government budget in recent years. In the United States, the most well known are the studies by Musgrave et al. (1974) and Pechman and Okner (1974). Most studies undertaken in other countries (e.g., O'Higgins and Ruggles 1981, Nicholson 1977) followed the approach developed by the Musgrave study. The studies available indicate that a conventional approach to estimating the tax burden has evolved. The conventional methodology is explained in more detail in the next chapter, while only a brief review of the basic concepts is presented here. It is well illustrated by the Musgrave et al. study on the United States. (Pechman and Okner use individual observations from the MERGE file rather than income ranges, but apply similar procedures.) The Musgrave et al. (1974) study of tax burdens involves three major steps, including (1) the allocation of tax burdens by household income brackets, (2) a corresponding allocation of income, and (3) the determination of effective rates as the ratio of tax to income in each income bracket. To solve the first step, the major problem is to determine what incidence assumptions are to be made. These assumptions are then implemented by allocation of the tax burden in line with a distributive series that reflects each assumption. The second step involves determination of the proper income base, and in the third involves calculation of the burden as a percent of income.

Musgrave et al. start from a distribution of income by ranges, and then they allocate taxes and expenditures to these ranges. The income distribution by ranges is derived in the Musgrave et al. study from the Brookings MERGE file, which is based on tax data and the data from the Survey of Economic Opportunity. The distribution of taxes depends on the assumptions made about the incidence, discussed below, and on the allocation series used. The latter are taken from a variety of sources, including tax data and surveys of consumer expenditures.

Similar studies have been carried out for other countries, although the methods vary, reflecting the differences in availability of data and in fiscal systems. In the United Kingdom, the estimates published annually in "Economic Trends" use individual data, rather than income ranges, from the Family Expenditure Survey, but the results are usually the same (Nicholson 1977). Studies with similar results have been carried out in India (NCAER 1970, 1972).

These empirical studies may be seen as implementing the simple partial static framework outlined above, with $(Y_1 - Y_0)$, applied to current income. The endowments and behavior of households are taken as given, as are all pretax factor prices and producer prices. The effect of the income tax is assumed to be to reduce posttax income; and the effect of indirect taxes is assumed to be to increase consumer prices. These assumptions have been criticized as being unrealistic. Prest (1955), for example, claimed that the assumption about indirect taxes can be justified only where the supply is perfectly elastic, whereas the assumption about the income tax can be justified only when factor supplies are completely inelastic. He states that "calculations of the incidence of direct and indirect taxes are based on conflicting and contradictory assumptions." (p.242). While Prest (1955) uses only a descriptive analysis, this point is demonstrated rigorously, analytically and empirically in Chapter III using the Harberger (1962) model and the SAM framework. As concluded in Chapter III, the assumptions of the traditional tax incidence studies are valid only for general factor and commodity taxes, while a general equilibrium framework has to be used for the analysis of selective factor and commodity taxes.

To avoid the criticism of the methodology employed in these studies, Musgrave et al. (1974) and Pechman and Okner (1974) empirically investigate the consequences of these alternative assumptions about incidence. Musgrave et al. contrast the "benchmark" assumptions used in measuring tax incidence with "progressive" and "regressive" alternatives. All three alternatives are defined in Table 2.1 below.

Table 2.1: Incidence Assumptions Made by Musgrave et al.

	Progressive	Benchmark	Regressive
Corporate income tax	Falls on dividend recipients	Half falls on all capital income receivers; half passed on to consumers	Passed on to all consumers
Property tax	Falls on all capital income receivers	Residential —occupants Commercial —half on all capital receivers —half on consumers	Residential —occupants Commercial —on consumers
Employers social insurance contributions	Falls on employee	Passed on to consumers	Passed on to consumers

Source: Musgrave et al. (1974), p. 261.

The progressive assumptions increase the percentage of income paid in taxes for higher income groups, while the regressive assumptions cause the percentage paid in taxes for these groups to fall. The effects of the progressive and regressive assumptions are exactly the opposite for lower income groups compared to higher income groups. On the other hand, over the range of middle incomes, the percentages remain relatively constant. Alternative incidence assumptions appear, on this basis, to be most critical at the top and the bottom of the income scale. The same conclusion is derived by Pechman and Okner (1974). As stated by them, the objectives of presenting alternative assumptions are to illustrate the differences implied by the major competing views among economists about the incidence of particular taxes. Further, they note that the calculations do not provide any empirical evidence either to verify or to deny the validity of competing incidence assumptions or the analysis based on any particular set of assumptions.

In summary, the conventional empirical studies of tax incidence actually take various assumptions of tax incidence for particular taxes found in the theoretical literature and evaluate these assumptions empirically. The most appropriate set of results depends on the judgement of the reader and his/her choice of the most plausible assumptions. This is recognized by Pechman and Okner (1974) in their statement about incidence assumptions (pp. 25-26):

> For the most part, these assumptions were pragmatic compromises made by the analysts in the absence of a consensus among economists as to the incidence of the major taxes in the tax system.

From this perspective the major weakness of the traditional empirical studies seems to be that they do not use a consistent framework or a model to evaluate tax incidence, but rather they borrow their (sometimes conflicting) assumptions from the literature and leave the reader to decide about the most appropriate outcome. As noted by Atkinson and Stiglitz (1980), almost any investigation of this type is likely to lead to results conditional on a range of alternative assumptions. For this reason, they suggest that the simple fixed-factor, two-sector models could be used for the purpose of improving conventional empirical tax incidence studies. However, although the two-sector general equilibrium model developed by Harberger has existed since 1962, it has not been used in conjunction with the conventional tax incidence approach. With the exception of a recent comparison of different approaches by Devarjan et al. (1980), the empirical findings of these studies have also not been compared to the empirical results obtained by using the general equilibrium approach. Analysts who have written a very extensive literature on tax incidence and who have conducted the numerous empirical tax incidence studies, listed in the first chapter, have so far not used a general equilibrium approach. The only attempt at integrating the Harberger model approach and findings with the traditional empirical studies has been a recent study by Meerman and Shome (1980). Their suggestions are presented in the next chapter. The remainder of this section presents the literature on the Harberger-type, general-equilibrium models, because the modified and extended Harberger model represents the essential part of the proposed methodology for improvement of the conventional empirical tax incidence studies presented in the next chapters of this study.

The Harberger Relative-Prices Model

Tax incidence analysis before 1962 was partial equilibrium analysis, although some economists, Rolph (1954), Musgrave (1959), and Wells (1955), had attempted to place incidence analysis in a general equilibrium context. In

1962, Harberger introduced to the field of public finance the two-sector general equilibrium model of tax incidence that, with various modifications and extensions, has since become the standard tool of incidence analysis in situations requiring a general equilibrium framework (McLure 1975).

The Harberger model, in its general form, is based upon standard neoclassical assumptions, with several important exceptions. The equations of the model are discussed extensively by Harberger (1962), and Mieszkowski (1967), and derived explicitly by Shoven and Whalley (1972). A version of the model equations is also presented in a Cobb-Douglas form in the next chapter of this study. For this reason, the review of the model will concentrate on the description of the assumptions and the advantages and shortcomings of the model for tax incidence analysis.

The original Harberger model included seven assumptions. These assumptions, some of which were relaxed in subsequent work with the model by McLure (1971) and Mieszkowski (1972), are:

(1) Fixed aggregate factor supplies, which eliminates a need to consider the work-leisure choice, the effects of taxation on saving, investment, and growth, and interactions between the supply of labor and capital;

(2) Perfect competition in factor and product markets;

(3) Perfect factor mobility, which does not consider obstacles to the movement of labor and capital among industries, with the result that net-of-tax rates of return are equalized for each factor in all of its alternative uses. This also means that the model should be applied to long-run analyses of tax incidence. However, McLure (1971) extended the model to include imperfect factor mobility;

(4) Linear homogeneous production functions; this assumption ignores economies of scale, because increases in both labor and capital inputs are assumed to produce equal percentage increases in output;

(5) Homogeneous marginal consumption propensities; the model makes marginal propensities to consume goods the same for all spending units, even though their average propensities may differ;

(6) No fixed-money assets; the model considers only relative price changes, ignoring the possibility that absolute changes are also important:

(7) Closed economic system; this limitation ignores the impact of import tariffs and export taxes on income distribution, thus allowing for evaluation of domestic taxes only.

Because of the extensive list of the restrictive assumptions, some authors cast doubt on the practical value of the Harberger model for tax incidence analysis (Break 1974). However, as noted by Break (1974, p.131), the usefulness of abstract models must be judged by the realism of both their assumptions and their results. Although the model abstracts many features from the economic reality the basic Harberger model effectively illuminates several important features of tax incidence theory that have not been recognized or demonstrated rigorously before in the public finance literature (McLure 1975), such as the importance of relative prices for tax incidence analysis. These features will be discussed in detail below.

For a complete picture of tax incidence in the Harberger model, it is necessary to study in detail only a tax on one commodity, a tax on one factor, and a tax on the use of one factor in the production of one commodity. This methodological point was first noted by Musgrave (1959) and then confirmed analytically by the Harberger model (McLure 1975). Musgrave noted that under the assumptions of perfect competition, constant returns to scale, and no savings (assumptions which are also a part of the Harberger model), the following equivalences hold between taxes levied at a given ad valorem rate:

$$\begin{array}{ccccccc} T_{XY} & \equiv & T_{LK} & = & T_L & + & T_K \\ & \| & & & \| & & \| \\ & T_X & & = & T_{XL} & + & T_{XK} \\ & + & & & + & & + \\ & T_Y & & = & T_{YL} & + & T_{YK} \end{array}$$

where

X and Y are two consumer goods;

L and K are two factors of production, labor and capital;

T_{XY} is a sales tax;

T_{LK} is a tax on gross incomes;

T_X, T_Y are commodity taxes; and

T_L, T_K are factor taxes.

In this basic tax matrix, X and Y stand for the two consumer goods and L and K for the two factors of production, labor and capital. The first propostion, which seems to be generally agreed upon (Break 1974), is that given the assumptions of the Harberger model, a tax on gross output or sales, T_{XY}, is equivalent to a tax on gross incomes, T_{LK}, each being borne in proportion to consumption or income, which are identical by assumption in the model. Thus, the incidence of a single commodity tax, for example T_X, makes it possible to derive the incidence of the other commodity tax, T_Y. Similarly, if the incidence of one of the factor taxes, for example T_L, is known, it is sufficient to determine the incidence of the other factor tax,

T_K , by subtraction. Finally, a tax on each factor used in producing a commodity is equivalent to an equal-rate tax on the commodity, as shown in the second and third rows of the matrix. Thus, if the incidence of T_X and T_{XK} is known, then T_{XL} can be obtained by subtraction.

The most important contribution to tax incidence analysis of the Harberger model is the identification of the structural parameters that determine the direction and amount of the relative price changes brought about by taxation. As discussed above, these parameters were identified before by Musgrave (1959), Wells (1955), and others; however, the interrelationships among them had never been systematically and precisely specified in a general theoretical formulation that could be used empirically. The methodology of this model made clear for the first time, that in analyzing incidence, the concern is only with changes in real (relative) prices leading to changes in real income, and that the long-term effects of taxes on income distribution are relevant (Nizar 1979). The model also demonstrated, that since the price of one factor (or commodity) can be held constant and all other prices expressed in terms of that price, only relative prices matter in tax incidence analysis.

According to McLure (1975), the importance of the model is its ability to deal with problems that partial equilibrium analysis can handle only imperfectly. This model takes into account the interdependence of markets. It should be noted that there is no problem in determining how an excise tax affects individuals in their roles as recipients of factor incomes by changing the relative net returns to factors, as well as how it affects them in their role as consumers through variations in relative product prices. Calculations of this type, i.e., evaluation of distributional implications of excise and other taxes on the sources and uses side of income, will be performed in the next chapter by using the basic methodology of the Harberger model applied to the social accounting framework.

The analysis of the Harberger model can also be extended to partial factor taxes, rather than being confined to excise taxes. It was, in fact, to analyze the incidence of corporate taxation that Harberger developed his two-sector, two-factor general equilibrium model. The incidence of partial taxes depends on the values of a number of parameters, including factor intensities, elasticities of substitution between factors, and elasticities of substitution of demand. Choosing plausible values for these parameters, Harberger has shown that the burden of the corporate tax in the United States will be borne by all owners of capital, in both the corporate and noncorporate sectors. The explanation for the result is that the tax induces capital to move from the corporate to the noncorporate sector, and during this process the net-of-tax returns to capital in both sectors are equalized at a lower level.

The Harberger model also gives answers to questions of the incidence of general taxes, assuming fixed total factor supplies. It indicates that a general tax on income or consumption will be borne in proportion to shares in income or consumption, regardless of the elasticities of supply and demand of the various commodities. And a general tax on all uses of one factor will be borne by that factor. This result holds independently of the values of various parameters, i.e., demand conditions for the factor, the factor intensity of production in the various sectors, and the mobility of both factors (McLure 1975).

As noted by Nizar (1979), substantial progress has been made in the study of tax incidence due to the general equilibrium approach based on the Harberger model and its extensions. On the other hand, with respect to the conventional empirical studies of tax incidence, he states, that studies that allocate the total tax burden by income groups under assumptions that bear little relation to the theory must be treated with skepticism.

The Harberger model has, however, two significant shortcomings. Because it is constructed and analyzed in terms of differentials and assumes the absence of any preexisting taxes (as will be shown in Chapter III), the model can, strictly speaking, be applied only to the analysis of the imposition of infinitestinal small taxes in a zero-tax world (Break 1974). Studies that deal with the possible differences in incidence patterns created by a specific tax change in a zero-tax situation compared to a situation with existing taxes, include initial work by Feldstein (1974), Shoven and Whalley (1972), and Fullerton et al. (1978). However, these studies are not explicitly related to the above discussed conventional empirical tax incidence studies.

As discussed above, there is a wide gap between the theoretical literature based on the Harberger model and the traditional empirical tax incidence studies. One reason for this gap or lack of interest of the conventional analysts to use findings of this model has probably been caused by the inability of the standard Harberger model to deal with the preexisting taxes. The attempt of this study is to extend the Harberger model for analysis in a SAM context and to incorporate preexisting taxes and to design a framework for empirical evaluation of the distributive implications of existing taxes in a given economy.

REFERENCES

Adelman, I., and C. T. Morris (1971). "An Anatomy of Patterns of Income Distribution in Developing Nations." U.S. Agency for International Development, Washington, D.C., mimeographed.

Adelman, I., and C T. Morris (1973). Economic Growth and Social Equity in Developing Countries. Stanford University Press.

Adler, J., E. R. Schlesinger, and C. E. Olson (1952). Public Finance and Economic Development in Guatemala. Stanford University Press.

Atkinson, A B., and J. E. Stiglitz (1980). Lectures on Public Economics. New York: McGraw-Hill Book Company.

Azfar, J. (1972). "The Income Distribution in Pakistan, Before and After Taxes, 1966-67." Unpublished Ph.D. dissertation, Harvard University.

Bird, R. M., and L. H. de Wulf (1973). "Taxation and Income Distribution in Latin America: A Critical Review of Empirical Studies." International Monetary Fund Staff Papers, January.

Break, G. F. (1974). "The Incidence and Economic Effects of Taxation," in The Economics of Public Finance, A Blinder, et al., Brookings Institution, Washington, D. C.

Devarjan, S., Don Fullerton, and R. A Musgrave (1980). "Estimating the Distribution of Tax Burdens, A Comparison of Different Approaches." Journal of Public Economics 13.

Dodge, D. A. (1975). "Impact of Tax, Transfer, and Expenditure Policies of Government of the Distribution of Personal Income in Canada." Review of Income and Wealth, Series 21, No. 1, pp. 1-52.

Feldstein, M. S. (1974). "Tax Incidence in a Growing Economy with Variable Factor Supply." Quarterly Journal of Economics, 88, pp. 551-573.

Fullerton, D., J. B. Showen, and J. Whalley (1978). "General Equilibrium Analysis of U.S. Taxation Policy " in Compendium of Tax Research 1978, Department of the Treasury, Washington, D.C.

Gandhi, V. P. (1966). Tax Burden on Indian Agriculture. Cambridge, Massachusetts.

Gillespie, W. I. (1965). "The Effect of Public Expenditures on the Distribution of Income," in R. A. Musgrave (ed.), Essays in Fiscal Federalism, Brookings Institution, Washington, D. C.

Harberger, A. C. (1962). "The Incidence of the Corporation Income Tax." Journal of Political Economy, No. 3, pp. 215-40.

Krzyzaniak, M. (1967). "The Burden of a General Tax on Profits in a Neoclassical World." Public Finance, XXII, pp. 472-95.

McLure, C. E., Jr. (1971). "The Theory of Tax Incidence with Imperfect Factor Mobility." Finanzarchiv, 30, pp. 27-48.

McLure, C. E., Jr. (1974a). "The Distribution of Income and Tax Incidence in Panama: 1969." Public Finance Quarterly, Vol. 2, pp. 155-201.

McLure, C. E., Jr. (1974b). "On the Theory and Methodology of Estimating Benefit and Expenditure Incidence." Paper presented at the Workshop on Income Distribution and its Role in Development (Houston, Texas, William Marsh Rice University).

McLure, C E., Jr. (1975). "General Equilibrium Incidence Analysis: The Harberger Model After Ten Years." Journal of Public Economics, 4, pp. 125 161.

Meerman, J. (1972). "Fiscal Incidence in Empirical Studies in Income Distribution in Poor Countires." U.S. Agency for International Development, Discussion Paper No. 25.

Meerman, J. (1973). "Review of Empirical Studies of Budget Incidence and Income Distribution in Poor Countries." The World Bank, mimeographed.

Meerman, J. (1974). "The Definition of Income in Studies of Budget Incidence and Income Distribution." Review of Income and Wealth, Series 20, pp. 515-22.

Meerman, J. (1978). "Do Empirical Studies of Budget Incidence Make Sense." Public Finance, Vol. 33, No. 3.

Meerman, J. (1979). Public Expenditure in Malaysia, Who Benefits and Why. Oxford University Press.

Meerman, J., and P. Shome (1980). "Estimating Counterfactual Income in Studies of Budget Incidence." Public Finance, Vol. 35, No. 2.

Mieszkowski, P. M. (1967). "On the Theory of Tax Incidence." Journal of Political Economy, 75, pp. 250-262.

Mieszkowski, P. M. (1972). "The Property Tax: An Excise or a Profits Tax?" Journal of Public Economics, 1, pp. 73-96.

Mitra, A (1963). "Tax Burden for Indian Agriculture," in R. Braibanti, and J. J. Spengler, (eds.), Administration and Economic Development in India, Duke University Press.

Musgrave, R. A. (1959). The Theory of Public Finance. New York: McGraw-Hill.

Musgrave, R. A., K. E. Case, and H. Leonard (1974). "The Distribution of Fiscal Burdens and Benefits." Public Finance Quarterly (July).

Musgrave, R. A., and P. B. Musgrave (1980). Public Finance in Theory and Practice. New York: McGraw-Hill Book Company.

National Council of Applied Economic Research (1970). "Incidence of Taxation in Gujarat." New Delhi.

National Council of Applied Economic Research (1972). "Incidence of Taxation in Mysore State." New Delhi.

Nicholson, J. L. (1977). "How Should Indirect Taxes be Allocated when Estimating the Redistribution of Income?" In A. J. Culyer and J. Wiseman (eds.), Public Economics and Human Resources, Paris.

Nizar, J. (1979). "Recent Theoretical Developments in Public Finance." Bulletin for International Fiscal Documentation, Vol. 33, No. 7, pp. 321-24.

O'Higgins, M., and P. Ruggles (1981). "The Distribution of Public Expenditures and Taxes among Households in the United Kingdom." Review of Income and Wealth, No. 3.

Organization of American States (1973). General Council. "Tax Policy as Income Distribution Instrument." Washington, D.C.

Pechman, J. A and B. A Okner (1974). Who Bears the Tax Burden?. Brookings Institution, Washington, D. C.

Prest, A R. (1955). "Statistical Calculations of Tax Burdens." Economica, Vol. XXII, No. 87.

Raj, K. N. (1959). "Resources for the Third Plan: An Approach." The Economic Weekly, Vol. 11, pp. 203-208.

Rolph, E. R. (1954). The Theory of Fiscal Economics. Berkeley: University of California Press.

Ruggles, P. (1980). "The Allocation of Taxes and Government Expenditures among Households in the United States." Unpublished Ph.D. dissertation, Harvard University.

Shoven, J. B., and J. Whalley (1972). "A General Equilibrium Calculation of the Effects of Differential Taxation of Income from Capital in the U.S." Journal of Public Economics, 1, pp. 281-321.

Snodgrass, D. R. (1974). "The Fiscal System as an Income Redistributor in West Malaysia." Public Finance, Vol. 29, No. 1, pp. 56-76.

Wells, P. (1955). "General Equilibrium Analysis of Excise Taxes." American Economic Review, 45, pp. 345-359.

World Bank (1980). World Development Report 1980. Oxford University Press, Washington, D.C.

de Wulf, L. H. (1975). "Fiscal Incidence Studies in Dèveloping Countries: Survey and Critique." International Monetary Fund Staff Papers, Vol. 22, No. 1.

CHAPTER III

METHODOLOGY USED IN THIS STUDY

Analysis of Tax Incidence Using the Harberger Model and Social Accounting Framework

In a recent article, Meerman (1978) presented a review of empirical studies of budget incidence and asked a question whether these studies make sense. His answer was that the studies are sensible and useful, but restricted, because ceteris paribus conditions are implicitly assumed for relative prices, technology, and output in making the incidence assumptions. He concluded that the most serious restriction of these ceteris paribus conditions — that for relative prices — is an unsolvable problem. Consequently, he developed a simple fiscal incidence model that does not take into consideration changes in relative prices due to taxation and applied this model to Malaysia (Meerman 1979) using the traditional approach regarding tax and benefit incidence.

However, a subsequent article on the same subject by Meerman and Shome (1980) attempted to correct the statement that changes in relative prices are unsolvable in empirical tax incidence studies. The two authors used the Harberger (1962) general equilibrium model to demonstrate a possible solution concerning how to account for changes in relative prices in empirical tax incidence studies. In their demonstration, they present the Harberger model and how it can be used to calculate the effects of taxes on the sources side of income for corporate tax, and how to obtain pretax (or counterfactual) incomes from which corporate taxes can be subtracted in order to obtain tax burden or tax incidence measurements for particular households. With respect to their approach, the authors conclude, that:

> We should also emphasize that some investigators are very much aware of the effects of government tax and expenditures on relative prices. But it has hitherto been widely believed that it is impossible to in any way come to grips with the problem. This is not completely the case, as suggested by the work on the Harberger model. We do have a beginning in dealing with the more general issues of the impact of taxes on counterfactual incomes.

Although the approach suggested by Meerman and Shome represents an important step forward towards improving the traditional approach of empirical fiscal incidence studies, at least two important issues still remain unanswered. These are: (1) how to calculate general equilibrium effects of various taxes (excises, selective factor taxes, general taxes) on both the sources and uses side of income, and (2) what kind of data are required or from where these data can be obtained to make the approach operational. A methodology to solve these critical problems will be proposed below.

The methodology of this study takes the approach suggested by Meerman and Shome (1980) as a departure, but introduces several essential improvements and extensions. The improvements are designed to test the accuracy of the traditional approach of empirical tax incidence studies as well as to develop a better methodology of empirical tax incidence studies. The major components of the proposed methodology are:

(1) The Harberger model is written in a social accounting matrix (SAM), showing the explicit relationship between the accounting framework and the model;

(2) Analytical calculations of the impacts of taxes on relative price changes will be performed for all of the critical taxes (tax on all uses of capital or labor, selective factor tax, excises, sales taxes), showing effects on both sources and uses of income.

(3) Analytical expressions obtained from (1) and (2) will be tested empirically using a hypothetical SAM.

(4) The results obtained by this methodology will be compared with those obtained from the traditional (Musgrave et al. 1974, Pechman and Okner 1974, and others) methodology. Eventual errors of the traditional approach due to lack of consideration of both sources and uses of income, factor intensity, and differences in consumption patterns will be tested.

In the following section, the traditional methodology of estimating tax incidence will be discussed in brief. The Harberger model will then be presented analytically in a SAM framework, and the major steps for implementing the proposed methodology will be outlined.

Traditional Methodology of Empirical Tax Incidence Studies

A brief description is given here of the major steps typically involved in the traditional approach to empirical tax incidence studies, as followed by Musgrave and others. The objective of these studies is to allocate tax burdens by income groups. This is done for each tax by taking the total amount collected and imputing the resulting burden to households grouped by income class. The total burden for each tax equals revenue collected.

The procedure is to stipulate the specific response of the economy to various taxes, based on theoretical analysis and market-structure specifications, and then to allocate the burden by income groups. Thus, it is assumed that excise and sales taxes will be borne by the consumers of the taxed products and that the income tax is borne by the taxpayer. For some taxes, alternative assumptions are explored. The burden distribution of the corporation tax may be examined by assuming that the tax is borne by shareholders, that it falls on all capital income, or that the burden is spread to wage earners or to consumers of corporate products. Similarly, alternative assumptions may be examined for the property and payroll taxes.

This procedure has the advantage that it can be implemented readily, that the underlying assumptions are explicitly stated, and that the implications of alternative hypotheses can be evaluated. However, the weakness of this procedure is that the (stipulated) incidence is limited to only partial responses of the economy (S. Devarjan, Don Fullerton, and R. A. Musgrave 1980). Thus, taxes on products or commodities are taken to affect households from the uses side of their accounts only, the burden being distributed in line with the distribution of consumer expenditures. This procedure ignores two important aspects of tax incidence. First, distribution of tax burdens according to proportion of household consumption ignores effects from the uses side that are due to changes in relative prices of goods. And second, further effects of selective commodity taxes on factor prices; which may simultaneously affect the position of households from the sources side (changes in factor incomes), are disregarded. Thus, in these studies, it is concluded that a sales tax on luxury items will be progressive (because high income households consume more luxury goods), whereas one on a necessity will be regressive.

Similarly taxes on factor income, such as the income tax, are taken to affect household positions from the sources side only, the burden being distributed according to earnings subject to tax. Factor taxes are in this case distributed in proportion to factor income, disregarding relative price effects that may change the price of labor or capital and corresponding factor incomes in both taxed and untaxed sector because of factor mobility or different factor intensity. Moreover, additional effects of factor taxes that may simultaneously affect income from the uses side (change in prices of consumption basket due to factor taxes) because of changes in relative product prices are ignored.[1/] The underlying argument of this procedure is that the distribution burden of a tax that initially impacts from the sources side will be dominated by sources side effects, because secondary effects operating from the uses side have no systematic relation to sources effects. The same is assumed for the taxes on the uses side as indicated above.

The following section is intended to present a methodology that can take account of tax incidence on both the uses and sources of income. In this methodology, the Harberger model will be used in a SAM framework in order to compare the traditional and modified methodology. Although the Harberger model employs many simplifying assumptions,[2/] it allows measurement of the magnitude and direction of the changes in relative prices caused by allowing general equilibrium interrelationships. The model as used below represents a first step in reproducing real world effects of taxation on changes in relative incomes.

The Analytical Model

The model presented below is based on the model developed by Harberger (1962) and its illustration developed by McLure and Thirsk (1975). The model is modified for present purposes to take into account the allocation of tax burden between two types of individuals (in this case, workers and capitalists); it is structured to investigate the impact of a tax allowing for

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1/ As indicated above, these effects are disregarded as well as in the Meerman and Shome (1980) proposal for calculating counterfactual incomes.

2/ Of the seven assumptions of the Harberger model given in the previous chapter, four are major: perfectly competitive economy, fixed technology, fixed supply of factors, and closed economic system.

all general equilibrium effects. The purpose of the model is to identify the strategic variables that determine the outcome of tax incidence analysis. Four major taxes are considered in this illustration: (1) taxes on all uses of capital, (2) taxes on capital or labor in one sector, (3) selective taxes on one good (excise), and (4) taxes on all goods or incomes. These four categories represent all of the major taxes that are relevant for tax incidence analysis.

Description of the Model

The Harberger model is a two-sector model. For the present purpose, Cobb-Douglas assumptions are made. An economy with two goods (X, Y) is considered; each good is produced by a Cobb-Douglas production function, using only capital and labor, which are available in fixed total supply, K and L :

$$\begin{aligned} Y_x &= L_x^{\alpha} K_x^{1-\alpha} \\ Y_y &= L_y^{\beta} K_y^{1-\beta} \qquad \alpha,\beta > 0 \end{aligned} \tag{1}$$

There are three consumers: (1) workers, (2) capitalists, and (3) government. Each consumer makes his/her purchasing decision by maximizing his/her utility subject to a budget constraint derived from his/her endowments of capital and labor. If Y_ℓ is worker's income and w the price of labor; Y_k is capitalist's income and r the price of capital; Y_g is government's income (equal to the tax), then consumption expenditures are defined as:

$$Y_x = X = a(Y_\ell + Y_k + Y_g)$$ 1/

$$Y_y = Y = (1-a)(Y_\ell + Y_k + Y_g)$$

1/ Assumptions about average propensity to consume can be relaxed at a later stage for implementation purposes, i.e., instead of aY and (1-a)Y ; aY_k, $(1-a)Y_k$, a consumption matrix from the SAM can be used.

where:

$$Y_\ell = wL^{1/} \qquad Y_x = \frac{a}{1-a} Y_y$$

$$Y_k = rK \tag{2}$$

$$Y_g = tax$$

I. Equilibrium with Tax on All Uses of Capital

In this model, it is assumed that the economy is initially at an equilibrium (with no taxes), with quantities normalized so that all prices are unity. Then taxes t_x and t_y are imposed on capital for both goods X and Y. In order to keep the analysis simple at this stage, it is assumed as in the McLure and Thirsk (1975) exposition of the Harberger model that the government spends the tax revenue exactly to replace the loss in private demand in each sector from tax-induced income loss.2/ That is, nominal national income is constant before and after the imposition of the tax.

If primes define the prices and quantities in the new after-tax equilibrium, then

$$P'_x X' = P_x X = X; \; P'_y Y' = P_y Y = Y \tag{3}$$

Because of the Cobb-Douglas assumptions, factor payments have a constant share of net revenue in each industry.

1/ Instead of workers and capitalists, household groups receiving both capital and labor income will be used for implementation purpose of the model. Data will be obtained from a SAM (see the next section).

2/ This procedure ignores the excess burden of the tax, so that the sum of net gains and losses to consumers equals the yield of the tax.

<u>Labor</u>: (no tax is imposed on labor)

$$\frac{\partial X}{\partial L} = \frac{w'}{P'_x} = \frac{\alpha X'}{L'_x}$$

$$\frac{\partial Y}{\partial L} = \frac{w'}{P'_y} = \frac{\alpha Y'}{L'_y}$$

$$w'L'_x = \alpha X'P'_x = \alpha X = L_x \tag{4}$$

$$w'L'_y = \beta Y'P'_y = \beta Y = L_y$$

$$w = w' = 1$$

<u>Capital</u>: (Tax t_x and t_x is imposed on capital in each sector, respectively)

$$\frac{\partial X}{\partial K} = \frac{\frac{r'}{1-t_x}}{P'_x} = \frac{(1-\alpha)X'}{K'_x}$$

$$\frac{\partial Y}{\partial K} = \frac{\frac{r'}{1-t_y}}{P'_y} = \frac{(1-\beta)Y'}{K'_y}$$

$$r'K'_x = (1-t_x)(1-\alpha)X'P'_x = (1-t_x)(1-\alpha)X = (1-t_x)K_x$$

$$K'_x = \frac{(1-t_x)K_x}{r'} \tag{5a}$$

$$r'K'_y = (1-t_y)(1-\beta)Y'P'_y = (1-t_y)(1-\beta)Y = (1-t_y)K_y$$

$$K'_y = \frac{(1-t_y)K_y}{r'} \tag{5b}$$

Note that P'_x and P'_Y define the new gross-of-tax price of X and Y. From the fixed factor-supply assumption, $(K'_x + K'_Y = K)$ 1/, and from the expression for r', the new net rental price of capital services, from (5a and 5b), it is possible to obtain the net price of capital, which is equal in both sectors:

$$r' = \frac{(1-t_x)(1-\alpha)X + (1-t_y)(1-\beta)Y}{K} \quad \text{or} \quad \frac{(1-t_x)K_x + (1-t_y)K_y}{K} \qquad (6a)$$

since $K = (1-\alpha)X + (1-\beta)Y$, [from (2) and (5)].

$$r' = \frac{(1-t_x)(1-\alpha)(\frac{a}{1-a})Y + (1-t_y)(1-\beta)Y}{(1-a)(\frac{a}{1-a})Y + (1-\beta)Y} = \frac{(1-t_x)(1-\alpha)a + (1-t_y)(1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \qquad (6b)$$

$\therefore$ if $t_x = t_y = t$, then

$$r' = \frac{(1-t)(1-\alpha)a + (1-t)(1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \qquad (7)$$

$$r' = (1-t)$$

Following the same procedure, and using the above expressions, it is possible to solve for all the new quantities, prices, and incomes:

$$P'_x = \frac{X}{X'}$$

$$P'_x = \frac{L_x^{\alpha} K_x^{1-\alpha}}{(\frac{L_x}{w'})^{\alpha} [\frac{(1-t_x)K_x}{r'}]^{1-\alpha}} \qquad \text{from 1 and 5}$$

1/ Capital is assumed to be perfectly mobile between the two sectors.

$$P'_x = w'^{\alpha}\left(\frac{r'}{1-t_x}\right)^{1-\alpha}$$

$$P'_y = \frac{Y}{Y'}$$

$$P'_y = \frac{L_y^{\beta}\ K_y^{\ 1-\beta}}{\left(\frac{L_y}{w'}\right)^{\beta}\left[\frac{(1-t_y)K_y}{r'}\right]^{1-\beta}}$$

$$P'_y = w'^{\beta}\left(\frac{r'}{1-t_y}\right)^{1-\beta}$$

if $t_x = t_y = t$, and substituting for r', then

$$P'_x = \left(\frac{r'}{1-t}\right)^{1-\alpha} = \left(\frac{1-t}{1-t}\right)^{1-\alpha} = 1$$

$$P'_y = \left(\frac{r'}{1-t}\right)^{1-\beta} = \left(\frac{1-t}{1-t}\right)^{1-\beta} = 1$$

$$\frac{P'_x}{P'_y} = 1$$

The above analytical expression represents a traditional way of solving the Harberger model to obtain after-tax (net) prices for wages (w'), the gross-of-tax price of good $X(P'_x)$, and the gross-of-tax price of good $Y(P'_y)$. From the new after-tax prices, assumptions of fixed supply of labor and capital, and constant nominal national income, it is possible to obtain the new after-tax incomes for workers, capitalists, and government. It is also possible to show the effects of the tax on both the sources (factor incomes) and uses (consumption expenditure) of income side. The methodology for obtaining after-tax incomes and the distributional effects of a particular tax on household incomes will be demonstrated by the use of a SAM. As it will be shown below, a SAM facilitates the presentation of the underlying accounting structure of the Harberger model, as well as its generalization, extensions, and applications. The SAM framework also guarantees consistency of the model and accounting structure and allows the analyst to trace through the effects of different taxes on income distribution. Extensions of the standard Harberger model will be presented in Chapter IV, while an application to the actual SAM country data will be presented in Chapter V. The rest of this chapter presents the Harberger model in a SAM framework, including its empirical exposition and comparison of the results with the methodology and results of the traditional tax incidence studies.

Analytical Exposition of the Harberger Model in a Social Accounting Framework

Table 3.1, 3.2, and 3.3 present the Harberger model in a SAM context. The SAM presented in these tables has four accounts: (1) current institutions account, (2) tax account, (3) factors-of-production account, and (4) activities-of-production account. The accounts of this SAM are indicated by the roman numerals I through IV, while the rows and columns of the SAM are numbered with arabic numbers 1 through 10. The general accounting rule of this SAM is the same as in any SAM, i.e., that the columns of a particular account represent expenditures and the rows represent receipts.[1/] However, the difference between this SAM and the conventional social accounts is that its cells are represented by the analytical expressions of the economic model, instead of actual statistical numbers. The purpose of this presentation is to show explicitly the relationships between the model and its underlying

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1/ For references to the SAM literature, see Pyatt and Thorbecke (1976), and Pyatt et al. (1977).

Table 3.1

Schematic Social Accounting Matrix (SAM)

Receipts \ Expenditures				INSTITUTIONS			TAXES		FACTORS		ACTIVITIES		TOTAL
				Workers	Capital	Govt.	X	Y	Labor	Capital	X	Y	
				1	2	3	4	5	6	7	8	9	10
I	INSTITUTIONS	Workers	1						$T_{1.6}$ = workers income				$T_{1.10}$ = Total income of workers
		Capitalists	2							$T_{2.7}$ = capitalists income			$T_{2.10}$ = Total income of capitalists
		Government	3				$T_{3.4}$ = Taxes on X	$T_{3.5}$ = Taxes on Y					$T_{3.10}$ = Total government income
II	TAXES	X	4								$T_{4.8}$ = Taxes on X		$T_{4.10}$ = Total tax revenues from X
		Y	5									$T_{5.9}$ = Taxes on Y	$T_{5.10}$ = Total tax revenues from Y
III	FACTORS	LABOR	6								$T_{6.8}$ = Value added by labor in X	$T_{6.9}$ = Value added by labor in Y	$T_{6.10}$ = Total labor income
		CAPITAL	7								$T_{7.8}$ = Value added by capital in X	$T_{7.9}$ = Value added by capital in Y	$T_{7.10}$ = Total capital income
IV	ACTIVITIES	X	8	$T_{8.1}$ = workers consumption of X	$T_{8.2}$ = capitalists cons. of X	$T_{8.3}$ = govt. cons. of X							$T_{8.10}$ = Total demand for good X
		Y	9	$T_{9.1}$ = workers cons. of Y	$T_{9.2}$ = capitalists cons. of Y	$T_{9.3}$ = govt. cons. of Y							$T_{9.10}$ = Total demand for good Y
V	TOTAL		10	$T_{10.1}$ = Total workers expenditures	$T_{10.2}$ = Total capitalists expend.	$T_{10.3}$ = Total govt. expend.	$T_{10.4}$ = Total taxes on X	$T_{10.5}$ = Total taxes on Y	$T_{10.6}$ = Total labor income	$T_{10.7}$ = Total capital income	$T_{10.8}$ = Net production expenditures in X	$T_{10.9}$ Net production expenditures in Y	

accounting framework and to find a solution of the model for changes in relative prices and incomes.

For the purpose of clarity of presentation, Table 3.1 presents entries of the SAM first in a schematic form. In section I of Table 3.1, current institutions are divided into three categories: workers, capitalists, and government. Workers and capitalists are domestic institutions receiving factor income from labor and capital, respectively. Government income is collected in row 3 from the tax account. The sum of the first three rows shows the total income of institutions. This income is spent on commodities X and Y in the first three columns of the institutions account. In section II, receipts of the tax account are shown in rows 4 and 5. Taxes are paid by the activities account and are received by the government from columns 4 and 5 of the tax account. In section III, two factors of production, labor and capital, are represented. Factors of production identify the receipt and disbursement of factor incomes within the economy. Factor income is derived from the activities of production account. This is shown in rows 6 and 7, while the allocation of this factor income between domestic institutions is shown in columns 6 and 7. Row account totals for each factor give a detailed view of the functional, or factorial, distribution of income within the economy, while the columns of the factor account indicate who receives these incomes. In section IV of the final account, expenditures of activities of production, on labor, capital, and payment of taxes are presented in columns 8 and 9. Demands for output of the activities account, i.e., final consumption expenditures are shown by the intersection of rows 8 and 9 with columns 1 to 3. This brief description of the SAM thus presents the accounting structure underlying its accounts and the accounting structure of the above outlined version of the modified Harberger model.

Table 3.2 presents the analytical expressions of the Harberger model written in the cells of the SAM. The cells of the SAM can be represented by the T_{ij} notation. The convention adapted is that i refers to the row and j to the column in which a particular T_{ij} is situated (Pyatt and Round 1978). T_{ij}'s correspond to $T_{ij} = 1,2,\ldots,10$. Only those T_{ij}'s that are not empty by definition are indicated in Tables 3.1 and 3.2, and only the nonempty cells need to be estimated. Description of the SAM model will start from the production activities account and the factor account. Columns 8 and 9 of the activity account in Table 3.2 show the generation of value added by activities. This value added is received by the factor account rows. Columns of the activities account can be expressed, in this instance, by Cobb-Douglas production functions, where net production expenditures by activities can be expressed as follows:

Columns 8 and 9 (activities account):

$$T_{6.8} + T_{7.8} = \alpha\, Y_x P_x + (1-\alpha) Y_x P_x = Y_x P_x \quad \text{(from Table 3.2)}$$

$$T_{6.9} + T_{7.9} = \beta\, Y_y P_y + (1-\beta) Y_y P_y = Y_y P_y$$

On the other hand, receipts by the factors of production account of value added from the activities account, can be expressed as follows:

Rows 6 and 7 (factor account):

$$T_{7.8} + T_{6.9} = \alpha\, Y_x P_x + \beta\, Y_y P_y = wL_x + wL_y = wL = Y_\ell \quad \text{(from Table 3.2)}$$

$$T_{7.8} + T_{7.9} = (1-\alpha) Y_x P_x + (1-\beta) Y_y P_y = rK_x + rK_y = rK = Y_k$$

Factor income from labor -- Y_ℓ, and capital -- Y_k, is distributed to the current institutions account, i.e., to workers and capitalists, at the

Table 3.2

The Harberger Model Written in a SAM Context

Receipts \ Expenditures			INSTITUTIONS: Workers	INSTITUTIONS: Capital	INSTITUTIONS: Govt.	TAXES: X	TAXES: Y	FACTORS: Labor	FACTORS: Capital	ACTIVITIES: X	ACTIVITIES: Y	TOTAL
			1	2	3	4	5	6	7	8	9	10
I INSTITUTIONS	Workers	1						Y_ℓ				Y_ℓ
	Capitalists	2							Y_k			Y_k
	Government	3				$Y_{tx}=0$	$Y_{ty}=0$					$Y_g = 0$
II TAXES	X	4								$t_x = 0$	0	$Y_{tx} = 0$
	Y	5								0	$t_y = 0$	$Y_{ty} = 0$
III FACTORS	LABOR	6								$\alpha Y_x P_x = wL_x$	$\beta Y_y P_y = wL_y$	$Y_\ell = wL$
	CAPITAL	7								$(1-\alpha)Y_x P_x = rK_x$	$(1-\beta)Y_y P_y = rK_y$	$Y_k = rK$
IV ACTIVITIES	X	8	aY_ℓ	aY_k	aY_g							$Y_x P_x$
	Y	9	$(1-a)Y_\ell$	$(1-a)Y_k$	$(1-a)Y_g$							$Y_y P_y$
V	TOTAL	10	Y_ℓ	Y_k	$Y_g=0$	$Y_{tx}=0$	$Y_{ty}=0$	Y_ℓ	Y_k	$Y_x P_x = a(Y_x + Y_y)$	$Y_y P_y = (1-a)(Y_x+Y_y)$	

intersection of the factor account columns and the institutions account rows ($T_{1.6}$ and $T_{2.7}$). The income of institutions is in turn all spent on good X and Y, according to given average consumption patterns indicated by (a), and (1-a) and obtained from the SAM. In column 1, for example, workers spend aY_{ℓ} of their income on good X, and $(1-a)Y_{\ell}$ on good Y, and capitalists spend aY_k on good X, and $(1-a)Y_k$ on good Y. This exhausts all of the national income. Government revenues and expenditures are in this case zero, because no taxes are assumed in this description of the economy.

In Table 3.3, an equal rate of tax is imposed on all uses of capital, i.e., on the gross income earned by capital in production of X and Y. In such a case, the net return to capital falls immediately. Because capitalists earn equal return no matter where their capital is employed, the net price of capital is the new equilibrium, with the gross price or cost of capital unchanged.

This is demonstrated in Table 3.3 of the SAM, where primes define new after-tax prices. The tax on capital in X is shown in the cell $T_{4.8} = t(1-\alpha)Y_x' P_x'$, and the tax on capital employed in production of Y is shown in the cell $T_{5.9} = t(1-\beta)Y_y' P_y'$. The sum of both taxes is, in turn, received by the government as its revenue. This is shown as payment of the tax account columns to the row of the government (intersection of the row 3 with columns 4 and 5). Because the tax is imposed on all capital employed in producing X and Y, it has to be subtracted from the capital factor income, intersection of row 7 with columns 8 and 9. Columns 8 and 9 thus show that net return to capital employed in producing X and Y declined for the tax amount, while the gross return of capital stays the same, because the tax is paid to the government out of gross capital income. This is expressed in the SAM by

Table 3.3

<u>Equilibrium With Tax on All Uses of Capital</u>

Receipts \ Expenditures			INSTITUTIONS			TAXES		FACTORS		ACTIVITIES		TOTAL
			Workers	Capital	Govt.	X	Y	Labor	Capital	X	Y	
			1	2	3	4	5	6	7	8	9	10
I INSTITUTIONS	Workers	1						$Y'_\ell = Y_\ell$				Y'_ℓ
	Capitalists	2							$Y'_k = (1-t)K$			Y'_k
	Government	3				Y'_{tx}	Y'_{ty}					Y'_g
II TAXES	X	4								$t_x(1-\alpha)Y'_xP'_x$		Y'_{tx}
	Y	5									$t_y(1-\beta)Y'_yP'_y$	Y'_{ty}
III FACTORS	LABOR	6								$\alpha Y'_xP'_x = w'L_x$	$\beta Y'_yP'_y = w'L_y$	$Y'_\ell = w'L = wL$
	CAPITAL	7								$(1-t_x)(1-\alpha) Y'_xP'_x = r'K_x$	$(1-t_y)(1-\beta) Y'_yP'_y = r'K_y$	$Y'_k = r'K = (1-t)K$
IV ACTIVITIES	X	8	aY'_ℓ	aY'_k	aY'_g							$Y'_xP'_x$
	Y	9	$(1-a)Y'_\ell$	$(1-a)Y'_k$	$(1-a)Y'_g$							$Y'_yP'_y$
V	TOTAL	10	Y'_ℓ	Y'_k	Y'_g	Y'_{tx}	Y'_{ty}	Y'_ℓ	Y'_k	$Y'_xP'_x$	$Y'_yP'_y$	

summing the T_{ij}'s of the activities account columns and the factor account rows:

Columns 8 and 9 (activities account):

$$T_{4.8} + T_{6.8} + T_{7.8} = T_{10.8} = Y'_x P'_x$$
$$T_{5.9} + T_{6.9} + T_{7.9} = T_{10.9} = Y'_y P'_y$$

$$t(1-\alpha)Y'_x P'_x + \alpha Y'_x P'_x + (1-t)(1-\alpha)Y'_x P'_x = Y'_x P'_x$$
$$t(1-\beta)Y'_y P'_Y + \beta Y'_y P'_y + (1-t)(1-\beta)Y'_y P'_y = Y'_y P'_y$$

Rows 6 and 7 (factor account):

$$T_{6.8} + T_{6.9} = T_{6.10} = Y'_\ell$$
$$T_{7.8} + T_{7.9} = T_{7.10} = Y'_k$$

$$\alpha Y'_x P'_x + \beta Y'_y P'_y = w'L_x + w'K_x = Y'_\ell = w'L$$

$$(1-t)(1-\alpha)Y'_x P'_x + (1-t)(1-\beta)Y'_y P'_y = r'K_x + r'K_y = Y'_k = r'K$$

The cost of labor is unchanged, because no tax is imposed on labor, and consequently $w = w' = 1$. On the other hand, the net price of capital (r') can be obtained straight from the SAM as follows:

$$r'K'_x = (1-t)(1-\alpha)Y'_x P'_x = (1-t)(1-\alpha)Y_x = (1-t)K_x$$

$$r'K'_y = (1-t)(1-\beta)Y'_y P'_y = (1-t)(1-\beta)Y_y = (1-t)K_y$$

$$r' = \frac{(1-t)(1-\alpha)Y_x + (1-t)(1-\beta)Y_y}{(1-\alpha)Y_x + (1-\beta)Y_x}$$

$$r' = \frac{(1-t)(1-\alpha)a + (1-t)(1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \quad [\text{since } Y_x = a(Y_x + Y_y) \text{ from } T_{10.8}]$$

$$r' = (1-t)$$

Because the after-tax wage is equal to the before-tax wage $w = w' = 1$, labor receives the same income as before in row 6 of the SAM, i.e., $T_{6.10} = Y'_\ell = Y_\ell$. This income is received by workers in row 1 ($T_{1.6}$) and spent in column 1 on goods X and Y ($T_{8.1}$ and $T_{9.1}$). However, capitalists receive income reduced for the tax, i.e., $T_{7.10} = Y'_k = (1-t)K < Y_k$. The reduction of the capitalists' income on the sources side is shown in row 2 ($T_{2.7}$), and the spending pattern of this after-tax income is shown in column 2 ($T_{8.2}$ and $T_{9.2}$).

The next step is to calculate changes in relative prices due to taxation. New prices for goods X and Y are indicated by primes. P'_x and P'_y can be obtained from the SAM in a generalized form by expressing columns of the SAM as before and after-tax price equations and rows of the SAM as quantity equations. Price equations for P'_x and P'_y can be obtained as follows:

Columns 8 and 9 of the activities account can be written as,

$$a^o_{ij} \left(\frac{p_i}{p_j}\right)^{1-\sigma j} + a^o_{ij} \left(\frac{p_i}{p_j}\right)^{1-\sigma j} = 1$$

a^o_{ij} is the value of a_{ij} in the base period, derived from T^o (in this case $a^o_{ij} = \alpha$, $(1-\alpha)$, and β, $(1-\beta)$. 1/

1/ $T = \| t_{ij} \|$ is a SAM and T^o the matrix of the values of t_{ij} in a base period such that $T^o = \| t^o \|$, i,j,=1,2,...,n .

σj is a parameter (elasticity of substitution)

Substituting for the Cobb-Douglas production function, using the same example as above:

$$\alpha\left(\frac{w'}{P'_x}\right)^{1-\sigma_x} + (1-\alpha)\left[\frac{\left(\frac{r'}{1-t}\right)}{P'_x}\right]^{1-\sigma_x} = 1$$

where $\lim_{\sigma_x \to 1} P_x$; and $w = w' = 1$

$$P'_x = w'^{\alpha}\left(\frac{r'}{1-t}\right)^{1-\alpha}$$

$$P'_x = \left(\frac{r'}{1-t}\right)^{1-\alpha}$$

Substituting for $r' = 1-t$,

$$P'_x = \left(\frac{r'}{1-t}\right)^{1-\alpha} = \left(\frac{1-t}{1-t}\right)^{1-\alpha}$$

$$P'_x = 1$$

$$\beta\left(\frac{w'}{P'_y}\right)^{1-\sigma_y} + (1-\beta)\left(\frac{\frac{r'}{1-t}}{P'_y}\right)^{1-\sigma_y} = 1$$

$$P'_y = w'^{\beta}\left(\frac{r'}{1-t}\right)^{1-\beta}$$

$$P'_y = 1$$

Summary Implication of a Tax on all Uses of Capital [1/]

$$r = w = w' = 1 \qquad \text{(from (4))}$$

$$r' = (1-t) \qquad \text{(from (7))}$$

$$P'_x = \frac{r'^{1-\alpha}}{(1-t)^{1-\alpha}} = \frac{(1-t)^{1-\alpha}}{(1-t)^{1-\alpha}} = 1$$

$$P'_y = \frac{r'^{1-\beta}}{(1-t)^{1-\beta}} = \frac{(1-t)^{1-\beta}}{(1-t)^{1-\beta}} = 1$$

$$\frac{P'_x}{P'_y} = 1$$

Changes in income:

By summarizing and using the above information obtained from the SAM on changes in relative prices, it is possible to calculate changes in real incomes or after-tax incomes for workers, capitalists, and government.

(a) Sources side:

(1) Workers: $w'L = (1)L = Y'_\ell = Y_\ell$

(2) Capitalists: $r'K = (1-t)K = Y'_k < Y_k$

(3) Government $tK = Y'_g \neq 0$

(b) Uses side:

$\frac{P'_x}{P'_y} = 1$ } no relative price changes in X and Y

1/ When $t_x \neq t_y$, the analysis can be performed in a way that will be demonstrated in the next section (III).

The general tax on capital is entirely borne by capital. Product prices experience no relative change. Capital bears the entire burden of the tax. In the same way, a general tax that is levied on all sources of labor income would be borne entirely by labor. The gross price of K and L is in this case unchanged.

The percentage change in real income after taxes can alternatively be presented by calculating price indices:

if P'_w is a measure of the price level facing workers in the new equilibrium (where P_w is one), then the percentage change in the real income of workers would be:

$$\frac{Y'_\ell/P'_w - Y_\ell}{Y_\ell}$$

where Y_ℓ = income of workers, and

$P'_w = aP'_x + (1-a)P'_y$ is the cost of the workers' consumption basket or the Laspeyres price index

Similarly, for capitalists the change in real income is:

$$\frac{Y'_c/P'_c - Y_k}{Y_k}$$

where Y_k = income of capitalists

$$P'_c = aP'_x + (1-a)P'_y$$

For capitalists to suffer a greater real income loss than workers in proportional terms, it must be the case that:

$$\frac{\dfrac{w'L}{aP'_x + (1-a)P'_y} - wL}{wL} > \frac{\dfrac{r'K}{aP'_x + (1-a)P'_y} - rK}{rK} \qquad \begin{aligned} w &= 1 \\ w' &= 1 \\ r &= 1 \\ r' &= (1-t) \end{aligned}$$

$$\frac{\dfrac{(1)L}{a(1) + (1-a)(1)} - (1)L}{(1)L} > \frac{\dfrac{(1-t)K}{1} - (1)K}{1K}$$

$$0 > -t$$

The above expressions confirm the previous result that the percentage change in real income of workers due to equal tax on all uses of capital is zero. On the other hand, the percentage change in real incomes for capitalists, due to the tax is reduced by the tax amount, i.e., (-t) as expressed above.

It is generally agreed in public finance literature that under competitive assumptions a general tax on capital or labor is entirely borne by capital or labor and affects only the sources side of incomes. It is also agreed that these taxes can be properly taken into account by using the traditional approach employed in empirical tax incidence studies. However, the problems arise when selective commodity or factor taxes are introduced, because they change relative incomes on both the sources and uses of income side. To demonstrate the issues involved and to propose a solution, the above methodology will be used for excise taxes and selective factor taxes.

II. Equilibrium with tax on one commodity

(tax on good X : t_{Lx} , t_{Kx})

A tax on one commodity can be calculated by imposing the same rate of tax on labor and capital in producing X , i.e.,

$$t_{Lx} = t_{Kx} = t$$

Following the same methodology as above, it is possible to derive new prices for r′, w′, P'_x , and P'_y.

$$r' = \frac{(1-t)(1-\alpha)a + (1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \quad \text{or} \quad r' = \frac{(1-t)K_x + K_y}{K}$$

$$w' = \frac{(1-t)\alpha a + \beta(1-a)}{\alpha a + \beta(1-a)} \quad \text{or} \quad w' = \frac{(1-t)Lx + Ly}{L}$$

$$P'_x: \quad \alpha\left(\frac{\frac{w'}{1-t}}{P'_x} \right)^{1-\sigma_x} + (1-\alpha)\left(\frac{\frac{r'}{1-t}}{P'_x} \right)^{1-\sigma_x} = 1$$

$$P'_x = \left(\frac{w'}{1-t}\right)^{\alpha} \left(\frac{r'}{1-t}\right)^{1-\alpha}$$

$$P'_x = \frac{w'^{\alpha} \; r'^{1-\alpha}}{1-t}$$

$$P'_y: \quad \beta\left(\frac{w'}{P'_y}\right)^{1-\sigma_y} + (1-\beta)\left(\frac{r'}{P'_y}\right)^{1-\sigma_y} = 1$$

$$P'_y = w'^{\beta} \cdot r'^{1-\beta}$$

$$P'_y = w'^{\beta} \cdot r'^{1-\beta} \qquad \text{(since no tax is imposed on Y)}$$

$$\frac{P'_x}{P'_y} = \frac{\frac{w'^{\alpha} \; r^{1-\alpha}}{1-t}}{w'^{\beta} \; r'^{1-\beta}} = \frac{w'^{\alpha} \; r'^{1-\alpha}}{w'^{\beta} \; r'^{1-\beta}(1-t)} = \frac{w'^{\alpha-\beta} \; r'^{\beta-\alpha}}{1-t}$$

Changes in income:

(a) Sources of income:

(1) Workers: $w'L$

(2) Capitalists: $r'K$ — Depends on factor intensity (see below)

(3) Government: tax

(b) Uses of income:

$$\frac{P'_x}{P'_y} = \frac{w'^{\alpha}\, r'^{1-\alpha}}{w'^{\beta}\, r'^{1-\beta}(1-t)} \quad \Big\} \text{ depends on factor intensity and consumption patterns}$$

if $\alpha = \beta$ =>

$$\frac{P'_x}{P'_y} = \frac{w'^{\alpha}\, r'^{1-\alpha}}{w'^{\alpha}\, r'^{1-\alpha}} = \frac{1}{1-t} \qquad (8)$$

$$P'_y = (1-t)P'_x$$

$$P'_x = \frac{P'_y}{1-t}$$

The preceding analytical expressions clearly show that the analysis is not as straightforward as in the previous case (I), especially when $\alpha \neq \beta$. The magnitude and direction of changes in relative incomes can be obtained only by making assumptions about factor intensity, for example:

(i) If the tax is imposed on a capital-intensive commodity, the price of capital will fall relative to the price of labor, i.e.,

if $\frac{K_x}{L_x} > \frac{K}{L} \Rightarrow \frac{r'}{w'} < 1$

since $r' = \frac{(1-t)\,(1-\alpha)a + (1-\beta)\,(1-a)}{(1-\alpha)a + (1-\beta)\,(1-a)}$

$$w' = \frac{(1-t)\alpha a + \beta(1-a)}{\alpha a + \beta(1-a)}$$

(ii) Changes in income:

(a) Sources of income:

A tax on a capital-intensive commodity will result in a greater percentage loss in income to capitalists;

(iii) (b) Uses of income:

If X is capital intensive, then the gross-of-tax price of the taxed commodity (X) increases relative to the price of the untaxed commodity: $P'_x > P'_y$

Therefore, consumers who consume larger proportions of good X will bear the larger burden of the tax.

However, to evaluate properly the magnitude of real income changes due to the tax, it is necessary to know factor shares (α, β), both of which can be obtained from a SAM, as well as consumption patterns, which can also be obtained from any SAM. The procedure for a numerical analysis will be outlined below.

Before proceeding to an analysis of relative income changes due to taxes within a SAM, assumptions followed by the traditional Musgrave approach to an evaluation of the tax burden of excise taxes will be presented briefly. In the traditional approach of empirical incidence of excise taxes (tax on one good), it is assumed that these taxes affect households from the uses side of their accounts only (as noted beforehand). Consequently, the burden is distributed in line with the distribution of consumer expenditures.

The following illustration will show that this is a special case that holds only when $\alpha = \beta$. In other words, these studies implicitly assume that both sectors have the same factor intensities and that the tax burden is borne entirely in proportion to consumption, for example:

$$\text{if } \alpha = \beta \Rightarrow \frac{P'_x}{P'_y} = \frac{1}{1-t}; \qquad \text{(from (8))}$$

In this case, changes in incomes are:

(a) Sources:

If there were no difference in factor intensities, both factor prices would diminish by the same percentage amounts and the tax would be borne in proportion to initial shares of national income on the sources side.

(b) Uses side:

If factor intensities were the same in the two sectors, the relative price of X would rise by exactly the tax percent. Because, in that case, the tax would be neutral on the side of the sources of income, the tax would be borne exclusively by consumers of good X (the tax would be shifted entirely to consumers of good X).

As stated above, this is exactly the assumption followed by the traditional approach of empirical tax incidence studies followed by Musgrave and others. However, this is only a special case, as demonstrated by the above analytical expressions of the model that allow for the general equilibrium effects. Thus, it is possible that when factor intensities differ between the sectors, the errors of the empirical incidence studies for excise taxes can be substantial, both on the sources and the uses of income side. However, to do the analysis properly, it is suggested here to use a SAM framework, because any SAM gives ready information on functional income distribution and consumption patterns. For example, to test income distribution implications of a tax imposed on the housing sector (housing is usually capital intensive), it is possible to take value added data for labor and capital from a SAM and thus obtain point estimates for α, and $(1-\alpha)$ for X : at the same time, it is possible to aggregate all other sectors into Y and obtain β and $(1-\beta)$. On the other hand, from the consumption expenditures account of a SAM, it is possible to obtain a matrix of consumption expenditures of different households on X and Y . Following the above analytical procedures for obtaining r', w', P_x' and P_y', after-tax incomes can be calculated for the sources and uses side of household income. These results can then be compared to the traditional approach, and the magnitude of errors can be estimated.

The methodology outlined above has several advantages compared with the traditional approach. This methodology allows for general equilibrium effects of taxes that affect both sources and uses of incomes. The information available in the SAM can be readily used, accuracy of the empirical studies can be improved, and a set of rules can be developed on how to use SAMs for calculating tax incidence. This methodology also allows the calculation of counterfactual incomes, i.e., what would the incomes be if there were no taxes. This will be demonstrated by the following example for a corporate income tax.

III. Equilibrium with a tax on capital in X

To derive new after-tax prices for r', w', P_x' and P_y', in the case of a tax on capital in X , the same methodology can be used as in case I, where the tax was imposed on all uses of capital. But here only a tax on capital in X is imposed.

$$r,\ w,\ P_x\ ,\ P_y = 1 \quad \text{(before tax)}$$

After tax: $w = w' = 1$, because no tax is imposed on labor.

If a tax is imposed on industry X , the effect of the tax is to reduce the net income received by owners of capital in industry X and to raise tax revenues by the same amount. With the initial sectoral allocation of capital, the net (after-tax) price of capital declines in industry X , but remains at 1.00 in industry Y . Over time, however, capital will flow from the taxed sector X to the untaxed sector Y until the net earnings of capital are the same in each sector. This is the long-run shifting mechanism by which a tax on only one factor affects the real incomes earned by that factor throughout the economy. Thus, on the side of sources of income, capital bears the entire burden of the tax on capital in one industry (X) and labor none of it. On the other hand, the allocation and price of labor are unaffected by the tax. Because labor continues to receive the same fraction of an unchanged national income after the tax is imposed, labor income escapes from the tax. But the mobility of capital insures that the tax on X or corporate income tax is borne on the side of sources of income by all owners of capital, not just those in the corporate sector.

This can be demonstrated analytically in the same way as before:

$$w = w' = 1 \text{ since } \frac{L_x + L_y}{L} = 1$$

$$r = 1$$

$$r' = \frac{(1-t)(1-\alpha)a + (1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \quad \text{or} \quad \frac{(1-t)K_x + K_y}{K}$$

$$P'_x : \alpha\left(\frac{w'}{P'_x}\right)^{1-\sigma x} + (1-\alpha)\left(\frac{\frac{r'}{1-t}}{P'_x}\right)^{1-\sigma x} = 1$$

$$P'_x = w'^{\alpha}\left(\frac{w'}{1-t}\right)^{1-\alpha}$$

$$P'_x = \left(\frac{r'}{1-t}\right)^{1-\alpha}$$

$$P'_y: \ \beta(\frac{w'}{P'_y})^{1-\sigma y} + (1-\beta)(\frac{r'}{P'_y})^{1-\sigma y} = 1$$

$$P'_y = w'^{\beta} \ r'^{1-\beta}$$

$$P'_y = r'^{1-\beta}$$

$$\frac{P'_x}{P'_y} = \frac{(\frac{r'}{1-t})^{1-\alpha}}{r'^{1-\beta}}$$

$$\frac{P'_x}{P'_y} = r'^{\beta-1}(\frac{r'}{1-t})^{1-\alpha}$$

Changes in income:

(a) Sources of income:

(1) Workers: $w'L = (1) L$

(2) Capitalists: $r'.K = \frac{(1-t)(1-\alpha)a + (1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \cdot K$

(3) Government: tax

(b) Uses of income:

$\frac{P'_x}{P'_y} = r'^{\beta-1}(\frac{r'}{1-t})^{1-\alpha}$ } depends on factor intensity and consumption patterns

On the side of sources of income, capital bears the entire burden of the capital tax on X and labor none of it. On the side of uses of income, consumers who spend a relatively large proportion of their income on the good that becomes more expensive (i.e., X) are made worse off, and those who purchase relatively large amounts of Y (which becomes less expensive) are better off.

$\therefore$ if $\alpha = \beta$

$$\frac{P'_x}{P'_y} = r'^{\beta-1}\left(\frac{r'}{1-t}\right)^{1-\alpha}$$

$$\frac{P'_x}{P'_y} = \frac{1}{(1-t)^{1-\alpha}}$$

$$P'_x = \frac{P'_y}{(1-t)^{1-\alpha}} \quad ; \quad P'_y = (1-t)^{1-\alpha} P'_x$$

When factor proportions are the same in both sectors, capital will still bear the entire burden of the tax on the side of sources of income, while on the side of uses of income consumers of good X are worse off, and consumers of good Y are better off (if the average propensity to consume X and Y is 0.5, then the sum of losses and gains on the uses side is zero).

The result obtained above, that a tax on capital in one industry is borne by all capital in both industries, has implications for empirical tax incidence studies. In short, the problem in these studies is to calculate pretax or counterfactual incomes and then to subtract taxes from these incomes.

In the case presented above, where a tax is imposed on capital in one sector, it is obvious that under competitive assumptions[1/] the tax falls

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1/ Most of the traditional tax incidence studies make competitive assumptions about the economies investigated.

on capital in both sectors, which means that the amount of the capital tax on X should be imputed to all owners of capital in order to obtain pretax incomes. However, as noted by Meerman and Shome (1980), in most empirical tax incidence studies, no attempt is made to adjust counterfactual income to be consistent with incidence assumptions. For example, Musgrave et al. (1974, p. 301) whose methodology has been followed by most other authors state that "proper treatment of the corporation tax calls for imputation of total corporate source income to shareholders." This means that total corporate income tax would have to be added back to the income of corporate shareholders to determine their counterfactual incomes. Another error of the traditional tax incidence studies, overlooked by Meerman and Shome (1980), is that they totally overlook the distributional implications of the selective capital tax on the uses side of income. As discussed above, selective factor taxes change relative prices of goods, which in turn affects relative incomes of consumers.

IV. Equilibrium with tax on both goods or income

In this section, a general tax on consumption or income will be evaluated. Aftertax incomes and prices are obtained in the same way as in previous examples.

$$r \; , \; w \; , \; P_x \; , \; P_y = 1$$

An equal tax is imposed on both labor and capital income in both sectors:

$$r' = \frac{(1-t)(1-\alpha)a + (1-t)(1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \quad \text{or} \quad \frac{(1-t)K_x + (1-t)K_y}{K}$$

$$w' = \frac{(1-t)\alpha a + (1-t)\beta(1-a)}{\alpha a + \beta(1-a)} \quad \text{or} \quad \frac{(1-t)L_x + (1-t)L_y}{L}$$

$$r' = 1-t$$

$$w' = 1-t$$

$$w' = r' = 1-t$$

$$P'_x: \quad \alpha\left(\frac{\frac{w'}{1-t}}{P'_x}\right)^{1-\sigma x} + (1-\alpha)\left(\frac{\frac{r'}{1-t}}{P'_x}\right)^{1-\sigma x} = 1$$

$$P'_x = \left(\frac{w'}{1-t}\right)^{\alpha}\left(\frac{r'}{1-t}\right)^{1-\alpha}$$

Substituting for $w' = r' = 1-t$, then

$$P'_x = \frac{1-t}{1-t} = 1$$

$$P'_y: \quad \beta\left(\frac{\frac{w'}{1-t}}{P'_y}\right)^{1-\sigma y} + (1-\beta)\left(\frac{\frac{r'}{1-t}}{P'_y}\right)^{1-\sigma y} = 1$$

$$P'_y = \left(\frac{w'}{1-t}\right)^{\beta}\left(\frac{r'}{1-t}\right)^{1-\beta}$$

Substituting for $w' = r' = 1-t$,

$$P'_y = \frac{1-t}{1-t} = 1$$

$$\frac{P'_x}{P'_y} = 1$$

<u>Changes in income</u>:

(a) <u>Sources side</u>:

(1) Workers: $w'L = (1-t)L$

(2) Capitalists: $r'K = (1-t)K$

(3) Government: tax

(b) Uses of income: $\frac{P_x'}{P_y'} = 1 \Rightarrow$ no relative price changes

A general tax on expenditures has the same incidence as a proportional income tax levied on all sources of income. A broad-based income or expenditure tax would be borne in proportion to initial shares of national income (or consumption). This result does not depend upon the particular specifications of production and demand relations used in this model; it is independent of factor mobility assumptions and neutral with respect to resource allocation decisions.

This result confirms that the treatment of general sales or income taxes in traditional empirical tax incidence is correct for these particular taxes, because their incidence falls either only on the sources or only on the uses side of income. However, the same is not true for selective commodity or factor taxes as demonstrated above in Sections II and III.

The next section will present an empirical exposition of the above methodology using hypothetical SAM numbers. The purpose of the exposition is to test the methodology and to evaluate the empirical results in comparison with the results of the traditional empirical tax incidence studies.

V. Empirical Exposition of the Methodology

This section presents empirical examples for calculating the tax incidence of (1) selective commodity taxes, (2) selective factor taxes, (3) general factor taxes, and (4) general commodity (expenditure) taxes using the previously discussed methodology.

Certain national income concepts are assumed in the following demonstration for a consistent empirical model of a two sector-economy. One assumption is that the value of output in each sector equals the sum of factor payments and that the sum of sectoral production (or value added) equals national income. These statements about where and how earnings occur refer to the sources of income. An additional assumption is that the total income received by owners of labor and capital is exhausted in the expenditures made on the two commodities and that the sum of expenditures on either good equals the total value of production of that good. These statements on how income is spent refer to the uses of income.

In this hypothetical two-sector economy, the sources of income are as shown in Table 3.4. This table is a SAM of the same form as Table 3.1 presented above. National income is $2800, one half of which is earned in each sector. Labor earns sixty percent of total income and capital receives the remainder. The production of X , compared to Y , is relatively capital intensive, because the share of capital is larger in that sector, i.e., α is 0.6, but β is only 0.2. A description of consumer behaviour is presented by the intersection of rows 8 and 9 by columns 1 to 3 of the SAM (Table 3.4). Each income group has different consumption patterns, which are held constant for the purpose of this analysis. Workers spend 30 percent of their income on good X and 70 percent of their income on good Y . The same ratios are 0.8 versus 0.2 and 0.6 versus 0.4 for capitalists and government, respectively. On the sources side of income, workers receive all of the labor income, capitalists receive only capital income, and government receives the tax. Given the assumed data of Table 3.4, the example for the analysis of incidence of selective commodity tax will be presented first.

1. Tax Incidence of Selective Commodity Taxes

In this example, a tax on the expenditure of income is imposed. This can be done in either a selective or general manner. Suppose that an

Table 3.4

A Base SAM for Empirical Analysis

Receipts \ Expenditures				INSTITUTIONS: Workers	INSTITUTIONS: Capital	INSTITUTIONS: Govt.	TAXES: X	TAXES: Y	FACTORS: Labor	FACTORS: Capital	ACTIVITIES: X	ACTIVITIES: Y	TOTAL
				1	2	3	4	5	6	7	8	9	10
I	INSTITUTIONS	Workers	1						$Y_\ell = 1680$				$Y_\ell = 1680$
		Capitalists	2							$Y_k = 1120$			$Y_k = 1120$
		Government	3				$Y_{tx} = 0$	$Y_{ty} = 0$					$Y_g = 0$
II	TAXES	X	4								$t_x = 0$		$Y_{tx} = 0$
		Y	5									$t_y = 0$	$Y_{ty} = 0$
III	FACTORS	LABOR	6								$\alpha Y_x P_x = (0.4)1400 = 560$	$\beta Y_y P_y = (0.8)1400 = 1120$	$Y_\ell = 1680$
		CAPITAL	7								$(1-\alpha)Y_x P_x = (0.6)1400 = 840$	$(1-\beta)Y_y P_y$ $(0.2)1400 = 280$	$Y_k = 1120$
IV	ACTIVITIES	X	8	$X_w = (0.3)Y_\ell = 504$	$X_c = (0.8)Y_k = 896$	$X_G = (0.6)Y_g = 0$							$Y_x P_x = 1400$
		Y	9	$Y_w = (0.7)Y_\ell = 1176$	$Y_c = (0.2)Y_k = 224$	$Y_G = (0.4)Y_g = 0$							$Y_y P_y = 1400$
V	TOTAL		10	$Y_\ell = 1680$	$Y_k = 1120$	$Y_g = 0$	$Y_{tx} = 0$	$Y_{ty} = 0$	$Y_\ell = 1680$	$Y_k = 1120$	$Y_x P_x = 1400$	$Y_y P_y = 1400$	

excise tax of thirty percent is applied against the gross price of good X , i.e., a sales tax of 42.86 percent applies to the net price of good X . This tax is most easily treated as an equal tax rate on total capital and labor used in producing good X , because payments to these factors completely exhaust the value of the product. As the tax reduces the net return of both factors involved in producing X by 0.3, capital and labor will flow out of sector X until their net returns are the same in both sectors. The operation of this competitive principle can be calculated in the same way as expressed in section II of this chapter.

Table 3.4 gives initial values of the economy, where: $\alpha = 0.4$; $(1-\alpha) = 0.6$; $\beta = 0.8$; $(1-\beta) = 0.2$; L = 1680; K = 1120; X = 1400; Y = 1400. Initially all prices: w , r , P_x , and $P_y = 1$, and there is no tax.

Then a tax, t = 0.3, is imposed on good X . This tax can be calculated by imposing the same rate of tax on labor and capital producing X , i.e., $t_{Lx} = t_{Kx} = t$. In order to calculate the burden of taxes on the sources and uses of income, new prices are calculated for r′, w′, P_x', and P_y'. For this purpose, analytical expressions derived in section II of this chapter are used. Substituting numerical values for α , β , a, and t , obtained from the SAM, the following new prices are obtained:

$$r' = \frac{(1-t)(1-\alpha)a + (1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)} \qquad \text{(from section II)}$$

$$r' = \frac{(1-0.3)(0.6) + 0.2}{(0.6) + 0.2} = \frac{0.62}{0.80} = 0.775 \qquad a = (1-a) = 0.5, \text{ since } X = Y = 1400$$

$$w' = \frac{(1-t)\alpha a + \beta(1-a)}{\alpha a + \beta(1-a)}$$

$$w' = \frac{(1-0.3)(0.4) + 0.8}{0.4 + 0.8} = \frac{1.08}{1.20} = 0.9$$

$$P'_x = \frac{w'^{\alpha} r'^{1-\alpha}}{1-t} = \frac{(0.9)^{0.4}\ (0.775)^{0.6}}{0.70} = \frac{0.822}{0.70} = 1.174$$

$$P'_y = \frac{w'^{\beta} r^{1-\beta}}{1} = (0.9)^{0.8}\ (0.775)^{0.2} = 0.873$$

The above calculations give net prices for labor (w′) and capital (r′) and after-tax prices for $X(P'_x)$ and $Y(P'_y)$. The after-tax net wage rate equals 0.9. Note that the net price of labor (0.9) does not fall by as much as the net price of capital, i.e., r′ = 0.775. Capital's return declines by 22.5 percent, compared with a decline of ten percent in the net price of labor. Capital bears a relatively greater burden of the tax, because sector X is relatively capital intensive compared with sector Y. If the factor intensities were opposite and sector X was relatively labor intensive, labor would bear proportionately more of the tax. If there were no differences in factor intensities, both factor prices would diminish by the same percentage amount, and the tax would be borne in proportion to initial shares of national income on the sources side. Comparing after-tax prices for $X(P'_x)$ and $Y(P'_y)$, it is clear that the price of X rises relative to the price of Y, because the tax was imposed on good X. Therefore, it can be expected that consumers of X will lose more of their income on the uses side than consumers of Y.

Changes in income on the sources side can be calculated by comparing after-tax factor incomes with before-tax factor incomes:

Changes in sources of incomes:

(1) Workers: $Y_\ell - Y'_\ell = wL - w'L = (1)1680 - (0.9)1680 = 1680 - 1512 = -168$

(2) Capitalists: $Y_k - Y'_k = (1)1120 - (0.775)1120 = -252$

(3) Government: $Tax = tY_x = 0.3(1400) = +420$

Changes in incomes on the sources side are presented in Table 3.5. While Table 3.4 represents a SAM where no taxes are imposed, Table 3.5 presents an after-tax economy, where primes define new prices and incomes. Y'_ℓ is after-tax income of workers, Y'_k is after-tax income of capitalists, and Y'_g is revenue of the government acquired from the tax receipts. The SAM of Table 3.5 also shows that institutions spend all of their after-tax income on good X and Y. This is indicated in the first three columns of the SAM, where X'_w and Y'_w are quantities of good X and Y consumed by workers after taxes are imposed. As demonstrated above, changes in incomes of institutions on the sources side can be calculated by subtracting after-tax factor incomes from before-tax factor incomes.

Changes of incomes on the uses side can, on the other hand, be calculated through the use of the following equation for any income group:

Table 3.5

Tax Incidence of Selective Commodity Taxes

Receipts \ Expenditures				INSTITUTIONS: Workers	INSTITUTIONS: Capital	INSTITUTIONS: Govt.	TAXES: X	TAXES: Y	FACTORS: Labor	FACTORS: Capital	ACTIVITIES: X	ACTIVITIES: Y	TOTAL
				1	2	3	4	5	6	7	8	9	10
I	INSTITUTIONS	Workers	1						$Y'_\ell = 1512$				$Y'_\ell = 1512$
		Capitalists	2							$Y'_k = 868$			$Y'_k = 868$
		Government	3				$Y'_{tx} =$ 420	$Y'_{ty} = 0$					$Y'_g = 420$
II	TAXES	X	4								$t_x Y'P' =$ (0.3)1400=420	0	$Y'_{tx} = 420$
		Y	5								0	$t_y = 0$	$Y'_{ty} = 0$
III	FACTORS	LABOR	6								$(1-t_x)\alpha Y'_x P'_x = w'L_x =$ (0.9)560=504	$\beta Y'_y P'_y = w'L_y =$ (0.9)1120= 1008	$Y'_e = w'L =$ (0.9)1680 = 1512
		CAPITAL	7								$(1-t_x)(1-\alpha) Y'_x P'_x = r'K_x =$ (0.775)840= 651	$(1-\beta) Y'_y P'_y = r'K_y =$ (0.775)280= 217	$Y'_k = r'K =$ (0.775)1120 = 868
IV	ACTIVITIES	X	8	$X'_w =$ (0.3) 1512 = 453.6	$X'_c =$ (0.8) 868 = 694.4	$X'_G =$ (0.6) 420 = 252							$Y'_x P'_x = 1400$
		Y	9	$Y'_w =$ (0.7) 1512 = 1058.4	$Y'_c =$ (0.2) 868 = 173.6	$Y'_G =$ (0.4) 420 = 168							$Y'_y P'_y = 1400$
V	TOTAL		10	$Y'_\ell =$ 1512	$Y'_k =$ 868	$Y'_g =$ 420	$Y'_{tx} =$ 420	$Y'_{ty} =$ 0	$Y'_\ell = 1512$	$Y'_k = 868$	$Y'_x P'_x =$ 1400	$Y'_y P'_y =$ 1400	

$$\Delta Y_i = -(X_j' \Delta Px + Y_j' \Delta Py) \qquad \begin{matrix} i = \ell, k, g \\ j = w, c, G \end{matrix}$$

where ΔY is change in real income, and ΔP_x or ΔP_y measures the percentage change in relative prices of good X and Y, respectively. The equation defines a change in consumer's real income on the uses side as the sum of the products of the quantity of each commodity purchased in the new after-tax situation and the percentage change in the price of the commodity.

<u>Changes in uses of income:</u>

(1) Workers: $$\Delta Y_\ell = -\left(\frac{X_w'}{P_x'} \Delta Px + \frac{Y_w'}{P_y'} \Delta Py\right)$$

X_w' is quantity of good X consumed by workers after taxes are imposed. If the workers average propensity to consume X is 0.3 and their after-tax factor income is $w'L$, then the expression for X_w' and Y_w' is:

$$X_w' = (0.3)(w'L) = (0.3)1512 = 453.6.$$

$$Y_w' = (0.7)(w'L) = (0.7)1512 = 1058.4$$

$$\Delta Y_\ell = -\left(\frac{453.6}{1.174} (0.174) - \frac{1058.4}{0.873} (0.127)\right)$$

$$\Delta Y_\ell = -67.23 + 153.97 = +86.74$$

(2) Capitalists:

$$\Delta Y_k = -\left(\frac{X_c' \ \Delta Px}{P_x'} + \frac{Y_c' \ \Delta Py}{P_y'} \right)$$

$$X_c' = (0.8)(r'K) = (0.8)868 = 694.4$$

$$Y_c' = (0.2)(r'K) = (0.2)868 = 173.6$$

$$\Delta Y_k = -\left(\frac{694.4}{1.174}(0.174) - \frac{173.6}{0.873}(0.127)\right)$$

$$\Delta Y_k = -102.92 + 25.25 = -77.67$$

(3) Government:

$$\Delta Y_g = -\left(\frac{X'_G}{P'_x}\Delta P_x + \frac{Y'_G}{P'_y}\Delta P_y\right)$$

$$X'_G = (0.6)420 = 252$$

$$Y'_G = (0.4)420 = 168$$

$$\Delta Y_g = -\left(\frac{252}{1.174}(0.174) - \frac{168}{0.873}(0.127)\right)$$

$$\Delta Y_g = -37.35 + 24.44 = -12.91$$

Both capitalists and the government are burdened by the rise in the relative price of X , because they are heavy consumers of those goods. Labor, on the other hand, benefits from the fall in the price of Y , the good that labor consumes in larger proportions. A reversal in these preference patterns would, on the other hand, reverse these particular results.

Real income changes on both the sources and uses sides of income for the different factor owners and goverment can be combined into one table to give the pattern of income redistribution as shown below:

Total changes in income:

	Sources	Uses	Total
(1) Workers:	−168	+87	−81
(2) Capitalists:	−252	−78	−330
(3) Government:	+420	−13	+407

With an original income of \$1680, workers lose \$81.26 (or about 5 percent) of their initial income, while capital owners suffer a reduction of \$320.67 from their initial income of \$1120 (or about 30 percent). Capitalists are made relatively worse off by the tax on good X, because this commodity is capital intensive and because capitalists spend more of their income on good X (which became more expensive).

As discussed in section II of this chapter in the traditional approach of empirical incidence of excise taxes, followed by Musgrave and others, it is assumed that these taxes affect consumers from the uses side of their income only. In these studies, the burden is distributed in line with the distribution of consumer expenditures. The redistributive pattern, as obtained above, can thus be compared with the traditional assumptions that tax on a single commodity is shifted forward and borne in proportion to the consumption of the good. In such a case, the burden of government receipts from taxes, i.e., \$420 would be allocated according to the share of each factor group in the total consumption of good X. Consumption expenditures on good X by workers and capitalists can be obtained from Table 3.4, where $T_{8.1} = X_w = 504$ and $T_{8.2} = X_c = 896$. This means that workers consume 36 percent and capitalists 64 percent of good X. Multiplying these percentages by total value of taxes (\$420) would result in a tax burden of \$151 for workers, \$269 for capitalists, and no burden for government. Comparing the two results, it is apparent that the traditional procedure attributes too much of the burden to workers, too little to capitalists, and ignores the tax incidence that is a consequence of government consumption. As demonstrated in section II of this chapter, the assumption used in the traditional approach is a special case. It holds only when factor intensities are the same in the two sectors, because in such a case, the price of X rises by exactly the tax percent. In that case, the tax would be neutral on the side of sources of income and would be borne exclusively by consumers of good X, because equal factor intensities produce constant opportunity costs, i.e., a completely elastic supply of good X at initial prices.

2. A Tax on Capital in One Sector

This example will demonstrate the case of a tax levied on the income of capital earned in sector X of the economy. This tax corresponds to the corporate income tax in which income earned by capital is taxed more heavily in one sector than in the other (noncorporate) sector, which is usually comprised mainly of housing and agriculture.

A tax on capital income earned in sector X is introduced at the rate of 50 percent of the gross price of capital paid by the enterpreneurs. This tax would generate government receipts of $420 (on a base of $840) and keep tax revenues the same as they were when a tax of thirty percent was applied against the gross price of good X. However, it should be noted that government income is not exactly the same in real terms in both cases. Revenues of the government are $420 in both cases on the sources side, but on the uses side, gains and loses result from tax-induced shifts in relative prices, which may either increase or decrease the government real incomes. This minor complication that arises from the government expenditures of its revenues is ignored here.1/ The effect of the tax reduces the net income received by the corporate sector in industry X by $420 and raises the tax revenues by the same amount. Because of the dual Cobb-Douglas assumptions,

1/ This complication can be avoided by allocating the value of government expenditures directly to households in the form of transfer income; this will be demonstrated in the next chapter.

capital in X receives a gross return of exactly \$840, as long as the nominal value of net national product is unchanged at \$2800.

To calculate the tax incidence of corporate tax on the sources and uses of income, the same procedure as in the example above can be used. First, from the equations obtained in section III of this chapter, after-tax prices for wages, capital, P_x and P_y can be obtained:

$$r' = \frac{(1-t)\ (1-\alpha)\ a + (1-\beta)\ (1-a)}{(1-\alpha)a + (1-\beta)\ (1-a)} \qquad \text{(from section III)}$$

$$r' = \frac{(1-0.5)(0.6) + 0.2}{(0.6) + 0.2} = \frac{0.5}{0.8} = 0.625$$

$w = w'$; because no tax is imposed on labor.

$$P'_x = w'^{\alpha} \left(\frac{r'}{1-t}\right)^{1-\alpha}$$

$$P'_x = \left(\frac{0.625}{0.50}\right)^{0.06} = 1.143$$

$$P'_y = w'^{\beta} r'^{1-\beta}$$

$$P'_y = (0.625)^{0.2} = 0.910$$

These calculations determine who bears the burden of the tax on the side of the sources of income. Tax receipts are \$420, and the net price of 1120 units of capital falls by 0.375 or a total of \$420; therefore, the increase in tax receipts is exactly matched by a reduction in the net income available to owners of capital factor income. Thus, on the side of sources of income, capital bears the entire burden of the corporate income tax and labor none of it. Because labor is not taxed, it avoids the tax on the sources side of income. On the other hand, mobility of capital from the corporate to the noncorporate sector causes that in the Cobb-Douglas case, where substitution is reasonably easy between factors in production, both corporate and noncorporate sectors pay the taxes on the side of sources of income, and not just those in the corporate sector.

Changes in sources of income:

1. Workers: $Y_\ell - Y'_\ell = wL - w'L = (1)1680 - (1)1680 = 0$

2. Capitalists: $Y_k - Y'_k = (1)1120 - (0.625)1120 = -420$

3. Government: $tax = t(1-\alpha)Y_x = (0.5)(0.6)1400 = +420$

After-tax incomes (sources side) for workers, capitalists, and government are presented in Table 3.6. The data in this table can be compared with those in Table 3.5. In the latter case, there is no change in labor income, i.e., $Y_\ell = Y'_\ell = wL = w'L$. On the other hand, capital income is reduced for the tax amount, i.e., $Y_k > Y'_k$, where $Y'_k = (1-t)K$, and where government receives tax revenue paid only by capitalists on the sources side of income. It is also apparent from the first three columns of Table 3.6 that workers income left for consumption stays the same, and that capitalists income is reduced for the tax which is, in turn, spent on goods X and Y by the government.

The incidence of the tax on the side of the uses of income depends on consumption patterns and how relative product prices are altered by the tax. Because the model assumes that national income is fixed at its original level in the after-tax situation, if one commodity increases in price the other must decrease in price. Consumers who spend a relatively large proportion of their income on the good that becomes more expensive are worse

Table 3.6

A Tax on Capital in One Sector

Receipts \ Expenditures			INSTITUTIONS: Workers	INSTITUTIONS: Capital	INSTITUTIONS: Govt.	TAXES: X	TAXES: Y	FACTORS: Labor	FACTORS: Capital	ACTIVITIES: X	ACTIVITIES: Y	TOTAL
			1	2	3	4	5	6	7	8	9	10
I INSTITUTIONS	Workers	1						$Y'_\ell = 1680$				$Y'_\ell = 1680$
	Capitalists	2							$Y'_k = 700$			$Y'_k = 700$
	Government	3				$Y_{tx} =$ 420	$Y_{ty} = 0$					$Y'_g = 420$
II TAXES	X	4								$t_x(1-\alpha)Y'_xP'_x = (0.5)(.6)1400 = 420$	0	$Y_{tx} = 420$
	Y	5								0	$t_y = 0$	$Y_{ty} = 0$
III FACTORS	LABOR	6								$\alpha Y'_xP'_x =$ $(0.4)1400 =$ 560	$\beta Y'_yP'_y =$ $(0.8)1400 =$ 1120	$Y'_\ell = wL = 1680$
	CAPITAL	7								$(1-t_x)(1-\alpha)$ $= r'K_x =$ $(0.625)840 =$ 525	$(1-\beta)Y'_xP'_x =$ $r'K_y =$ $(0.625)280 =$ 175	$Y'_k = r'K =$ $(0.625)1120 = 700$
IV ACTIVITIES	X	8	$X'_w =$ (0.3) $1680 =$ 504	$X'_c =$ (0.8) $700 =$ 560	$X'_G =$ (0.6) $420 =$ 252							$Y'_xP'_x = 1400$
	Y	9	$Y'_w =$ (0.7) $1680 =$ 1176	$Y'_c =$ (0.2) $700 =$ 140	$Y'_G =$ (0.4) $420 =$ 168							$Y'_yP'_y = 1400$
V TOTAL		10	$Y'_\ell =$ 1680	$Y'_k =$ 700	$Y'_g =$ 420	$Y_{tx} =$ 420	$Y_{ty} = 0$	$Y'_\ell = 1680$	$Y'_k = 700$	$Y'_xP'_x =$ 1400	$Y'_yP'_y =$ 1400	

off and vice versa. The tax incidence on the uses side of the income can be calculated in the same way as in the above example:

Changes in uses of income:

1. Workers: $$\Delta Y_{\ell} = -\left(\frac{X'_w}{P'_x} \Delta P_x + \frac{Y'_w}{P'_y} \Delta P_y \right)$$

$$X'_w = (0.3)(w'L) = (0.3)(1680) = 504$$

$$Y'_w = (0.7)(w'L) = (0.7)(1680) = 1176$$

$$\Delta Y_{\ell} = -\left(\frac{504.6}{1.143} (0.143) - \frac{1176}{0.910} (0.09)\right)$$

$$\Delta Y_{\ell} = -63.1 + 115.3 = +53.2$$

2. Capitalists:

$$\Delta Y_k = -\left(\frac{X'_c}{P'_x} \Delta Px - \frac{Y'_c}{P'_y} \Delta Py\right)$$

$$X'_c = (0.8)(r'K) = (0.8)700 = 560$$

$$Y'_c = (0.2)(r'K) = (0.2)700 = 140$$

$$\Delta Y_k = -\left(\frac{560}{1.143} (0.143) - \frac{140}{0.910} (0.09)\right)$$

$$\Delta Y_k = -70.0 + 13.8 = -56.2$$

3. Government:

$$\Delta Y_g = -\left(\frac{X'_G}{P'_x}\,\Delta Px - \frac{Y'_G}{P'_y}\,\Delta Py\right)$$

$$X'_G = (0.6)420 = 252$$

$$Y'_G = (0.4)420 = 168$$

$$\Delta Y_g = -\left(\frac{252}{1.143}\,(0.143) - \frac{168}{0.910}\,(0.09)\right)$$

$$\Delta Y_g = -31.5 + 16.6 = -14.9$$

Forming the relative price ratio $P'_x/P'_y = 1.143/0.910 = 1.256$, shows that the price of good X has risen with respect to the price of Y by 25.6 percent. Similarly as in the case above (tax on commodity X), labor benefits from the fall in the price of Y, and capitalists and government lose. This is because both government and capitalists consume more of good X and workers more of good Y . The combined tax incidence from the sources and uses of income side gives the following result:

Total Changes in incomes:

	Sources	Uses	Total
(1) Workers	0	+53	+53
(2) Capitalists:	-420	-56	-476
(3) Government:	+420	-15	+405

From the above results, it is clear that labor, which is not affected by the corporate tax, suffers no loss on the sources side and gains

$53.2 on the uses side. On the other hand, capitalists who lose $420 on the side of sources of income, incur an additional loss of $56.2 on the uses side of income. The government's loss on the side of the uses of income happens because $420 of tax revenue is in real terms worth $14.9 less than if the revenue had been raised in a way that did not raise the price of good X . However, if the government preferred to consume more of good Y in proportion to good X , then it would actually benefit twice, from the sources and uses side of income.

This example again confirms the criticism of traditional tax incidence studies, discussed in the section three of this chapter, that treat corporate income tax as a tax which falls on recipients of dividends only. In other words, corporate taxes are subtracted from gross capital income of shareholders only. Other recipients of capital income (owners of unincorporate enterprises) are assumed to be unaffected by the corporate taxes, and no account is taken of the effects of these taxes on the uses side due to changes in relative prices. As demonstrated above, a proper treatment of corporate taxes would be to subtract these taxes from all recipients of factor capital income and to take into account also changes in relative prices which affect after-tax incomes from the uses side of income. A treatment that takes these recommendations into account will be applied to a SAM for Egypt in Chapter V.

3. Tax Incidence of General Factor Taxes

In this example, a tax on all uses of one factor will be analyzed. A tax rate of 25 percent is imposed on the gross income earned by labor services everywhere in the economy. This tax would generate government revenues of $420 (on a base of 1680, 420/1680 = 0.25) and keep tax proceeds the same as they were in the previous example where only a tax on the corporate source of capital income was imposed. When the tax is imposed, the net return to labor falls to $0.75 per unit. Because the same rate of tax on labor is levied in both sectors, this will be the equilibrium net price of labor, with the gross price or cost of labor unchanged. New prices for labor, capital, and X and Y can be calculated by using analytical expressions obtained in section I of this chapter:

$r' = r = 1$; because no tax is imposed on capital

$$w' = \frac{(1-t)\alpha a + (1-t)\beta(1-a)}{\alpha a + \beta(1-a)}$$

$$w' = 1-t$$

$$w' = 1-(0,25) = 0.75$$

$$P'_x: \quad \alpha\left(\frac{1-t}{P'_x}\right)^{1-\sigma x} + (1-\alpha)\left(\frac{r'}{P'_x}\right)^{1-\sigma x} = 1$$

$$P'_x = \left(\frac{w'}{1-t}\right)^{\alpha} r'^{\,1-\alpha}$$

Substituting for $w' = (1-t)$, and $r' = 1$,

$$P'_x = \left(\frac{w'}{1-t}\right)^{\alpha} (1)^{1-\alpha} = 1$$

$$P'_y: \quad \beta\left(\frac{\frac{w'}{1-t}}{P'_x}\right)^{1-\sigma y} + (1-\beta)\left(\frac{r'}{P'_y}\right)^{1-\sigma y} = 1$$

$$P'_y = \left(\frac{w'}{1-t}\right)^{\beta} r'^{\,1-\beta}$$

$$P'_y = 1$$

$$\frac{P'_x}{P'_y} = 1$$

Changes in sources of income:

(1) Workers: $Y_\ell - Y'_\ell = wL - w'L = (1)\ 1968 - (0.75)1680 = -420$

(2) Capitalists: $Y_k - Y'_k = 0$

(3) Government: $t(L) = (0.25)\ 1680 = +420$

As is apparent from the above calculations, product prices experience no change, because neither the cost of labor nor the cost of capital is affected by the tax. Thus, no competitive pressure emerges for an intersectoral reallocation of factors, and output is unchanged in both industries. The after-tax situation can be summarized in a table that shows total changes in incomes:

Total Changes in Incomes

	Sources	Uses	Total
(1) Workers	−420	0	−420
(2) Capitalists	0	0	0
(3) Government	+420	0	+420

This table shows that a general tax on labor is neutral and that the resulting effect of the tax is that labor bears the entire burden of the tax. Compared to selective factor taxes presented above, both taxes have identical effects on the sources side. However, the selective factor tax induces capital (or labor) flows and causes additional redistribution on the side of the use of income, while the general tax on labor causes no relative price changes.

The redistributive effects of general factor taxes can again be presented in a SAM framework. Table 3.7 presents the after-tax situation. The tax on labor is subtracted from the gross price of labor in columns 8 and 9 and added to the tax account in rows 4 and 5 of the SAM. Because an equal tax is imposed on all labor employed in X and Y , the tax reduces the gross income of labor proportionally in both sectors and does not change the gross price of X and Y ($P'_x = P'_Y = P_x = P_y = 1$). Thus, all that happens is that capital income stays the same, while labor income — Y'_ℓ , which is received by workers, is reduced by the tax amount ($Y'_\ell = (1-t)L$). However, if a selective labor tax were introduced, then the tax would induce labor to move from the taxed to the untaxed industry, it would raise the relative price of the taxed good, and cause the amount purchased of the taxed sector's product to fall and that of the untaxed sector to rise. Consequently, incomes would be affected twice, from the sources and uses side.

In summary, under competitive assumptions, a general tax that is levied on all sources of labor income would be borne entirely by labor. By the same logic, a tax on capital income earned in all of capital's employments would have neutral effects on product prices and would be borne entirely by capital owners. Taxes that can be considered close to general factor taxes in the real world are payroll taxes, social security taxes imposed on labor, and property taxes imposed on capital.

The general rule established in the theory of tax incidence, and followed in this study, is that tax incidence analysis should always consider effects on both the sources and uses side of incomes. However, conventional analysis (Musgrave et al. 1974) discussed at the beginning of this chapter implies that taxes are borne solely by "producers" or only by "consumers" in proportion to their income or consumption. As demonstrated above, this rule

Table 3.7

Tax Incidence of General Factor Taxes

Receipts \ Expenditures			INSTITUTIONS: Workers	INSTITUTIONS: Capital	INSTITUTIONS: Govt.	TAXES: X	TAXES: Y	FACTORS: Labor	FACTORS: Capital	ACTIVITIES: X	ACTIVITIES: Y	TOTAL
			1	2	3	4	5	6	7	8	9	10
I INSTITUTIONS	Workers	1						$Y'_{\ell} = 1260$				$Y'_{\ell} = 1260$
	Capitalists	2							$Y'_k = 1120$			$Y'_k = 1120$
	Government	3				$Y'_{tx} =$ 140	$Y'_{ty} =$ 280					$Y'_g = 420$
II TAXES	X	4								$t_x \alpha Y'_x P'_x =$ (0.25)(0.4) 1400 = 140	0	$Y'_{tx} = 140$
	Y	5								0	$t_y \beta Y'_y Y'_y =$ (0.25)(0.8) 1400 = 280	$Y'_{ty} = 280$
III FACTORS	LABOR	6								$(1-t_x)\alpha Y'_x Y'_x$ $= w'L_x$ = (0.75)560 = 420	$(1-t_y)\beta Y'_y P'_y$ $= w'L_y$ = (0.75)1120 = 840	$Y'_{\ell} = w'L =$ (0.75)1680 = 1260
	CAPITAL	7								$(1-\alpha)Y'_x P'_x =$ (0.6)1400 = 840	$(1-\beta)Y'_y P'_y =$ (0.2)1400 = 280	$Y'_k = 1120$
IV ACTIVITIES	X	8	$X'_w =$ (0.3) 1260 = 378	$X'_c =$ (0.8) 1120 = 896	$X'_G =$ (0.6) 420 = 252							$Y'_x P'_x = 1400$
	Y	9	$Y'_w =$ (0.7) 1260 = 882	$Y'_c =$ (0.2) 1120 = 224	$Y'_G =$ (0.4) 420 = 168							$Y'_y P'_y = 1400$
V TOTAL		10	$Y'_{\ell} =$ 1260	$Y'_k =$ 1120	$Y'_g =$ 420	$Y'_{tx} =$ 140	$Y'_{ty} =$ 280	$Y'_{\ell} = 1260$	$Y'_k = 1120$	$Y'_x P'_x = 1400$	$Y'_y P'_y = 1400$	

holds only in special cases and one of them is the example of general factor taxes.

4. Tax Incidence of General Commodity Taxes (sales tax).

To raise the same government revenue from taxes as in the previous three cases ($420), a tax of 15 percent on the gross income would have to be imposed (0.15 x 2800 = 240). This tax can be treated in a similar way as a tax on one commodity (see Section II), which was calculated by imposing the same rate of tax on labor and capital in producing X . Here a tax on X and Y is introduced, which means that imposition of a uniform tax rate on both commodities is the same as a value-added tax on income. In other words, a general tax on expenditures has the same incidence as a proportional income tax imposed on all sources of income. To calculate new prices for w', r', P'_x, and P'_y , equations from section IV of this chapter are used:

$$w' = \frac{(1-t)\alpha a + (1-t)\beta(1-a)}{\alpha a + \beta(1-a)}$$

$$w' = 1-t$$

$$r' = \frac{(1-t)(1-\alpha)a + (1-t)(1-\beta)(1-a)}{(1-\alpha)a + (1-\beta)(1-a)}$$

$$r' = 1-t$$

$$P'_x: \quad \alpha\left(\frac{\frac{w'}{1-t}}{P'_x}\right)^{1-\sigma x} + (1-\alpha)\left(\frac{\frac{r'}{1-t}}{P'_x}\right)^{1-\sigma x} = 1$$

$$P'_x = \left(\frac{w'}{1-t}\right)^{\alpha}\left(\frac{r'}{1-t}\right)^{1-\alpha}$$

Substituting for $w' = r' = 1\text{-}t$, then

$$P'_x = \frac{1-t}{1-t} = 1$$

$$P'_y: \quad \beta\left(\frac{\frac{w'}{1-t}}{P'_y}\right)^{1-\sigma y} + (1-\beta)\left(\frac{\frac{r'}{1-t}}{P'_y}\right)^{1-\sigma y} = 1$$

$$P'_y = \left(\frac{w'}{1-t}\right)^{\beta}\left(\frac{r'}{1-t}\right)^{1-\beta}$$

Substituting for $w' = r' = 1\text{-}t$,

$$P'_y = \frac{1-t}{1-t} = 1$$

$$\frac{P'_x}{P'_y} = 1$$

Changes in income:

Sources side

(1) Workers: $Y_\ell - Y'_\ell = wL - w'L = 1680 - (1-0.15)1680 = -252$

(2) Capitalists: $Y_k - Y'_k = rK - r'K = 1120-(1-0.15)1120 = -168$

(3) Government: $t(Y_\ell + Y_k) = 0.15(2800) = +420$

Total Changes in Income

	Sources	Uses	Total
(1) Workers:	-252	0	-252
(2) Capitalists:	-168	0	-168
(3) Government:	+420	0	+420

In the after-tax situation, the prices of both labor and capital declined from unity to 0.85. Thus, in the after-tax equilibrium, the returns to all factors decline by the same percentage rate. There is no change in relative output prices of goods X and Y , and therefore there is no distributional impact of these taxes on the uses side of income.

The same result is presented in the SAM context in Table 3.8. This table shows the origin of taxes, i.e., taxes affect all four cells of the value-added matrix (intersection of rows 6 and 7 with columns 8 and 9). Taxes are subtracted proportionally from the value-added matrix and added to the tax matrix ($T_{4.8} = tY_x$, and $T_{5.9} = tY_y$). This reduces labor and capital factor incomes, where $Y_\ell' = (1-t)L = T_{6.8} + T_{6.9}$, and $Y_k' = (1-t)K = T_{7.8} + T_{7.9}$. After-tax factor incomes are, in turn, received by institutions, thus reducing their before-tax incomes from the sources side. These new incomes of institutions are then spent on goods X and Y . Because there is no relative price changes, there is no further effect of taxes from the uses side of income. The result of the general equilibrium effect of general commodity taxes is that the general expenditure tax is neutral with respect to resource-allocation decisions and is borne in proportion to initial shares in national income. This also means that the partial equilibrium static analysis assumed in the traditional empirical studies of tax incidence is sufficient for an analysis of the distributive effects of these particular taxes.

The above approach and analytical and numerical examples demonstrate the usefulness of the SAM framework for the tax incidence analysis. The approach also shows the importance of considering general equilibrium effects of taxes on both the sources and uses side of income. The results of the general equilibrium effects differ substantially for selective factor and commodity taxes compared to partial static analysis of taxes, the approach used in the conventional empirical studies of tax incidence.

Table 3.8

Tax Incidence of General Commodity Taxes

Receipts \ Expenditures				INSTITUTIONS: Workers	INSTITUTIONS: Capital	INSTITUTIONS: Govt.	TAXES: X	TAXES: Y	FACTORS: Labor	FACTORS: Capital	ACTIVITIES: X	ACTIVITIES: Y	TOTAL
				1	2	3	4	5	6	7	8	9	10
I	INSTITUTIONS	Workers	1						$Y'_\ell = 1428$				$Y'_\ell = 1428$
		Capitalists	2							$Y'_k = 952$			$Y'_k = 952$
		Government	3				$Y'_{tx} =$ 210	$Y'_{ty} =$ 210					$Y'_g = 420$
II	TAXES	X	4								$t_x Y'_x P'_x =$ (0.15)1400 = 210	0	$Y'_{tx} = 210$
		Y	5								0	$t_y Y'_y P'_y =$ (0.15)1400 = 210	$Y'_{ty} = 210$
III	FACTORS	LABOR	6								$(1-t_x)\alpha Y'_x P'_x = w'L_x =$ (0.85)560 = 476	$(1-t_y)\beta Y'_y P'_y = w'L_y =$ (0.85)1120 = 952	$Y'_\ell = w'L =$ (0.85)1680 = 1428
		CAPITAL	7								$(1-t_x)(1-\alpha) Y'_x P'_x = r'K_x$ = (0.85)840 = 714	$(1-t_y)(1-\beta) Y'_y P'_y = r'K_y$ = (0.85)280 = 238	$Y'_k = r'K =$ (0.85)1120 = 952
IV	ACTIVITIES	X	8	$X'_w =$ (0.3) 1428 = 428.4	$X'_c =$ (0.8) 952 = 761.6	$X'_G =$ (0.6) 420 = 252							$Y'_x P'_x = 1400$
		Y	9	$Y'_w =$ (0.7) 1428 = 999.6	$Y'_c =$ (0.2) 952 = 190.4	$Y'_G =$ (0.4) 420 = 168							$Y'_y P'_y = 1400$
V	TOTAL		10	$Y'_\ell =$ 1428	$Y'_k =$ 952	$Y'_g =$ 420	$Y'_{tx} =$ 210	$Y'_{ty} =$ 210	$Y'_\ell = 1428$	$Y'_k = 952$	$Y'_x P'_x =$ 1400	$Y'_y P'_y =$ 1400	

In the next chapters the SAM framework and the approach developed above will be applied to an analysis of tax incidence. For this purpose, a SAM for Egypt will be used in Chapter V. Actual SAMs built for different countries contain much more information, including preexisting taxes and an input-output table, than the simplified SAM example presented above. For this reason, several additional assumptions and modification of the methodology presented will be made in Chapters IV and V.

REFERENCES

Devarjan, S., Don Fullerton, and R. A. Musgrave (1980). "Estimating the Distribution of Tax Burdens, A Comparison of Different Approaches." Journal of Public Economics, 13.

Harberger, A. C. (1962). "The Incidence of the Corporation Income Tax." Journal of Political Economy, No. 3, pp. 215-40.

McLure, C. E., and W. R.Thirsk (1975). "A Simplified Exposition of the Harberger Model I: Tax Incidence." National Tax Journal, 28, pp. 1-27.

Meerman, J. (1978). "Do Empirical Studies of Budget Incidence Make Sense?" Public Finance, Vol. 33, No. 3.

__________ (1979). Public Expenditure in Malaysia, Who Benefits and Why. Oxford University Press.

Meerman, J., and P. Shome (1980). "Estimating Counterfactual Income in Studies of Budget Incidence." Public Finance, Vol. 35, No. 2.

Musgrave, R. A., K. E. Case, and H. Leonard (1974). "The Distribution of Fiscal Burdens and Benefits." Public Finance Quarterly (July).

Pechman, J. A., and B. A Okner (1974). Who Bears the Tax Burden? Brookings Institution, Washington, D.C.

Pyatt, G., and E. Thorbecke (1976). Planning Techniques for a Better Future. International Labour Office, Geneva.

Pyatt, G., and A. Roe, with R. Lindley and G. Round and others (1977). Social Accounting for Development Planning with Special Reference to Sri Lanka. Cambridge: Cambridge University Press.

Pyatt, G., and G. Round (1978). "The Distribution of Income and Social Accounts: A Study of Malaysia in 1970." The World Bank, Development Research Center, mimeographed.

CHAPTER IV

EMPIRICAL APPLICATION OF MODIFIED HARBERGER MODELS IN A SAM FRAMEWORK -- INCLUSION OF INTERINDUSTRY TRANSACTIONS AND PREEXISTING TAXES

As discussed in Chapter II, one major shortcoming of the Harberger (1962) model, criticized by several authors (Break 1974, McLure 1975), is that the model implicitly assumes the absence of any preexisting taxes. For this reason the model can, strictly speaking, be applied only to the analysis of taxes in a zero-tax situation. Another shortcoming of the standard Harberger model is that it does not include interindustry transactions as part of its accounting framework. Absence of interindustry flows from the model means that distributional effects arising from changes in relative prices due to taxes levied on intermediate commodities (purchased by activities) are not part of the incidence analysis as shown in Chapter III. As indicated in Chapter II, absence of preexisting taxes in the Harberger model has been studied initially by Feldstein (1974), Shoven and Whalley (1972), and Fullerton et al. (1978). However, their work is not explicitly related to the extensive work undertaken by the analysts using the above-reviewed conventional approach to empirical analysis of tax incidence. Theoretical treatment of the importance of interindustry transactions within the Harberger model has been analyzed in terms of differentials in a similar way as the original Harberger model, and a general derivation of this analysis is presented in Atkinson and Stiglitz (1980), pp. 217-219. On the other hand, the importance of taxation in a pure input-output context, without a full general equilibrium model, has been pointed out by the early work of Metzler (1951), and recently by Atsumi (1981).

The analysis presented in this chapter attempts to extend the standard Harberger model presented in Chapter III: (1) to include intermediate demand for commodities by activities (input-output table), and (2) to allow for tax incidence analysis of an economy characterized by an existing tax structure. This means that a modified tax incidence model will be formulated so as to deal explicitly with the possible differences in tax incidence patterns created by specific tax changes in a zero-tax situation compared to a situation with existing taxes. The model presented below is written in a SAM framework and applied to the SAM data base, thus extending the analysis presented in Chapter III.

The Analytical Model

The model presented below is based on a modified Harberger model written in a SAM framework as developed in Chapter III. The model is additionally modified for this analysis to take into account the allocation of tax burdens between two types of households (in this case, urban households and rural households); it is structured to investigate the impact of a tax allowing for all general equilibrium effects,1/ including interindustry transactions (intermediate demand). The model is also extended to allow comparison of the incidence of taxes in an economy with preexisting taxes and an economy with no taxes. The purpose of the model is to identify differences in tax burdens arising from relative price changes of factors and commodities due to taxes imposed on either value added, activities (fees and licences), or commodities. Two versions of the extended Harberger model are presented. The first version of the model uses the Cobb-Douglas production function for both

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1/ The definition of "general equilibrium analysis" means here that prices and quantities adjust simultaneously in the model.

value added and intermediate inputs. In the second version, the production process is disaggregated into two parts. The net output is represented by the Cobb-Douglas production function, while the gross output is represented by the input-output production function.

Two versions of the model are presented in order to show the flexibility of the model, i.e., that the model allows for different specifications of production functions and consumption patterns. Any type of production specification, the Cobb-Douglas (CD), the input-output (IO), or the constant elasticity of substitution (CES) production function could be used alternatively in this model. However, as it appears in the development literature, the evidence on differences in the specification of the elasticities of substitution is inconclusive (Nicholson 1978). Different authors use various production specifications, depending primarily on data availability and economic issues explored. For example, the CD production function is very often used because its simple functional form is computationally economical and yields statistically significant estimates of the coefficients without imposing excessive demands upon data accuracy. For these reasons, the CD production function is most often used in econometric research (Yotopoulos and Nugent 1976). The properties of IO functions are generally considered to be less realistic than those of the neoclassical functions, because of the fixed technology assumptions of the static model. On the other hand, the IO production function is an especially useful tool for empirical analysis of general equilibrium systems. The IO function provides answers to questions referring to the effect of a change in the final demand for industry j on the output of industry i. The neoclassical tools, as such, do not provide answers to these questions, and are thus primarily applicable to partial equilibrium analysis. The CES specification is the most flexible of the three, in the sense that it allows use of any value for the elasticity of substitution $(\infty > \sigma > 0)$. However, accordingly it makes additional demands upon data availability. Although the CES specification restricts σ to constancy, it permits a much wider choice among alternative values. The CD and IO production functions are special limiting cases of the CES, i.e., if $\sigma = 0$, then the production function takes on the Leontief IO form with fixed proportions, and if $\sigma = 1$, then the production function is of the CD type.

Basic assumptions of two versions of the extended Harberger model include the following:

(1) perfect competition in factor and product markets (no market imperfections);

(2) fixed aggregate factor supplies (L , K);

(3) no accumulation (savings); consequently, incomes equal expenditures;

(4) fixed technology (in the second version of the model);

(5) closed economic system (no trade), thus allowing for evaluation of domestic taxes only.

(6) full employment of factors (no unemployment);

(7) perfect factor mobility (in the CD version of the model);

(8) fixed stock of capital (or land) is assumed in each sector in the second version of the model. Consequently, in this model, a single variable input for all sectors is labor;

(9) as regards consumption behavior, the same budget shares are assumed before and after tax changes. In other words, consumers income of urban and rural households is spent on different goods in constant proportions.

Some of the basic assumptions presented above, i.e., perfectly competitive economy. fixed supply of factors, perfect mobility of factors, closed economic system, and no accumulation are the same as of the standard Harberger model. Therefore, the limitations of this model with respect to these assumptions are the same as discussed in detail in Chapter II. Among the assumptions, the most critical ones, which need to be modified in the future, are the assumptions on consumption response, intrasectoral distribution of income, foreign trade, and income measurement. Suggestions for the modifications of some of the assumptions will be given in Chapter VI.

An especially critical assumption when working with an economy represented by a SAM is the assumption about a closed economic system, because foreign trade is a consistent part of the SAM data base. Because foreign trade is excluded from the model, income distribution implications of import tariffs and export taxes, which may be substantial especially in developing countries, are not part of the analysis. Consequently, the model allows for evaluation of redistributional effects of fiscal policy for domestic taxes only. The classification of the population (urban and rural households) in this model is also restrictive, because the model does not allow measurements of intrasectoral distribution of income. However, this classification should be looked upon as a convenient expositional device, which can be easily improved simply by a more detailed disaggregation of the SAM data. On the other hand, this classification is nevertheless useful, because even in more disaggregated SAMs, it is still necessary to have urban and rural sectors. It should be also noted that this model does not take into account internal migration, which also influences income distribution patterns. Although the list of the restrictive assumptions is rather extensive, some of them can be easily modified in the future research. The justification for these restrictive assumptions is that this simple formulation of the model allows the previous work to be extended and lays the groundwork for further possible extensions.

The main purpose of this study is to develop a methodology for tax incidence analysis in a SAM framework and to show its feasibility for numerical applications. Consequently, the primary emphasis of the model presented in this chapter is to develop a general framework for tax incidence analysis that eventually can be extended further and applied to the actual SAM data. Because of the data constraints, and for the purpose of illustration, the model is formulated at first in the simplest CD form. This specification is then extended in the second version of the model by using a combination of CD and IO specifications.

This chapter is organized into two major sections. In the first section, the CD version of the model is presented analytically in a SAM framework. The solution of this model is then tested by using hypothetical SAM numbers. In the next section, the second version of the model is presented in analytical form, and an analysis of its numerical results is conducted. The second version of the model extended for nine sectors is then applied to the actual SAM for Egypt, 1979 in Chapter V.

Description of the Model

1. Cobb-Douglas Production Function[1/]

The extended Harberger model used for this analysis is a two-sector model. For the first version of the model, CD assumptions are made. An economy with two goods (X , Y) is considered. Each good is produced by a CD

1/ I am indebted to R. Sah for useful suggestions in formulating this model.

production function, using capital and labor, which are available in fixed total supply (K , L), and intermediate inputs X_x, X_y , Y_x , and Y_y :

$$X = A(L_x)^{\alpha_1} (K_x)^{\alpha_2} (X_x)^{\alpha_3} (Y_x)^{\alpha_4} \qquad \alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 = 1 \qquad (1)$$

$$Y = B(L_y)^{\beta_1} (K_y)^{\beta_2} (X_y)^{\beta_3} (Y_y)^{\beta_4} \qquad \beta_1 + \beta_2 + \beta_3 + \beta_4 = 1 \qquad (2)$$

In this model, variables α_1 to α_4 , and β_1 to β_4 are obtained from the base SAM and are assumed to stay constant. In principle, these variables are determined in exactly the same way as in the model presented in Chapter III above. The only difference between the two models is that the CD production function is specified in this model by combining four inputs (α_1 to α_4) instead of two inputs, labor and capital (α and $(1-\alpha)$) used in the model in Chapter III.

The model assumes fixed aggregate factor supplies, so that

$$L = L_x + L_y \qquad (3)$$

$$K = K_x + K_y \qquad (4)$$

Major equations of the model are presented in a SAM framework in Table 4.1a below. Equations (3) and (4) are presented in rows 4 and 5 in the SAM in Table 4.1a.

There are three consumers: (1) urban households (uh), (2) rural households (rh), and (3) government (g). Households derive their income from their endowments of capital and labor, while government income is equal to tax

Table 4.1a

Analytical Presentation of the CD Model in a SAM Framework

				INSTITUTIONS			FACTORS		ACTIVITIES		COMMODITIES		TAXES	TOTAL
				URBAN HOUSE-HOLDS	RURAL HOUSE-HOLDS	GOVERN-MENT	LABOR	CAPITAL	X	Y	X	Y		
				1	2	3	4	5	6	7	8	9	10	11
I	INSTITUTIONS	URBAN HH	1				$a(wL)$	$b(rK)$						Y_{uh}
		RURAL HH	2				$(1-a)(wL)$	$(1-b)rK$						Y_{rh}
		GOVERN-MENT	3										Y_t	Y_g
II	FACTORS	LABOR	4						wL_x	wL_y				wL
		CAPITAL	5						rK_x	rK_y				rK
III	ACTIVITIES	X	6								$(P_x-t_x)X$			$(P_x-t_x)X$
		Y	7									$(P_y-t_y)Y$		$(P_y-t_y)Y$
IV	COMMODITIES	X	8	cY_{uh}	dY_{rh}	eY_g			P_xX_x	P_xX_y				P_xX
		Y	9	$(1-c)Y_{uh}$	$(1-d)Y_{rh}$	$(1-e)Y_g$			P_yY_x	P_yT_y				P_yY
V	TAXES		10								t_xX	t_yY		Y_t
VI	TOTAL		11	Y_{uh}	Y_{rh}	Y_g	wL	rK	$(P_x-t_x)X$	$(P_y-t_y)Y$	P_xX	P_yY	Y_t	

revenue. In the same way as in the model presented in Chapter III, the government spends the tax revenue exactly to replace the loss in private demand in each sector from tax-induced income loss. This procedure ignores the excess burden of the tax, so that the sum of net gains and losses for consumers equals the yield of the tax. Government and each household spend all of their income either on good X or Y . Because no accumulation (savings) is assumed in this model, income equals expenditures. Each consumer makes his/her purchasing decision by maximizing his/her utility, subject to a budget constraint derived from his/her income. If Y_{uh} is income of urban households, Y_{rh} is income of rural households, and Y_g is income of the government, 1/ then consumption expenditures are defined as:

$$cY_{uh} + dY_{rh} + eY_g = P_x (X - X_x - X_y) \tag{5}$$

$$(1-c)Y_{uh} + (1-d)Y_{rh} + (1-e)Y_g = P_y (Y - Y_x - Y_y) \tag{6}$$

The above two equations, (5) and (6), simply mean that the sum of incomes of urban and rural households and the government is spent either on good X or Y in constant proportions. Variables c , (1-c) , d , (1-d), e , and (1-e) are obtained from the base SAM and are assumed to stay constant. These variables mean, for example, that a proportion c of urban household income (Y_{uh}) is spent on good X and a proportion (1-c) is spent on good Y . The definition for variables d and e is the same as for variable c . P_x and P_y represent market prices of commodities, because

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1/ In the second version of the model, tax revenues are allocated directly to households in the form of transfer incomes, thus allowing for "budget incidence" analysis.

commodities are bought by all consumers at market prices. Equations (5) and (6) are presented and explained in a SAM framework in Table 4.1a below in rows 8 and 9 of the SAM.

In this model, urban and rural households derive their incomes from their endowments of factors, i.e., labor and capital. Total labor income in the model is equal to wL and rK, where w = wage, r = price of capital, and L and K are quantities of labor and capital, respectively. If urban households own a proportion (a) of total labor and a proportion of (b) of total capital, then total income of urban households (Y_{uh}) is equal,

$$Y_{uh} = a(wL) + b(rK)$$

Because there are only two households, it follows that total income of rural households is equal to:

$$Y_{rh} = (1-a)(wL) + (1-b)(rK)$$

These two equations are presented in rows 1 and 2 in the SAM in Table 4.1a.

Government income (Y_g) is derived from commodity taxes t_x and t_y, and is equal to the total tax revenue (row 3 of Table 4.1a),

$$Y_g = (t_x X + t_y Y) = Y_t = \text{tax revenue}$$

Using equations (5) and (6) and substituting for Y_{uh}, Y_{rh}, and Y_g gives demand equations for X and Y,

$$c[a(wL) + b(rK)] + d[(1-a)(wL) + (1-b)(rK)] + \tag{7}$$

$$+ e(t_x X + t_y Y) = P_x (X - X_x - X_y)$$

$$(1-c)[a(wL) + b(rK)] + (1-d)[(1-a)(wL) + (1-b)(rK)] + \tag{8}$$

$$+ (1-e)(t_x X + t_y Y)] = P_y (Y - Y_x - Y_y)$$

On the supply side, prices and quantities for expenditures by activities are determined by the following equations,

$$(P_x - t_x)X = P_x X_x + P_y Y_x + wL_x + rK_x \tag{9}$$

$$(P_y - t_y)Y = P_x X_y + P_y Y_y + wL_y + rK_y \tag{10}$$

In this model P_x and p_y represent commodity prices (market prices), while $(P_x - t_x)$ and $(P_y - t_y)$ represent factory gate prices (without wholesale or retail margins or taxes) for X and Y. Equations (9) and (10) are presented in columns 6 and 7 in the SAM in Table 4.1a. They represent gross production expenditures for activity X and Y, i.e., cost of labor, capital, and intermediate inputs.

The equations from (1) through (10) represent the basic accounting structure of this model. Unknowns or endogenous variables of this model are: P_x, P_y, w, r, X and Y. Exogenous variables of the model are tax rates t_x and t_y. Because the model contains six unknowns, it needs six simultaneous equations for its solution. These equations are the following:[1/]

1/ For a derivation of equations (11) to (16), see Appendix 1.

$$L = L_x + L_y = \frac{(P_x - t_x)\alpha_1 X}{w} + \frac{(P_y - t_y)\beta_1 Y}{w} \tag{11}$$

$$K = K_x + K_y = \frac{(P_x - t_x)\alpha_2 X}{r} + \frac{(P_y - t_y)\beta_2 Y}{r} \tag{12}$$

$$c[a(wL) + b(rK)] + d[(1-a)(wL) + (1-b)(rK)] + e(t_x X + t_y Y) \tag{13}$$

$$= P_x X - (P_x - t_x)\,\alpha_3 X - (P_x - t_x)\,\alpha_4 X$$

$$(1-c)[a(wL) + b(rK)] + (1-a)(wL) + (1-b)(rK)] + (1-e)(t_x + t_y Y) \tag{14}$$

$$= P_y Y - (P_x - t_x)\alpha_4 X - (P_y - t_y)\,\beta_4 Y$$

$$(P_x - t_x)X = P_x\left[\frac{(P_x - t_x)\alpha_3 X}{P_x}\right] + P_y\left[\frac{(P_x - t_x)\alpha_4 X}{P_y}\right] + (P_x - t_x)\alpha_1 X + (P_x - t_x)\alpha_2 X \tag{15}$$

$$(P_y - t_y)Y = P_x\left[\frac{(P_y - t_y)\beta_3 Y}{P_x}\right] + P_y\left[\frac{(P_y - t_y)\beta_4 Y}{P_y}\right] + (P_y - t_y)\beta_1 Y + (P_y - t_y)\beta_2 Y \tag{16}$$

As indicated above, in this model, variables a, b, c, d, e, α_1 to α_4, and β_1 to β_4 are obtained from the base SAM and are assumed to stay constant, while t_x and t_y can vary. By normalizing $w = 1$ and solving the above system of six equations, six unknowns (endogenous variables): P_x, P_y, w, r, X, and Y can be determined. Values of the endogenous variables will vary with commodity taxes t_x and t_y, which are exogenously determined. Because t_x and t_y can vary, the impact of taxes on factor prices, commodity prices, and level of output can be determined by solving the model.

The above model can be written in a SAM framework as shown in Table 4.1a. There are five major accounts in the SAM presented in Table 4.1a. These accounts and the structure of this SAM are in principle the same as of the SAM presented in Chapter III (Table 3.1). The major difference is that two production accounts are distinguished in Table 4.1a, one for activities and another for commodities. Two other differences are that the account for activities includes an input-output table and that commodity taxes are introduced as a wedge between final output prices and factor costs, thus reducing factor payments by the amount of the tax which becomes government resources (tax revenue).

It should be noted that the input-output table in the SAM shown in Table 4.1a is at market prices, and therefore it appears at the intersection of the activity account columns and the commodity account rows. In columns 6 and 7, activities buy labor inputs ($T_{4.6}$ and $T_{4.7}$), pay rents on capital ($T_{5.6}$ and $T_{5.7}$), and purchase intermediate inputs at market prices. The sum of these elements gives the gross output vector ($T_{11.6}$ and $T_{11.7}$). In rows 6 and 7, gross outputs are bought by the commodity account, which also pays taxes levied on commodities ($T_{10.8}$ and $T_{10.9}$). All commodity purchases (rows 8 and 9) are recorded at market prices. These derive in columns 8 and 9 from commodity taxes and the gross outputs of activities at producer (ex-factory) prices ($T_{6.8}$ and $T_{6.9}$). Value added is distributed from the factor account to households in the same way as in Table 3.1 (Chapter III). The tax revenue is distributed to the government at the intersection of row 3 with column 10 ($T_{3.10}$). Household and government incomes, the sum of rows 1, 2, and 3, are then spent on commodities in columns 1, 2, and 3. This short description of the SAM presents the accounting structure underlying its accounts and the accounting structure of the CD version of the extended Harberger model.

In addition to the accounting structure of the model, Table 4.1a presents the analytical expressions of the model written in the cells of the SAM. The supply equations can be read straight from the activity and commodity columns (6, 7 and 8, 9) in Table 4.1a and are equal to equations (9) and (10) of the model presented above. Demand equations, on the other hand, can be read from commodity rows 8 and 9 of the SAM and are equal to equations (5) and (6) of the model. Finally equations (3) and (4) can be read from rows 4 and 5 in the SAM of Table 4.1a. In the same way as in the SAM presented in Table 3.1 (Chapter III), columns of this SAM present price equations, while rows present quantity equations of the underlying model. Consequently, the basic solution to this model can be obtained in a similar way as demonstrated in Chapter III above.

Empirical results of the CD Version of the Model

In Table 4.1b, a hypothetical SAM, numbers are entered in order to test and analyze the solution of the model with respect to different rates for commodity taxes t_x and t_y. The SAM in Table 4.1b gives initial values of a hypothetical two-sector economy, where gross output in sector X equals 493 and in sector Y, 428 units. Labor as a factor of production earns 66 percent of total factor income and capital receives the remainder. This factor income is distributed to households in fixed proportions which are assumed to remain constant in the model. Urban households receive 60 percent of total labor income and 70 percent of total capital income. On the other hand, rural households receive the remainder, i.e., 40 percent of total labor income and 30 percent of total capital income ($a = 0.6$, $(1-a) = 0.4$,

Table 4.1b

A Base SAM for the CD Model with IO Table

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		1	2	3	4	5	6	7	8	9	10
		INST-URB HOUSEHOL	INST-RUR HOUSEHOL	INSTITUT GOVERNME	FACTORS LABOR	FACTORS CAPITAL	ACTIVITY X	ACTIVITY Y	COMMODIT X	COMMODIT Y	TAXES
1	INST-URB HOUSEHOL				(a) 228.	(b) 133.					
2	INST-RUR HOUSEHOL				(1-a) 152.	(1-b) 58.					
3	INSTITUT GOVERNME										101.
4	FACTORS LABOR						(α_1) 230.	(β_1) 150.			
5	FACTORS CAPITAL						(α_2) 115.	(β_2) 76.			
6	ACTIVITY X								493.		
7	ACTIVITY Y									428.	
8	COMMODIT X	(c)* 206.	(d) 121.	(e) 58.			(α_3) 56.	(β_3) 87.			
9	COMMODIT Y	155.	89.	43.			(α_4) 92.	(β_4) 115.			
10	TAXES								(t_x) 35.	(t_y) 66.	
11	TOTAL	(1-c) 361.	(1-d) 210.	(1-e) 101.	380.	191.	493.	428.	528.	494.	101.

*/ Numbers in parentheses represent the base SAM coefficients:

a = 0.6
(1-a) = 0.4
b = 0.7
(1-b) = 0.3
c = d = e = 0.57
(1-c) = (1-d) = (1-e) = 0.43

$\alpha_1 = 0.47$
$\alpha_2 = 0.23$
$\alpha_3 = 0.11$
$\alpha_4 = 0.19$

$\beta_1 = 0.35$
$\beta_2 = 0.18$
$\beta_3 = 0.20$
$\beta_4 = 0.27$

$t_x = 0.07$
$t_y = 0.15$

b = 0.7, and (1-b) = 0.3). 1/ The production of X and Y is relatively labor intensive since $\alpha_1 = 0.47$, and $\beta_1 = 0.35$, while $\alpha_2 = 0.23$, and $\beta_2 = 0.18$. A description of consumer expenditures is presented at the intersection of rows 8 and 9 with columns 1 to 3. In this hypothetical economy, each income group has the same consumption patterns, which are held constant for the purpose of this analysis. Urban and rural households and government spend 57 percent of their income on good X and 43 percent on good Y (c = d = e = 0.57). The main data parameters are summarized in Table 4.1b.

Existing commodity taxes are introduced at the intersection of the tax account row 10 with commodity columns 8 and 9. The initial commodity tax levied on X (t_x) is 7 percent of the gross output of X , while the tax levied on commodity Y (t_y) is equal to 15 percent. The SAM in Table 4.1b represents a base SAM, where initial taxes t_x and t_y exist, and all prices for w , r , P_x , and P_y are equal to unity.

Then new tax rates for commodities X and Y are introduced. The tax rate for commodity X is increased from 7 percent to 12 percent, while the tax rate levied on commodity Y is decreased from 15 percent to 5 percent. The solution of the model gives new results for endogenous variables of the model as presented in Table 4.1c. Because the price of labor has been normalized in this model to unity, i.e., w = 1 , all relative price changes have to be evaluated in relation to the labor price. Table 4.1c gives new prices for P'_x , P'_y , w' , r' , and new values for X' and Y' . Because of changes in the tax rates, gross output in X declines from 493 to 464 units, a decrease of 6 percent; and gross output in Y increases from 428 to 466

1/ These ratios are presented in Table 4.1b in parentheses.

Table 4.1c

Change in Commodity Taxes I (results)

PRINT OF MATRIX

		1	2	3	4	5	6	7	8	9	10
		INST-URB HOUSEHOL	INST-RUR HOUSEHOL	INSTITUT GOVERNME	FACTORS LABOR	FACTORS CAPITAL	ACTIVITY X	ACTIVITY Y	COMMODIT X	COMMODIT Y	TAXES
1	INST-URB HOUSEHOL				228.	133.					
2	INST-RUR HOUSEHOL				152.	58.					
3	INSTITUT GOVERNME										79.
4	FACTORS LABOR						217.	163.			
5	FACTORS CAPITAL						108.	83.			
6	ACTIVITY X								464.		
7	ACTIVITY Y									466.	
8	COMMODIT X	206.	121.	45.			53.	95.			
9	COMMODIT Y	155.	89.	34.			87.	125.			
10	TAXES								56.	23.	
11	TOTAL	361.	210.	79.	380.	191.	464.	466.	520.	490.	79.

	ACCOUNT		PRICE	VALUE	QUANTITY
1	INST-URB	HOUSEHOL		361.1	
2	INST-RUR	HOUSEHOL		210.0	
3	INSTITUT	GOVERNME		79.0	
4	FACTORS	LABOR	1.00000	380.0	380.0
5	FACTORS	CAPITAL	1.00047	191.1	191.0
6	ACTIVITY	X	.98029	464.2	473.6
7	ACTIVITY	Y	.97263	466.3	479.4
8	COMMODIT	X	1.02515	520.0	507.2
9	COMMODIT	Y	.88482	489.6	553.3
10	TAXES			79.0	

$w' = 1.000$

$r' = 1.000$

$(P'_x - t'_x) = 0.980$

$(P'_y - t'_y) = 0.973$

$P'_x = 1.025$

$P'_y = 0.825$

units, an increase of 9 percent. Total tax revenues (and consequently the government revenue) decline from 101 to 79 units, a decrease of 21.7 percent. The new price of labor (w') is equal to one and the new price of capital (r') is also approximately equal to one. This means that in this solution of the model, sources of household incomes are unaffected in nominal (absolute) terms. However, as discussed above, this is because the price of labor was normalized to one. Consequently, real incomes have to be evaluated with respect to changes in relative prices in relation to the price of labor. The effect of the change in commodity taxes on relative prices is reflected in new prices for the activity and commodity accounts columns. Because new commodity prices affect the purchasing power of consumers (cost of consumption basket), they in turn, affect real incomes of households and the government from the uses side of income.

Changes in real incomes for urban households, rural households, and the government, after new taxes are imposed, can be calculated by taking into account changes in commodity prices for X and Y . Because the tax rate has been increased substantially for commodity X and decreased for commodity Y, it can be expected that the price of commodity X will rise relative to the price of commodity Y in the new tax situation. This is demonstrated by the solution of the model presented in Table 4.1c, where $P_x' = 1.025$, and $P_y' = 0.885$. This means that the price of commodity X increased by 2.5 percent and the price of commodity Y decreased by 11.5 percent of the initial price ($P_x = P_y = 1$).

Changes in real incomes for urban and rural households and the government, on the uses side, can be calculated by using the same equations as in Chapter III, section V above.

Changes in uses of income:

(1) Urban households:

$$\Delta Y_{uh} = -\left(\frac{X'_{uh}}{P'_x} \Delta P_x + \frac{Y'_{uh}}{P'_y} \Delta P_y \right)$$

$X'_{uh} = 206$ (obtained from the SAM, Table 4.1c)

$Y'_{uh} = 155$

$$\Delta Y_{uh} = -\left[\frac{206}{1.025} (0.025) - \frac{155}{0.885} (0.115) \right]$$

$$\Delta Y_{uh} = -5.02 + 20.14 = +15.12$$

(2) Rural households:

$$\Delta Y_{rh} = -\left(\frac{X'_{rh}}{P'_x} \Delta P_x + \frac{Y'_{rh}}{P'_y} \Delta P_y \right)$$

$X'_{rh} = 121$

$Y'_{rh} = 89$

$$\Delta Y_{rh} = -\left[\frac{121}{1.025} (0.025) - \frac{89}{0.885} (0.115) \right]$$

$$\Delta Y_{rh} = -2.95 + 11.56 = +8.61$$

(3) Government:

$$\Delta Y_g = -\left(\frac{X'_G}{P'_x} \Delta P_x + \frac{Y'_G}{P'_y} \Delta P_y \right)$$

$X'_G = 45$

$Y'_G = 34$

$$\Delta Y_g = - [\frac{45}{1.025} (0.025) + \frac{34}{0.885} (0.115)]$$

$$\Delta Y_g = - 1.09 + 4.42 = + 3.33$$

The combined tax incidence from the sources and uses of income side is shown in the table below.

Total changes in incomes:

	Sources:	Uses:	Total:
(1) Urban households:	0	+15	+15
(2) Rural households	0	+ 9	+ 9
(3) Government:	-22	+ 3	-19

It should be noted that the above particular results depend on the basic assumptions of the model, as well as on the values of coefficients for $\alpha_1 - \alpha_4$, $\beta_1 - \beta_4$, and values for the a , b , c , d , and e variables given in the base SAM. In a similar way as in the model presented in Chapter III, the results of this model depend on differences in factor intensities between the two sectors, as well as on the pattern of consumption expenditures for a particular household group. For example, if the consumption patterns of one of the consumer groups were reversed, i.e., if the group would consume more of a good Y , which became cheaper relative to X , then accordingly real income of this group would change in a positive direction. Therefore, with a different base SAM, different results would be obtained. These issues will be explored further in the next section, where additional examples and different assumptions of the model will be analyzed.

As demonstrated above, the CD version of the extended Harberger model gives similar results for selective commodity taxes as the model presented in Chapter III. However, the advantage of this model over the standard Harberger model is that this extended model takes into account all of the general equilibrium effects in an economy, including consequences of the intermediate demand (interindustry transactions) for tax incidence analysis. Another advantage of the model is that it allows evaluation of the distributional implications that would arise if an existing tax structure is altered. Depending on policy issues, the model allows examination and comparison of the effects of different tax rates on income distribution. It also allows examination of the effects that would occur if one type of a tax is substituted for another type of a tax. These issues will be examined in more detail in the next section. In general, the primary usefulness of the model is to give some insights into tax incidence analysis, i.e., given the assumptions, the model allows examination of the magnitude and direction of change in real incomes of institutions due to changes in a given tax structure.

The obvious advantage of this model over the model presented in Chapter III is that this model allows for analysis of tax incidence of an economy characterized by an existing tax structure. Such an analysis is not possible with the standard Harberger model, as demonstrated in Chapter III. However, the second advantage of this model for tax incidence analysis, i.e., inclusion of interindustry transactions and their effects on the relative prices and income distribution, is not shown explicitly from the above experiment and its results. Although it is intuitively clear that the model that includes intermediate transactions is a better simplification of an economy than the model that includes only value added (net output), it is not clear immediately what is the difference in the magnitude and the direction of changes in relative prices and real incomes of institutions between the two models. For this reason, an additional experiment is performed below, as an attempt to analyze possible differences between the results of the two models.

Comparison of the CD Model Results -- Exclusion of the Input-Output Table

A second experiment with the CD version of the model is performed to test the difference between the empirical results obtained above, and the results that would be obtained if interindustry transactions are excluded from the same model. The base SAM for the first experiment is presented in Table 4.1b, while the base SAM for the second experiment is presented in Table 4.1d. The only difference between the two SAMs is that in the second SAM, the input-output entries ($T_{8.6}$, $T_{9.6}$, $T_{8.7}$ and $T_{9.7}$) were eliminated by setting each entry to be equal to one. Then the SAM was rebalanced by adding new entries in columns and rows 6 and 7. The SAM obtained this way has the same structure as the SAM in Table 4.1b, including the values for its coefficients (a , b , c , d , and e). In this way, consumption patterns stay the same, as well as factor intensities, and proportions between labor and capital in sectors X and Y (α , $(1-\alpha)$, β , and $(1-\beta)$) . Next, to derive a SAM that resembles the SAM in Table 4.1b in all respects, except the input-output table, existing tax rates in Table 4.1d were calculated to be exactly the same as in the SAM in Table 4.1b. The resulting values for this SAM, and the base run, where all prices are equal to unity, are presented in Table 4.1d. This table also presents a summary of main data parameters.

Then the existing commodity tax rates were changed in exactly the same way as in the first experiment. The tax rate for commodity X was

Table 4.1d

A Base SAM Without the IO Table

PRINT OF MATRIX

		1	2	3	4	5	6	7	8	9	10
		INST-URB HOUSEHOL	INST-RUR HOUSEHOL	INSTITUT GOVERNME	FACTORS LABOR	FACTORS CAPITAL	ACTIVITY X	ACTIVITY Y	COMMODIT X	COMMODIT Y	TAXES
1	INST-URB HOUSEHOL				228.	133.					
2	INST-RUR HOUSEHOL				152.	58.					
3	INSTITUT GOVERNME										58.
4	FACTORS LABOR						230.	150.			
5	FACTORS CAPITAL						115.	76.			
6	ACTIVITY X								346.		
7	ACTIVITY Y									229.	
8	COMMODIT X	206.	121.	41.			1.	1.			
9	COMMODIT Y	155.	89.	17.			1.	1.			
10	TAXES								24.	34.	
11	TOTAL	361.	210.	58.	380.	191.	346.	229.	370.	263.	58.

	ACCOUNT	PRICE	VALUE	QUANTITY
1	INST-URB HOUSEHOL		361.0	
2	INST-RUR HOUSEHOL		210.0	
3	INSTITUT GOVERNME		58.1	
4	FACTORS LABOR	1.0000	380.0	380.0
5	FACTORS CAPITAL	1.0000	191.0	191.0
6	ACTIVITY X	1.0000	346.3	346.3
7	ACTIVITY Y	1.0000	228.8	228.8
8	COMMODIT X	1.0000	370.2	370.2
9	COMMODIT Y	1.0000	262.9	262.9
10	TAXES		58.1	

increased from 7 to 12 percent, while the tax rate levied on commodity Y was decreased from 15 to 5 percent of the gross output. The solution of the model gives new results for endogenous variables of the model, as presented in Table 4.1e. In the same way as in the first experiment, the new price of labor (w') is equal to one, and the new price of capital (r') is also approximately equal to one. However, there are differences between the two results for commodity prices. New prices for commodities were $P'_x = 1.025$, and $P'_y = 0.885$ in the first experiment. In the second experiment, without the input-output table, new prices for commodities are $P'_x = 1.041$, and $P'_y = 0.931$. While new prices in both experiments move in the same direction, there are differences in the magnitude of change which have income distribution implications. In the first experiment (case), the price of commodity X increases by 2.5 percent of the initial price, while the same price increases by 4.1 percent in the second case. On the other hand, the after-tax price of Y decreases by 11.5 percent of the initial price in the first case, and by 6.9 percent in the second case. These differences arise primarily from the secondary effects caused by intermediate consumption. Because activity X consumes a relatively large amount of the good Y, which price decreased due to its tax decrease, this creates a lower price increase for good X in the first case compared to the second case. In the same way, activity Y consumes more from itself than from X, and the final result of the secondary price effects due to intermediate consumption is a more equal increase or decrease in both commodity prices. It can be expected that, with a more disaggregated input-output table, the interindustry feedback effect will create even more price differentials.

Table 4.1e

Change in Commodity Taxes II (results)

PRINT OF MATRIX

		1	2	3	4	5	6	7	8	9	10
		INST-URB HOUSEHOL	INST-RUR HOUSEHOL	INSTITUT GOVERNME	FACTORS LABOR	FACTORS CAPITAL	ACTIVITY X	ACTIVITY Y	COMMODIT X	COMMODIT Y	TAXES
1	INST-URB HOUSEHOL				228.	133.					
2	INST-RUR HOUSEHOL				152.	58.					
3	INSTITUT GOVERNME										49.
4	FACTORS LABOR						219.	161.			
5	FACTORS CAPITAL						110.	81.			
6	ACTIVITY X								331.		
7	ACTIVITY Y									244.	
8	COMMODIT X	206.	121.	38.			1.	1.			
9	COMMODIT Y	155.	89.	10.			1.	1.			
10	TAXES								36.	12.	
11	TOTAL	361.	210.	49.	380.	191.	331.	244.	367.	256.	49.

	ACCOUNT	PRICE	VALUE	QUANTITY
1	INST-URB HOUSEHOL		361.1	
2	INST-RUR HOUSEHOL		210.0	
3	INSTITUT GOVERNME		48.6	
4	FACTORS LABOR	1.00000	380.0	380.0
5	FACTORS CAPITAL	1.00037	191.1	191.0
6	ACTIVITY X	1.00003	331.0	331.0
7	ACTIVITY Y	.99999	244.1	244.1
8	COMMODIT X	1.04104	367.4	352.9
9	COMMODIT Y	.93151	256.3	275.2
10	TAXES		48.6	

Income distribution implications of these two results depend primarily on the pattern of consumption expenditures. In the two experiments presented above, there would be no difference in changes in real incomes from the uses side for urban and rural households. This is because in both SAMS, in Tables 4.1b and 4.1d, urban and rural households spend equal proportions of their incomes on good X and Y ; in other words, their consumption patterns are the same. For this reason, they would be affected equally from the increase in price of X and decrease in price of Y in both cases. However, the results would be substantially different if, for example, urban households consumed only good X , and rural households consumed only good Y . In such a situation, urban households would lose more of their income on the uses side in the second case, where the price of good X increases more than in the first case. On the other hand, rural households would be better off in the first case, where the price of good Y decreased more than in the second case. This is an extreme example, however, these differentials will arise each time as long as there are differences in consumption patterns between the two household groups.

As demonstrated above, the inclusion of interindustry transactions in the model causes commodity prices to move in the same direction (due to tax changes), as these would move in the absence of an input-output table. However, the inclusion of an input-output table causes secondary effects, which have implications on both the magnitude of price changes as well as on the magnitude of real income changes of institutions. Therefore, more accurate results can be obtained for tax incidence analysis when the model includes interindustry transactions.

In the next section the model is written by combining CD and IO specifications of production functions. The model is also extended further in order to evaluate simultaneously tax and "benefit" incidence ("budget incidence") and to evaluate the distributional effects of value added, activity, and commodity taxes.

2. Cobb-Douglas and Input-Output Production Functions 1/ Description of the Model

The second version of the model is similar to the first version presented above in its basic assumptions, with the exception that the production process is split into two parts. The net output is represented by the CD production function, while the gross output is specified by using the IO production function. An additional assumption is that (in the short run) capital is immobile between the two sectors, i.e, fixed stock of capital (or land) is assumed in each sector. Consequently, a single variable input for all sectors in this model is labor.

In summary, the following basic assumptions are used in this model:

(1) perfect competition in factor and in product markets;

(2) fixed aggregate factor supplies;

(3) full employment of factors;

(4) no accumulation;

(5) fixed technology;

(6) closed economic system;

(7) fixed stock of capital (or land) in each sector;

(8) income is spent on two goods in constant proportions.

The model is specified to analyze tax incidence for three types of taxes: value added taxes, activity taxes, and commodity taxes. These taxes

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1/ I am indebted to G. Pyatt for useful suggestions in formulating this model and its SAM.

can be imposed all at the same time or some of them can be set to zero in order to compare differences in their distributional effects.

To incorporate the above modifications of the model, it was necessary to change the base SAM, which represents the basic accounting framework of the model. This modified SAM is presented in Table 4.2a. In this SAM, activities are separated into net and gross accounts. Activities shown in columns 6 and 7 (Table 4.2a) buy labor inputs ($T_{1.6}$ and $T_{1.7}$), pay rents on fixed assets ($T_{2.6}$ and $T_{2.7}$), and pay taxes on value added ($T_{3.6}$ and $T_{3.7}$). The sum of these columns gives the net output of activities. The net outputs shown in rows 6 and 7, are bought by the gross output account of activities which, in addition, buys intermediate goods from the commodity account ($T_{10.8}$, $T_{10.9}$, $T_{11.8}$, and $T_{11.9}$) and pays taxes levied on activities ($T_{3.8}$ and $T_{3.9}$). In rows 8 and 9, gross outputs are shown to be purchased by the commodity account columns. Commodity taxes ($T_{3.10}$ and $T_{3.11}$) are levied on commodities X and Y in columns 10 and 11. Column sums of the commodity account give market prices of commodities. These commodities are then bought by households at the intersection of rows 10 and 11 by columns 4 and 5, and by the gross account of activities, intersection of rows 10 and 11 with columns 8 and 9. All commodities, including intermediate demand, are purchased at market prices.

Another difference between the first and the second version of the model and its underlying SAM is that the second model allows evaluation of both tax and "benefit" incidence simultaneously, i.e., an analysis of budget incidence. In an accounting sense, this has been achieved by dropping the government account of the SAM and redistributing tax revenues directly to households in the form of transfer incomes. This is shown in the SAM (Table

Table 4.2a

Schematic SAM

				FACTORS		TAXES	HOUSEHOLDS		ACTIVITIES				COMMODITIES		TOTAL
									NET		GROSS				
				LABOR	CAPITAL		URBAN	RURAL	X	Y	X	Y	X	Y	
				1	2	3	4	5	6	7	8	9	10	11	12
I	FACTORS	LABOR	1						$T_{1.6}$	$T_{1.7}$					$T_{1.12}$
		CAPITAL	2						$T_{2.6}$	$T_{2.7}$					$T_{2.12}$
II	TAXES		3						$T_{3.6}$	$T_{3.7}$	$T_{3.8}$	$T_{3.9}$	$T_{3.10}$	$T_{3.11}$	$T_{3.12}$
III	HOUSEHOLDS	URBAN	4	$T_{4.1}$	$T_{4.2}$	$T_{4.3}$									$T_{4.12}$
		RURAL	5	$T_{5.1}$	$T_{5.2}$	$T_{5.3}$									$T_{5.12}$
IV	ACTIVITIES NET	X	6								$T_{6.8}$				$T_{6.12}$
		Y	7									$T_{7.9}$			$T_{7.12}$
V	ACTIVITIES GROSS	X	8										$T_{8.10}$		$T_{8.12}$
		Y	9										$T_{9.10}$	$T_{9.11}$	$T_{9.12}$
VI	COMMODITIES	X	10				$T_{10.4}$	$T_{10.5}$			$T_{10.8}$	$T_{10.9}$			$T_{10.12}$
		Y	11				$T_{11.4}$	$T_{11.5}$			$T_{11.8}$	$T_{11.9}$			$T_{11.12}$
VII	TOTAL		12	$T_{12.1}$	$T_{12.2}$	$T_{12.3}$	$T_{12.4}$	$T_{12.5}$	$T_{12.6}$	$T_{12.7}$	$T_{12.8}$	$T_{12.9}$	$T_{12.10}$	$T_{12.11}$	$T_{12.12}$

4.2a) at the intersection of the tax account column with the household account rows, where tax incomes are received directly from the tax account in cells $T_{4.3}$ and $T_{5.3}$. To calculate the value of these two cells from an actual SAM, it is necessary to add government transfers received by households and benefits from public expenditures. Income transfers from the government to households are a constituent part of any SAM, while benefits received by households from public expenditures can be calculated from a household budget survey. These benefits can then be allocated to households as transfer incomes. On the other hand, if available data are insufficient to determine shares of benefits from public expenditures (government consumption) for each household group, then shares can be determined exogenously in the model. Consequently, by varying these shares (distribution of benefits on a per capita basis, in proportion to income, etc.), income distribution implications of alternative allocation of government spending can be determined.

The rest of the accounts, with the exception of this treatment of the activity account and government spending, correspond exactly to the SAM and the model presented in Table 4.1. Therefore, the above description of the SAM presents the accounting structure of the second version of the model as well as the accounting framework of the data base for the model.

Analytical Structure of the Model

The model based on the SAM outlined in Table 4.2a is presented in a SAM framework in Table 4.2b. In this table, the SAM is written in the form of equations, where columns of the SAM determine price equations and rows of this SAM determine quantity equations, in the same way as in Table 4.1a. The analytical structure of this model is similar to the CD version of the model

Table 4.2b

<u>Analytical Presentation of the Second Version of the Model in a SAM</u>

				FACTORS		TAXES	HOUSEHOLDS		ACTIVITIES NET		ACTIVITIES GROSS		COMMODITIES		TOTAL
				LABOR	CAPITAL		URBAN	RURAL	X	Y	X	Y	X	Y	
				1	2	3	4	5	6	7	8	9	10	11	12
I	FACTORS	LABOR	1						wL_x	wL_y					wL
		CAPITAL	2						rK_x	rK_x					rK
II	TAXES		3						t_6X_6	t_7Y_7	t_8X_8	$t_{10}Y_{10}$	$t_{11}X_{11}$	$t_{11}Y_{11}$	Y_t
III	HOUSEHOLDS	URBAN	4	$a(wL)$	$b(rK)$	cY_t									Y_{uh}
		RURAL	5	$(1-a)(wL)$	$(1-b)(rK)$	$(1-c)Y_t$									Y_{rh}
IV	ACTIVITIES NET	X	6								P_6X_6				P_6X_6
		Y	7									P_7Y_7			P_7Y_7
V	ACTIVITIES GROSS	X	8										P_8X_8		P_8X_8
		Y	9										P_9X_9	P_9Y_9	P_9Y_9
VI	COMMODITIES	X	10				dY_{uh}	eY_{rh}			$P_{10}X_{10}$	$P_{10}X_y$			$P_{10}X_{10}$
		Y	11				$(1-d)Y_{uh}$	$(1-e)Y_{rh}$			$P_{11}Y_x$	$P_{11}Y_y$			$P_{11}Y_{11}$
VII	TOTAL		12	wL	rK	Y_t	Y_{uh}	Y_{rh}	P_6X_6	P_7X_7	P_8X_8	P_9Y_9	$P_{10}X_{10}$	$P_{11}Y_{11}$	

with some modifications presented below. The full analytical structure and derivation of the model's equations are presented in Appendix 2, while only the basic equations in a SAM framework are presented here. It should be noted that, although the SAM accounts have been disaggregated into more accounts for the second version of the model, the basic mathematical solution of this model remains the same as that of the CD version of the model. Thus, disaggregation or aggregation does not change the basic structure of the model.

On the supply side of the model and the SAM accounts, the net output of activities is represented by the equations shown in columns 6 and 7 in Table 4.2b. The CD production specification is used in these two columns. The gross output of activities is indicated by the equations in columns 8 and 9, where diagonal entries of net outputs are combined with the input-output table (intersection of columns 8 and 9 with rows 10 and 11), and activity taxes ($T_{3.8}$ and $T_{3.9}$), by using the IO production function. The supply of commodities X and Y is shown in columns 10 and 11, where commodity taxes are levied on the gross output. Input-output specifications are used for the equations in columns 10 and 11.

Demand equations of the model are presented in rows 10 and 11 of the commodity account. These equations mean that the final demand is equal to the intermediate demand (intersection of rows 10 and 11 with columns 8 and 9), plus consumption demand for commodities X and Y by urban and rural households (intersection of commodity rows with columns 4 and 5). Because there is no accumulation in this model, incomes of institutions equal expenditures by institutions. Urban and rural households spend proportions d and e of their income on commodity X , and (1-d) and (1-e) on good Y . These ratios are presented in the SAM in Table 4.2b. Factor incomes are received by institutions from the factor account in this SAM in exactly the same way as in the previous SAMs, described in Chapter III and section 1 of this chapter. In addition to factor incomes, urban and rural households also receive incomes from tax revenues as discussed above. This description of the SAM in Table 4.2b presents both the accounting structure of the model and its basic equations. The equations of the model are described in more detail in Appendix 2.

As evident from the above description of the SAM model and from the specifications derived in Appendix 2, the basic structure of this model is essentially the same as that of the CD version of the model discussed in section 1 of this chapter. By normalizing the wage rate to one and using the above specifications, the model can be solved in the same way as the CD version of the model. In this model, variables a , b , c , d , e , $_1$, $_2$, $_1$, and $_2$ are obtained from the base SAM as in the previous model. While prices for labor, capital, and commodities are endogenously determined by the model, tax rates and the allocation of the tax revenue to households, i.e., c , and (1-c) , are exogenous variables. By changing these exogenous variables, the tax and benefit incidence can be determined from the results of the model. This is demonstrated below numerically, first for a hypothetical SAM and then in the next chapter for a SAM for Egypt, 1979.

Empirical Analysis of the Second Version of the Model

Numerical values for the second version of the model are presented in the SAM in Table 4.2c. In this hypothetical two-sector economy, gross output in sector X equals 533 and in sector Y 478 units. Value added in sector X is equal to 345 and in sector Y 226 units. Factor intensity is

Table 4.2c

A Base SAM for the Second Version of the Model

PRINT OF MATRIX

		1 FACTORS LABOUR	2 FACTORS CAPITAL	3 TAXES	4 HOUSEHLD URBAN	5 HOUSEHLD RURAL	6 ACTIVITY NET-X	7 ACTIVITY NET-Y	8 ACTIVITY GROSS-X	9 ACTIVITY GROSS-Y	10 COMMODIT X	11 COMMODIT Y	12 CAPITAL X	13 CAPITAL Y	14 TOTAL
1	FACTORS LABOUR						(α) 230.0	(β) 150.0							380.0
2	FACTORS CAPITAL												115.0	76.0	191.0
3	TAXES						(t_6) 12.0	(t_7) 20.0	(t_8) 28.0	(t_9) 30.0	(t_{10}) 35.0	(t_{11}) 60.0			185.0
4	HOUSEHLD URBAN	(a) 152.0	(b) 134.0	(c) 115.0											401.0
5	HOUSEHLD RURAL	(1-a) 228.0	(1-b) 57.0	(1-c) 70.0											355.0
6	ACTIVITY NET-X								357.0						357.0
7	ACTIVITY NET-Y									246.0					246.0
8	ACTIVITY GROSS-X										533.0				533.0
9	ACTIVITY GROSS-Y										25.0	453.0			478.0
10	COMMODIT X				(d) 225.0	(e) 200.0			81.0	87.0					593.0
11	COMMODIT Y				(1-d) 176.0	(1-e) 155.0			67.0	115.0					513.0
12	CAPITAL X						(1-α) 115.0								115.0
13	CAPITAL Y							(1-β) 76.0							76.0
14	TOTAL	380.0	191.0	185.0	401.0	355.0	357.0	246.0	533.0	478.0	593.0	513.0	115.0	76.0	

PRINT OF MATRIX

a = 0.40
(1-a) = 0.60
b = 0.70
(1-b) = 0.30
c = 0.62
(1-c) = 0.38
e = 0.56
(1-e) - 0.44

α = 0.66
(1-α) = 0.34

β = 0.66
(1-β) = 0.34

t_6 = 0.04
t_7 = 0.09

t_8 = 0.05
t_9 = 0.07
t_{10} = 0.06
t_{11} = 0.13

the same in both sectors, since $\alpha = 0.66$ and $\beta = 0.66$. Urban households receive 40 percent of total labor income and 70 percent of total capital income, i.e., $a = 0.4$ and $b = 0.7$; and rural households receive the remainder. In addition to factor incomes, urban households receive 62 percent of total tax revenues in the form of transfer income, and rural households receive 38 percent of total transfer income ($c = 0.62$, and $(1-c) = 0.38$). The sum of factor and transfer incomes represents total income of households, shown as receipts in rows 4 and 5 of the SAM and as expenditures on commodities X and Y in columns 4 and 5. Consumption patterns are the same for urban and rural households, i.e., $d = e = 0.56$, and $(1 - d) = (1 - e) = 0.44$. The main data parameters are summarized in Table 4.2c.

Three types of existing taxes are introduced in this hypothetical economy: (1) value added taxes, (2) activity taxes, and (3) commodity taxes. Value added taxes are introduced at the intersection of the tax account row with the columns of the net activity account. Activity and commodity taxes, on the other hand, appear at the intersection of the gross activity account and commodity account columns with the tax account row. Initial value added taxes for t_6 equal 4 and for t_7 equal 5 percent of value added in X and Y, respectively. Activity taxes for t_8 equal 5 and for t_9 equal 7 percent of gross output, and commodity taxes for t_{10} equal 6 and for t_{11} equal 7 percent for X and Y, respectively. Total tax revenue is equal to 185 units.

These existing tax rates are purely hypothetical, however, the tax structure may reflect a real policy situation. Usually, policymakers are faced with a question concerning how to raise taxes or change an existing tax structure, and want to know the distributional implications with respect to tax changes. These are the questions that can also be addressed by this model, taking into account its assumptions. Several different experiments of this nature can be performed with this model. For example, an experiment, analyzed below, might be to compare the tax incidence of value added taxes, activity taxes, or commodity taxes when each of these taxes is increased or decreased for some equal percentage rate. By increasing or decreasing each tax separately by an equal rate, the percentage increase or decrease in output, commodity prices, factor prices, tax revenues, and change in real incomes for different household groups can be determined by the model.

Table 4.2d shows the results of the model where value added taxes were increased by 10 percent in both sectors, i.e., $t_6 = 0.04$ and $t_6' = 0.14$, $t_7 = 0.09$, and $t_7' = 0.19$; while other taxes were kept constant. Because of the change in value added taxes, gross output in X increased from 533 to 584 units, an increase of 9.5 percent; and gross output in Y increased from 478 to 523 units, an increase of 9.5 percent. Total tax revenues increased from 185 to 257 units, an increase of 39 percent or 72 units. The new price of labor is equal to one, and the new price of capital is also equal to one. Commodity prices for X and Y increased for both goods, where $P_x = 1.096$ and $P_y = 1.093$. These results are presented in Table 4.2d.

Changes in real incomes for urban and rural households, on the uses side, can be calculated by using the same equations as in the example above.

Changes in uses of income:

(1) Urban Households:

$$Y_{uh} = -\left(\frac{X'_{uh}}{P'_x} P_x + \frac{Y'_{uh}}{P'_y} P_y\right)$$

Table 4.2d

<u>Change in Value Added Taxes (results)</u>

PRINT OF MATRIX

		1 FACTORS LABOUR	2 FACTORS CAPITAL	3 TAXES	4 HOUSEHLD URBAN	5 HOUSEHLD RURAL	6 ACTIVITY NET-X	7 ACTIVITY NET-Y	8 ACTIVITY GROSS-X	9 ACTIVITY GROSS-Y	10 COMMODIT X	11 COMMODIT Y	12 CAPITAL X	13 CAPITAL Y	14 TOTAL
1	FACTORS LABOUR						229.8	150.2							380.0
2	FACTORS CAPITAL												114.9	76.1	191.0
3	TAXES						46.5	42.7	30.7	32.8	38.3	65.7			256.6
4	HOUSEHLD URBAN	152.0	134.0	159.5											445.5
5	HOUSEHLD RURAL	228.0	57.0	97.1											382.1
6	ACTIVITY NET-X								391.1						391.1
7	ACTIVITY NET-Y									269.0					269.0
8	ACTIVITY GROSS-X										583.7				583.7
9	ACTIVITY GROSS-Y										27.3	495.7			523.1
10	COMMODIT X				250.0	215.3			88.7	95.4					649.3
11	COMMODIT Y				195.5	166.8			73.2	125.8					561.4
12	CAPITAL X						114.9								114.9
13	CAPITAL Y							76.1							76.1
14	TOTAL	380.0	191.0	256.6	445.5	382.1	391.1	269.0	583.7	523.1	649.3	561.4	114.9	76.1	

	ACCOUNT		PRICE	VALUE	QUANTITY
1	FACTORS	LABOUR	1.00000	380.0	380.0
2	FACTORS	CAPITAL		191.0	
3	TAXES			256.6	
4	HOUSEHLD	URBAN		445.5	
5	HOUSEHLD	RURAL		382.1	
6	ACTIVITY	NET-X	1.09630	391.1	356.8
7	ACTIVITY	NET-Y	1.09238	269.0	246.2
8	ACTIVITY	GROSS-X	1.09580	583.7	532.7
9	ACTIVITY	GROSS-Y	1.09325	523.1	478.5
10	COMMODIT	X	1.09568	649.3	592.6
11	COMMODIT	Y	1.09325	561.4	513.5
12	CAPITAL	X	.99908	114.9	115.0
13	CAPITAL	Y	1.00140	76.1	76.0

$X'_{uh} = 250$ (obtained from Table 4.2d)

$Y'_{uh} = 195.5$

$$\Delta Y_{uh} = - \left[\frac{250}{1.096}(0.096) - \frac{195.5}{1.093}(0.093)\right]$$

$$\Delta Y_{uh} = - 21.90 - 16.63 = - 38$$

(2) Rural Households:

$$\Delta Y_{rh} = - \left(\frac{X'_{rh}}{P'_x}\Delta P_x + \frac{Y'_{rh}}{P'_y}\Delta P_y\right)$$

$X'_{rh} = 215.3$

$Y'_{rh} = 166.8$

$$\Delta Y_{rh} = - \left[\frac{215.3}{1.096}(0.096) = \frac{166.8}{1.093}(0.093)\right]$$

$$\Delta Y_{rh} = - 18.86 - 14.19 = - 33$$

Changes in income on the sources side can be calculated by comparing after-tax household incomes with before-tax incomes:

Changes in sources of income:

(1) Urban Households:

$$Y_{uh} = a(wL) + b(rK) + cY_t$$

$Y_{uh} = 152 + 134 + 159$ (from Table 4.2c)

$Y'_{uh} = 152 + 134 + cY'_t$

$Y'_t = 256$ (from Table 4.2d)

$cY'_t = (0.62)256 = 159$

$Y'_{uh} = 152 + 134 + 159.5 = 445$

$\Delta Y_{uh} = Y'_{uh} - Y_{uh} = 445.5 - 401.0 = + 44$

(2) Rural Households:

$Y_{rh} = 228 + 57 + 70 = 355$

$Y'_{rh} = 228 + 57 + 97.1 = 382$ (from row 5 in Table 4.2d)

$\Delta Y_{rh} = Y'_{rh} - Y_{rh} = 382.1 - 355 = + 27$

The combined tax incidence from the sources and uses of income side gives the following result:

Total changes in incomes:

	Sources	Uses	Total
(1) Urban households:	+44	-38	+6
(2) Rural households:	+27	-33	-6
	+71	-71	-

The results of the model show that the distributional effects of increasing value added taxes by an equal rate in both sectors are minimal for this hypothetical economy. Urban households gain 6 units in real incomes, while rural households lose the same amount. The distributional effects are, in this case, minimal because factor intensity is the same in both sectors and because consumption patterns are also the same for both households. Urban households gain after new taxes are imposed primarily because they receive a higher proportion of transfer incomes (c = 0.62). In a similar way, as shown with the model presented in Chapter III, the results of this model would, however, change substantially if factor intensities were different in the two sectors and if consumption patterns were different for the two household groups. The purpose of the above example is primarily to demonstrate how the model can be used for tax incidence analysis.

This model is applied to the actual SAM for Egypt in the next chapter. Basic specifications, the assumptions, and the analytical structure of the model applied to the Egypt SAM are the same as in the model presented above. The purpose of the analysis presented in the next chapter is to demonstrate how the methodology developed above can be applied to the actual social accounting data framework and what steps are necessary for an analysis of tax incidence by using the above model.

References

Atkinson, A. B., and J. E. Stiglitz (1980). Lectures on Public Economics. New York: McGraw-Hill Book Company.

Atsumi, H. (1981). "Taxes and Subsidies in the Input-Output Model." Quarterly Journal of Economics, pp. 47-77.

Break, G. F. (1974). "The Incidence and Economic Effects of Taxation." In The Economics of Public Finance, A. Blinder, et al., Brookings Institution, Washington, D.C.

Feldstein, M. S. (1974). "Tax Incidence in a Growing Economy with Variable Factor Supply," Quarterly Journal of Economics, 88, pp. 551-573.

Fullerton, D., J. B. Showen, and J. Whalley (1978). "General Equilibrium Analysis of U.S. Taxation Policy." In Compendium of Tax Research 1978, Department of the Treasury, Washington, D.C.

Harberger, A. C. (1962). "The Incidence of the Corporation Income Tax." Journal of Political Economy, No. 3, pp. 215-40.

McLure, C. E., Jr. (1975). "General Equilibrium Incidence Analysis: The Harberger Model After Ten Years." Journal of Public Economics, 4, pp. 125-161.

Metzler, L. A. (1951). "Taxes and Subsidies in Leontief's Input-Output Model." Quarterly Journal of Economics, pp. 148-53.

Nicholson, W. (1978). Microeconomic Theory: Basic Principles and Extensions. New York: The Dryden Press.

Shoven, J. B., and J. Whalley (1972). "A General Equilibrium Calculation of the Effects of Differential Taxation of Income from Capital in the U.S." Journal of Public Economics, 1, pp. 281-321.

Yotopoulos, P. A., and J. B. Nugent (1976). Economics of Development, Empirical Investigations. New York: Harper and Row, Publishers.

CHAPTER V

EMPIRICAL APPLICATION OF THE MODIFIED HARBERGER MODEL TO THE SAM FOR EGYPT, 1979

The purpose of this chapter is to analyze the redistributive impact of indirect taxes and subsidies in Egypt on urban and rural households. One of the important policy issues motivating this study has been a concern with the effects of specific commodity taxes and subsidies on the living standards of various household groups. This policy issue is particularly relevant for Egypt where government subsidies and indirect taxation play a large role in the economy. There are production subsidies and consumption subsidies that are direct expenditures from the government budget, and there are two parallel systems of indirect taxation, i.e., government trade, and nongovernment trade subsidies/taxes. The two systems of indirect taxation are explained in detail below. The present structure of commodity subsidies and taxes in Egypt has a significant impact on consumer welfare, and the government budget. For example, consumption subsidies amounted to 11 percent of GDP in 1979 (Dervis et al. 1980). On the other hand, indirect taxation of commodities affects real incomes of households because of relative price changes, both from the sources and uses of income side. To analyze these fiscal policy issues, the methodology developed in Chapter IV is used.

This chapter is organized into two main parts. In the first part, the SAM2 for Egypt is described briefly, presenting the basic structure of the original and modified (aggregated) SAM which fits the accounting structure of the above-discussed model. In the next part, the second version of the model (developed in Chapter IV) is applied to the SAM for Egypt to analyze a distribution of tax burdens among urban and rural households. Three types of experiments are analyzed with the model: (1) distributional implications of removing government subsidies; (2) distributional implications of selective commodity taxes; and (3) distributional implications of alternative allocation patterns of tax revenues to households.

Description of the SAM2 for Egypt

SAM2 for Egypt is presented in Appendix 3, Table 5.A1.1/ This SAM gives the most disaggregated picture of direct and indirect taxation, including subsidies, provided so far in the SAM literature. This SAM also provides, for the first time for Egypt, relatively detailed information about the structure of direct and indirect taxation. The basic accounting structure of SAM2 for Egypt is the same as for any SAM. Because major differences between this SAM and the conventional SAMs (Pyatt et al., 1977) lie in the treatment of the tax account, and because the focus of this study is on fiscal incidence, only the tax account of SAM2 will be presented in more detail here.

SAM2 identifies the major channels and institutions through which government fiscal policies are carried out in Egypt. Six categories of taxes are identified in the tax account of SAM2: (1) indirect taxes; (2) sales taxes; (3) subsidies; (4) direct taxes; (5) import tariffs; and (6) export taxes. These taxes are presented in rows and columns from 91 to 95 in Table 5.A1. Direct taxes are treated conceptually in this SAM as part of the institutions expenditures account, while indirect taxes and subsidies are a part of the commodity account (the columns). Direct taxes on households,

1/ For a detailed documentation of SAM2, see: Working Paper No. 7, "SAM2 and Documentation," DRTPC, Cairo University, 1982; and for a detailed description of the conceptual framework of SAM2, see: B. Pleskovic and M. Crosswell (1981), "Social Accounting Matrices for Egypt: Outlines and Suggestions for Disaggregation of Individual Accounts," Working Paper No. 1, World Bank, mimeographed.

public and private companies' incomes can be found at the intersection of the row (93) indicating direct taxes with columns indicating particular institutions. The columns of all six categories of taxes represent "expenditures" of the tax account, or uses of funds. In fact, each of these columns has one entry, which represents revenue received by the government from taxes. This treatment follows the general rule established in the conventional SAM literature (Pyatt et al., 1977).

Indirect taxes are, on the other hand, disaggregated through the commodity accounts. One of the major criteria for the disaggregation of the commodity account in SAM2 has been to distinguish commodities both with respect to different markets and to varying prices. The latter are a consequence of different tax rates and subsidies levied on these commodities. There are two major subdivisions of the commodity account that indicate different markets and prices of commodities due to indirect taxes and subsidies. In the first instance, the commodity account of SAM2 is subdivided into: (1) domestic commodities, (2) imported commodities, and (3) exported commodities. This disaggregation takes care of three different markets and three types of taxes: indirect taxes levied on domestic goods produced by private and public activities, import tariffs, and export taxes, including subsidies which may differ according to each distributional channel.

The second subdivision of commodities indicated in Table 5.A1 is with respect to government-traded and nongovernment-traded commodities. Commodity taxes and subsidies in Egypt are not uniform with respect to the same commodity under the two trading systems. The primary reason for this is the "government trade" institution, which is the mechanism for implementing commodity subsidies and indirect taxes. Government trade (principally, the General Supply Authority), first identified in the earlier SAM for Egypt, 1976, built by DRTPC (Eckaus et al., 1979), is a special institution created by the Egyptian Government. The major role of this institution is to buy domestic or imported goods and to deliver them to the distribution companies (wholesale trade), directly to consumers and producers or to the rest of the world (exports). The government trade1/ also finances the difference between purchasing prices and selling prices at which the goods are delivered to consumers. The difference represents either subsidies to consumers or producers who buy government-traded goods; or export taxes in cases of government-traded exports, since these are bought at a lower price on the domestic market and sold at world prices to the rest of the world. Thus, the distribution of commodities through government-trade channels is the main vehicle for implementing subsidies and indirect taxes in Egypt.

In Table 5.A1, commodities are distinguished as domestic, imported, or exported for each of the two major commodity distribution channels (government trade and nongovernment trade). The major difference between these two channels arises from the subsidies component implemented through government trade. The government trade institution is treated as a separate row and column in the SAM2. Government trade "receipts" (positive in the case of commodity taxes and negative in the case of subsidies) are recorded at the intersection of its row (9) with the columns corresponding to government trade commodities (Table 5.A1). These receipts are then transferred to the conventional government account at the intersection of the government row (12) and the government-trade column. Each time there is an entry in the government-trade row, it changes the price of the respective commodity

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1/ For a detailed description of government trade, see Working Paper No. 7, "SAM2 and Documentation, Government Trade Sector," DRTPC, Cairo University 1982.

indicated in the columns of this intersection. For example, domestically produced private agricultural goods have the same price at "farm gate". However, half of these goods can be assumed to be sold at subsidized prices through the government-trade apparatus and the remainder at prices not affected by indirect taxes. In this case, the subsidy would show as a negative element at the intersection of the government-trade row with government-trade agricultural private commodity column ($-T_{9.37}$), while there would be no entry in that same row intersecting with nongovernment-traded commodities ($T_{9.64} = 0$). Because of the subsidy entry added in the government-trade column, this commodity becomes cheaper in comparison to the same commodity found in the nongovernment commodity column. This is the basic principle through which government-traded subsidies are identified conceptually in SAM2. Actual government-traded subsidies can be read from Table 5.A1. However, in addition to the price difference between government-traded and nongovernment-traded commodities arising as a consequence of subsidies imposed on government-traded commodities, there are other sources of price differences between those two types of commodities. These additional differences arise from different rates of indirect taxes imposed on both commodities. Actual rates of indirect taxes are indicated in row 91 in Table 5.A1.

This description of SAM2 and its tax account gives the basic information about the organization of the tax data needed for implementing the general equilibrium model developed above. Because SAM 2 has been constructed for several other purposes, its basic disaggregation is much larger than needed for the model's application. The model used in this section has the same basic specifications, assumptions, and accounting framework as the second version of the model presented above. The only difference is that instead of a hypothetical two-sector SAM, a nine-sector SAM for Egypt is used. However, because the SAM2 includes several additional accounts (rest of the world, capital account, companies, government, etc.), several modifications of the original SAM2 had to be made to derive a version of SAM2 that can fit the accounting structure of the model as presented in Table 4.2a (Chapter IV). These modifications include a two-stage aggregation of the accounts, which are not needed in disaggregated form for the model application. These steps are described in Appendix 3, including presentation of intermediate versions of the aggregated SAM2 (Table 5.A2, and Table 5.A3).

Empirical Analysis of Tax Incidence in Egypt

Table 5.1a presents a base SAM for the application of the general equilibrium model to the Egyptian data. The basic accounting structure of this SAM corresponds exactly to the accounting structure of the SAM presented in Table 4.2c (Chapter IV). Both SAMs include one factor account, including labor and capital; one institution account, including urban and rural households; two accounts for activities--net and gross; the commodity account; and the tax account. The only difference between the two SAMs is that the SAM presented in Table 5.1a includes nine sectors for activities and commodities instead of two sectors. Another difference between these two SAMs is that the SAM in Table 5.1a includes an additional account--consolidated government--which is not part of the SAM presented in Table 5.1a. This consolidated government account, row and column 33 (Table 5.1a), includes aggregation of rows and columns of the SAM2 capital account, government account, and the rest of the world account. A procedure for derivation of this account is described in detail in Appendix 3.

Table 5.1a

<u>Aggregated SAM2 for Egypt (A Base SAM)</u>

PRINT OF MATRIX

			1	2	3	4	5	6	7	8	9
			FACTORS LABOR	FACTORS CAPITAL	INST. URBAN	INST. RURAL	NET-AC AGRICULT	NET-AC FOODPROS	NET-AC TEXTILES	NET-AC OTH-INDU	NET-AC ELECTRIC
1	FACTORS	LABOR									
2	FACTORS	CAPITAL									
3	INST.	URBAN	4072230.	1578742.		21000.					
4	INST.	RURAL	1506175.	2314360.	28700.						
5	NET-AC	AGRICULT									
6	NET-AC	FOODPROS									
7	NET-AC	TEXTILES									
8	NET-AC	OTH-INDU									
9	NET-AC	ELECTRIC									
10	NET-AC	CONSTRUC									
11	NET-AC	OILPROD.									
12	NET-AC	TRANSPO.									
13	NET-AC	SERVICES									
14	GROSS-AC	AGRICULT									
15	GROSS-AC	FOODPROS									
16	GROSS-AC	TEXTILES									
17	GROSS-AC	OTH-INDU									
18	GROSS-AC	ELECTRIC									
19	GROSS-AC	CONSTRUC									
20	GROSS-AC	OILPROD.									
21	GROSS-AC	TRANSPO.									
22	GROSS-AC	SERVICES									
23	COMMODIT	AGRICULT			715930.	896521.					
24	COMMODIT	FOODPROS			1090596.	923647.					
25	COMMODIT	TEXTILES			501445.	373679.					
26	COMMODIT	OTH-INDU			493907.	242168.					
27	COMMODIT	ELECTRIC			23883.	14391.					
28	COMMODIT	CONSTRUC									
29	COMMODIT	OILPROD.			137424.	82806.					
30	COMMODIT	TRANSPO.			153955.	29107.					
31	COMMODIT	SERVICES			783488.	301675.					
32	INDR.	TAXES					0.	0.	0.	0.	0.
33	CONS.	GOVERNMT	86500.	4101100.	2744134.	1436493.	100980.	448990.	129270.	524037.	14300.
34	CAPITAL	AGRICULT					2049300.				
35	CAPITAL	FOODPROS						211736.			
36	CAPITAL	TEXTILES							265170.		
37	CAPITAL	OTH-INDU								457465.	
38	CAPITAL	ELECTRIC									66582.
39	CAPITAL	CONSTRUC									
40	CAPITAL	OILPROD.									
41	CAPITAL	TRANSPO.									
42	CAPITAL	SERVICES									
43	CONS.	LABOR					639803.	130030.	234000.	329248.	35700.
44	TOTAL		5664905.	7994202.	6673461.	4321487.	2790083.	790756.	628440.	1310750.	116582.

Table 5.1a (continued)

PRINT OF MATRIX

10	11	12	13	14	15	16	17	18	19	20
NET-AC CONSTRUC	NET-AC OILPROD.	NET-AC TRANSPO.	NET-AC SERVICES	GROSS-AC AGRICULT	GROSS-AC FOODPROS	GROSS-AC TEXTILES	GROSS-AC OTH-INDU	GROSS-AC ELECTRIC	GROSS-AC CONSTRUC	GROSS-AC OILPROD.
				2790083.						
					790756.					
						628440.				
							1310750.			
								116582.		
									1320900.	
										2060530.
				757182.	1202219.	156735.	58342.			
				25230.	172212.	4955.	106580.			
				1476.	649.	575186.	6915.		333.	1296.
				37052.	5429.	69913.	511354.	870.	197429.	136764.
				103.	713.	4001.	26012.		67.	5667.
				703.	495.	3004.	7496.	571.	160.	14313.
				10540.	1069.	8470.	71537.	11265.	5831.	167409.
				1995.	2303.	13098.	18023.	2245.	2501.	4864.
				29835.	39549.	133356.	145252.	5191.	166779.	141208.
0.	0.	0.	0.	33088.	20672.	13871.	19479.	1214.	14988.	22535.
599900.	153063.	69558.	328102.							
472200.										
	1863567.									
		679303.								
			1887279.							
248800.	43900.	219700.	991424.							
1320900.	2060530.	968561.	3206805.	3687287.	2236066.	1611029.	2281740.	137938.	1708988.	2554586.

Table 5.1a (continued)

PRINT OF MATRIX

21	22	23	24	25	26	27	28	29	30	31
GROSS-AC TRANSPO.	GROSS-AC SERVICES	COMMODIT AGRICULT	COMMODIT FOODPROS	COMMODIT TEXTILES	COMMODIT OTH-INDU	COMMODIT ELECTRIC	COMMODIT CONSTRUC	COMMODIT OILPROD.	COMMODIT TRANSPO.	COMMODIT SERVICES
968561.										
	3206805.									
		3407587.								
			2188766.							
				1397029.						
					2168440.					
						137938.				
							1708988.			
								545084.		
									634180.	
		997471.	443518.	304125.	420957.			54509.		2928890.
28395.	327699.									
2555.	278991.									
750.	45259.									
40406.	355499.									
7104.	33232.									
25172.	54082.									
43955.	170337.									
21908.	320261.									
102192.	676634.									
10982.	55771.	14087.	111282.	-40266.	-6178.	1135.	-14988.	206300.	55480.	39434.
1251980.	5524569.	4419144.	2743566.	1660888.	2583219.	139073.	1694000.	805893.	689660.	2968324.

Table 5.1a (continued)

PRINT OF MATRIX

32	33	34	35	36	37	38	39	40	41	42
INDR. TAXES	CONS. GOVERNMT	CAPITAL AGRICULT	CAPITAL FOODPROS	CAPITAL TEXTILES	CAPITAL OTH-INDU	CAPITAL ELECTRIC	CAPITAL CONSTRUC	CAPITAL OILPROD.	CAPITAL TRANSPO.	CAPITAL SERVICES
	2792300.									
	41600.	2049300.	211736.	265170.	457465.	66582.	472200.	1863567.	679303.	1887279.
419089.	582400.									
271452.	200800.									
	279700.									
	47300.									
	214000.									
	113300.									
	2009502.									
	617800.									
	375100.									
	276122.									
	138800.									
	153900.									
	492428.									
	23900.									
	1588004.									
	95250.									
	119400.									
	443165.									
	131656.									
	19061997.									
690541.	29798423.	2049300.	211736.	265170.	457465.	66582.	472200.	1863567.	679303.	1887279.

Table 5.1a (continued)

PRINT OF MATRIX

43	44
CONS. LABOR	TUTAL
2872605.	5664905.
	7994202.
	6073461.
	4321487.
	2790083.
	790756.
	628440.
	1310750.
	116582.
	1320900.
	2006530.
	968561.
	3206805.
	3087287.
	2236066.
	1011027.
	2281740.
	137938.
	1708988.
	2554586.
	1251980.
	5524569.
	4419144.
	2743566.
	1660888.
	2583219.
	139073.
	1694000.
	805893.
	689660.
	2968324.
	670541.
	29798423.
	2049300.
	211736.
	265170.
	457465.
	66582.
	472200.
	1863567.
	679303.
	1687279.
	2872605.
2872605.	

Table 5.1a (continued) -- A Base Run

	ACCOUNT		PRICE	VALUE	QUANTITY
1	FACTORS	LABOR		5664904.8	
2	FACTORS	CAPITAL		7994202.2	
3	INST.	URBAN		6673461.1	
4	INST.	RURAL		4321486.5	
5	NET-AC	AGRICULT	1.00000	2790083.0	2790083.0
6	NET-AC	FOODPROS	1.00000	790756.1	790756.0
7	NET-AC	TEXTILES	1.00000	628439.9	628440.0
8	NET-AC	OTH-INDU	1.00000	1310749.8	1310749.9
9	NET-AC	ELECTRIC	1.00000	116582.0	116582.0
10	NET-AC	CONSTRUC	1.00000	1320900.0	1320900.0
11	NET-AC	OILPROD.	1.00000	2060530.1	2060530.0
12	NET-AC	TRANSPO.	1.00000	968561.0	968561.0
13	NET-AC	SERVICES	1.00000	3206804.9	3206805.0
14	GROSS-AC	AGRICULT	1.00000	3687286.6	3687287.1
15	GROSS-AC	FOODPROS	1.00000	2236065.8	2236066.1
16	GROSS-AC	TEXTILES	1.00000	1611028.8	1611029.0
17	GROSS-AC	OTH-INDU	1.00000	2281739.6	2281739.9
18	GROSS-AC	ELECTRIC	1.00000	137938.0	137938.0
19	GROSS-AC	CONSTRUC	1.00000	1708987.8	1708988.0
20	GROSS-AC	OILPROD.	1.00000	2554585.8	2554586.0
21	GROSS-AC	TRANSPO.	1.00000	1251979.9	1251980.0
22	GROSS-AC	SERVICES	1.00000	5524569.4	5524570.0
23	COMMODIT	AGRICULT	1.00000	4419144.5	4419145.1
24	COMMODIT	FOODPROS	1.00000	2743565.6	2743566.1
25	COMMODIT	TEXTILES	1.00000	1660887.8	1660887.9
26	COMMODIT	OTH-INDU	1.00000	2583218.8	2583218.9
27	COMMODIT	ELECTRIC	1.00000	139073.0	139073.0
28	COMMODIT	CONSTRUC	1.00000	1693999.8	1694000.0
29	COMMODIT	OILPROD.	1.00000	805892.9	805893.0
30	COMMODIT	TRANSPO.	1.00000	689659.9	689660.0
31	COMMODIT	SERVICES	1.00000	2968323.7	2968324.0
32	INDR.	TAXES		690540.8	
33	CONS.	GOVERNMT		29798423.3	
34	CAPITAL	AGRICULT	1.00000	2049300.1	2049300.0
35	CAPITAL	FOODPROS	1.00000	211736.0	211736.0
36	CAPITAL	TEXTILES	1.00000	265170.0	265170.0
37	CAPITAL	OTH-INDU	1.00000	457465.0	457465.0
38	CAPITAL	ELECTRIC	1.00000	66582.0	66582.0
39	CAPITAL	CONSTRUC	1.00000	472200.0	472200.0
40	CAPITAL	OILPROD.	1.00000	1863567.1	1863567.0
41	CAPITAL	TRANSPO.	1.00000	679303.0	679303.0
42	CAPITAL	SERVICES	1.00000	1887279.0	1887279.0
43	CONS.	LABOR	1.00000	2872605.0	2872605.0

The reason for the inclusion of this account into the SAM in Table 5.1a is that the original SAM2 for Egypt (or any SAM) includes rest of the world, capital, and government accounts. Because actual SAMs are balanced by representing all of the interactions in an economy, including foreign trade and capital accumulation, it is impossible to derive a SAM for the domestic economy only without unbalancing the basic accounting structure and consistency of the SAM framework. Thus, in order to keep the accounts of the Egypt SAM balanced, and to derive an accounting structure of the Egypt SAM which is consistent with the accounting structure of the model, the rest of the world, capital, and government accounts were aggregated into a single "consolidated government" account. However, because the basic assumptions of the extended Harberger model presented in Chapter IV exclude foreign trade and capital accumulation, an additional assumption was made to apply the model to the Egypt SAM data. This additional assumption of the model is that the SAM entries for the rest of the world, capital, and government accounts (consolidated government) are treated as constant shares of the column accounts of the SAM.

This is the only additional assumption of the model that was necessary to apply the extended Harberger model to an actual SAM data framework. In all other respects, the analytical and accounting structure of the model applied below to the Egyptian SAM data, stays the same as that of the model applied to a hypothetical SAM in section 2 of Chapter IV. As discussed in Chapter IV, a disaggregation of the SAM accounts does not change the basic structure or the mathematical solution of the model. Therefore, the basic equations of the model presented in Chapter IV apply also to the model presented here.

For the clarity of presentation, the basic assumptions[1/] of the second version of the model are summarized as follows:

(1) perfect competition in factor and product markets;

(2) fixed aggregate factor supplies;

(3) full employment of factors;

(4) no accumulation;

(5) fixed technology;

(6) closed economic system;

(7) fixed stock of capital (or land) is assumed in each sector;

(8) household incomes are spent on commodities in constant proportions; and

(9) entries of the consolidated government account are treated as constant shares of the economic activity.

This model is applied to the SAM for Egypt, 1979 (Table 5.1a) in order to analyze some aspects of indirect taxation in Egypt. These aspects and empirical analysis of the results are presented in detail in the next part of this chapter.

Analysis of the Distributional Effects of Indirect Taxes and Subsidies in Egypt

Four experiments are performed with the model. In the first experiment, the existing indirect taxes are increased by removing the existing commodity subsidies. The existing indirect taxes are replaced with the existing subsidies in the second experiment. In the third experiment, selective commodity taxes are levied on necessities. Finally, in the last experiment, distributional implications of alternative allocation patterns of

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1/ The major limitations of these assumptions are discussed in Chapter IV.

tax revenues to households are analyzed. These experiments are chosen for two main reasons. One of these is to test the sensitivity of the model's results (a direction of changes in relative prices and incomes) with respect to different indirect tax and subsidy rates. The other reason for choosing these particular experiments is a concern with the impact of domestic subsidies and indirect taxes on income distribution. However, as shown in the following sections, domestic subsidies in Egypt have an approximately neutral effect on real incomes of urban and rural households. As demonstrated by the third experiment, this is so primarily because domestic subsidies in Egypt are not concentrated on necessities, which are consumed more heavily by rural households. These issues are explained in more detail for each experiment in the following sections.

(a) Increase in Indirect Taxes by Removing Existing Commodity Subsidies

This section presents an analysis of the distributional effects of subsidies levied on domestic commodities in Egypt. In the first experiment with the model, existing commodity subsidies are removed. This is achieved by subtracting the existing commodity subsidies from the existing net indirect commodity taxes. Values for both, net indirect taxes and commodity subsidies were obtained from SAM2. Table 5.1b below presents the existing and changed tax structure for the purpose of this analysis. Column 1 of Table 5.1b was obtained from Table 5.1a, the intersection of row 32 (indirect taxes) with commodity columns 23 to 31 of the SAM. Column 2 of Table 5.1b below presents percentage rates of the existing net indirect taxes. As this table shows, the structure of commodity taxes in Egypt is very diverse, ranging from very high tax rates levied on oil products (0.34) to negative tax rates levied on textiles, other industries, and the construction sector.

Table 5.1b

Structure of Commodity Taxes and Subsidies in Egypt

		1	2	3	4	5	6
		Existing Commodity Taxes				New Commodity Taxes	
		Net indirect taxes		Subsidies		(Elimination of subsidies)	
COMMODITIES		Absolute value	% of gross output 1/	Absolute value	%	Absolute value	%
23	Agriculture	14,085	0.32	-8,236	-0.19	22,323	0.51
24	Food proc.	111,282	4.23	-3,319	-0.13	114,601	4.35
25	Textiles	-40,266	-2.37	-50,600	-2.91	10,334	0.61
26	Other ind.	-6,178	-0.24	-59,848	-2.26	53,670	2.07
27	Electricity	1,135	0.82	-	-	1,135	0.82
28	Construction	-14,988	-0.88	-35,041	-2.01	20,053	1.17
29	Oil products	206,300	34.41	-40,000	-6.25	246,300	41.01
30	Transport.	55,480	8.74	-27,500	-3.83	82,980	13.08
31	Services	39,434	1.34	-41,235	-1.37	80,669	2.71

1/ Percentage rates are rounded for the purpose of this table. To achieve an exact solution of the model, as demonstrated in Table 5.1a (where all prices are equal to unity in the base run), tax rates are calculated to ten decimal points.

Source: SAM2.

Commodity subsidies are presented in row 3 of the same table. These were obtained from the original SAM2 (Table 5.A1), cells $T_{9.37}$, $T_{9.38}$ (government-trade subsidies), and cells $T_{92.66}$ to $T_{91.72}$ (nongovernment-traded subsidies). The existing subsidy rates are presented in column 4 of Table 5.1b. These differ substantially with respect to each commodity in a similar way as the net indirect tax rates.

New indirect tax rates are entered in column 5 in Table 5.1b These indirect taxes were obtained by subtracting values in column 3 from values in column 1. The removal of existing subsidies, as calculated in Table 5.1b, means an increase of the net indirect taxes for the amount of subsidy levied on a particular commodity. New tax rates, which are a basis for this experiment, are presented in column 6 in Table 5.1b. These new tax rates are then used as exogenous variables to solve the model.

Main data parameters (exogenous variables) for this experiment are summarized as follows.

(i) existing net indirect taxes levied on the nine commodities are:
0.32, 4.23, -2.37, -0.24, 0.82, -0.88, 34.41, 8.74, 1.34 %;

(ii) new commodity tax rates for the nine commodities are:
0.51, 4.35, 0.61, 2.07, 0.82, 1.17, 41.01, 13.08, 2.17 % of gross output; and

(iii) c = 0.61, (1-c) = 0.39: this means that tax revenues are allocated to households in proportion to income. Urban households receive a proportion (c), and rural households a proportion (1-c) of total tax revenues, respectively.

The solution of the model for new commodity prices, factor prices, and the level of output is presented in Appendix 4, Table 5.B1 (page 1), rows

23 through 31. These values are also presented in a summary form in Table 5.1c below. As this table shows, all commodity prices increased due to the increase in indirect tax rates. For example, the new price of oil products is equal to 1.059, which is an increase of 5.9 percent on the initial price. The price of oil products increased more than that of other commodities because of the high subsidy rate (-6.25) previously levied on oil products. New prices for capital are presented in rows 34 to 42 in the same table. The return to capital increased in agriculture, food products, and electricity, in relation to the return to labor and capital in other sectors, because tax rates for these commodities increased at a lower rate compared to other commodities. On the other hand, the return to capital decreased in relative terms for commodities that were previously subsidized at a higher rate; for example, in transportation, textiles, other industries, etc. All price changes are relatively small, since indirect taxes were not changed drastically.

The immediate impact of the reduction of subsidies, by raising indirect taxes and, consequently prices of commodities, can be expected to drive up the cost of living for all consumers. The heaviest burden will fall on consumers who devote a larger share of their budget to products whose prices increased more in relation to other commodities. Changes in real incomes, due to a tax increase on the uses side for urban and rural households, are calculated using the same equations as in Chapter III, and sections 1 and 2 of this chapter. These calculations are presented in Table 5.1c below.

As indicated in this table, with an original income of LE 6673,462, urban households lose LE 107,804, or about 1.6 percent of their initial income. On the other hand, rural households with an original income of LE 4321,487 lose LE 75,224, or about 1.7 percent of their initial income on the

Table 5.1c

Changes in Uses of Incomes for Urban and Rural Households

COMMODITY		$\frac{\Delta P_x}{P'_x}$	Urban households: X'_{uh} 1/	Urban households: $\frac{X'_{uh}\ \Delta P_x}{P'_x}$	Rural households: X'_{rh}	Rural households: $\frac{X'_{rh}\ \Delta P_x}{P'_x}$
23	Agriculture	$\frac{0.01855}{1.01855}$	737,668	-13,434	922,931	-16,808
24	Food proc.	$\frac{0.01749}{1.01749}$	1123,710	-19,316	950,856	-16,345
25	Textiles	$\frac{0.04644}{1.04644}$	516,670	-22,929	384,687	-17,072
26	Other ind.	$\frac{0.03217}{1.03217}$	508,904	-17,072	249,302	-11,064
27	Electricity	$\frac{0.01211}{1.01211}$	24,608	-294	14,815	-177
28	Construction	$\frac{0.01856}{1.01856}$	-	-	-	-
29	Oil Products	$\frac{0.05895}{1.05895}$	141,597	-7,876	85,245	-4,741
30	Transport.	$\frac{0.04453}{1.04453}$	158,630	-6,763	29,964	-1,277
31	Services	$\frac{0.02556}{1.02556}$	807,277	-20,120	310,562	-7,740
Total			ΔY_{uh} =	-107,804	ΔY_{rh} =	-75,224

1/ X'_{uh} for commodities 23 to 31 were obtained from Table 5.B2 (Appendix IV), p. 2, intersection of rows 23-31 with columns 3 and 4.

X'_{rh}(s) are obtained in the same way as X'_{uh} .

uses side. This means that a reduction of subsidies levied on domestic commodities (an increase in indirect taxes for the amount of subsidies) has a neutral effect on the uses side of income for urban and rural households.

In this model, the sources of income for urban and rural households are affected by changes in factor prices and by the increase in tax revenues, in the same way as demonstrated in section 2 of Chapter IV. The new incomes for urban and rural households can be found in Table 5.B1 (Appendix 4) as the sum of rows or columns 3 and 4. The incomes of urban households on the sources side increased from the original LE 6673,461 to LE 6876,089, an increase of LE 202,626, or 3 percent of their initial income. On the other hand, the incomes of rural households increased from LE 4321,487 to LE 4448,788, an increase of LE 127,301, or 2.9 percent of their original income. In this experiment, the values for the exogenous coefficients c and (1-c) equal 0.61 and 0.39, respectively. This means that tax revenues are distributed to households as direct transfers in proportion to their income; in the Egypt SAM2, this also coincides with the values of actual government transfers to these two household groups. Because of relatively small changes in factor prices, especially the returns to capital in a new tax situation, changes in incomes from the sources side are dominated by the the tax revenues received. Consequently the sources-side effects are approximately neutral in this case (3.0 and 2.9 percent).

The combined tax incidence from the sources and uses of income side gives the following results.

Total changes in incomes:

		Sources	Uses	Total
(1)	Urban Households	+202,626 (3.0%)	-107,804 (1.6%)	+94,822 (1.4%)
(2)	Rural Households	+127,301 (2.9%)	-75,224 (1.7%)	+52,077 (1.2%)

The combined tax incidence from the sources and uses of income side results in a slight gain for urban households whose real income increases by 1.4 percent, while the real income of rural households increases by 1.2 percent of their initial income. Taking into account the assumptions of the model, the above result indicates that the removal of domestic commodity subsidies in Egypt has an approximately neutral distributional effect with respect to urban and rural households. However, in order to evaluate the above result in light of different policy options, alternative tax changes will be evaluated using the same model and the same basic assumptions. Alternative tax changes are presented in the following sections, where the distributional impact of the existing subsidies, selective commodity taxes, and sales taxes are evaluated with the model.

(b) Decrease in Indirect Taxes by Replacing the Existing Indirect Taxes with existing subsidies

In the second experiment with the model, the existing indirect taxes are replaced with the existing subsidies. The subsidy rates are indicated in columns 3 and 4 in Table 5.1b above. These subsidy rates were entered into the SAM presented in Table 5.1a.

Main data parameters (exogenous variables) for this experiment are summarized as follows.

(i) existing net indirect tax rates:

0.32, 4.23, -2.37, -0.24, 0.82, -0.88, 34.41, 8.74, 1.34 %;

(ii) new tax rates (existing subsidies):

-0.19, -0.13, -2.91, -2.26, - , -2.01, -6.25, -3.83, -1.37 %; and

(iii) $c = 0.61$, $(1-c) = 0.39$.

The results of the model for new commodity prices, factor prices, and the level of output are presented in Table 5.2a below and in Table 5.B2 (Appendix 4). In contrast to the solution of the model for the first

Table 5.2a

Changes in Uses of Incomes for Urban and Rural Households

			Urban households		Rural households	
COMMODITY		$\frac{\Delta P_x}{P'_x}$	X'_{uh} 1/	$\frac{X'_{uh}}{P'_x}\Delta P_x$	X'_{rh}	$\frac{X'_{rh}}{P'_x}\Delta P_x$
23	Agriculture	$\frac{0.03182}{0.96818}$	671,960	22,084	846,708	27,828
24	Food proc.	$\frac{0.06229}{0.93771}$	1023,615	67,996	872,327	57,947
25	Textiles	$\frac{0.03511}{0.96489}$	470,648	17,126	352,917	12,842
26	Other ind.	$\frac{0.04597}{0.95403}$	463,573	22,337	228,713	11,021
27	Electricity	$\frac{0.03778}{0.96622}$	22,416	880	13,591	534
28	Construction	$\frac{0.01939}{0.98061}$	-	-	-	-
29	Oil Products	$\frac{0.29199}{0.70801}$	128,984	53,194	78,205	32,252
30	Transport.	$\frac{0.11379}{0.88621}$	144,500	18,553	27,490	3,530
31	Services	$\frac{0.05416}{0.94584}$	735,369	42,108	284,913	16,314
Total			ΔY_{uh} =	+244,278	ΔY_{rh} =	+162,268

1/ X'_{uh} for commodities 23 to 31 were obtained from Table 5.B2 (Appendix IV), p. 2, intersection of rows 23-31 with columns 3 and 4.

X'_{rh}(s) are obtained in the same way as X'_{uh} .

experiment, where all commodity prices increased, all commodity prices decrease when the existing indirect taxes are replaced by pure subsidies. The largest price decrease occurs in the oil sector, i.e., $P'_{29} = 0.708$, a decrease in oil prices of 29 percent of the initial price. This happens because relatively high indirect taxes levied on the oil sector (0.34) were replaced with a relatively high subsidy rate (-6.25%). The next largest price decrease occurs in the transportation sector, because this sector has the second largest existing tax and subsidy rate. While commodity prices decrease in a new tax situation, prices for capital increase in relation to wage rate. This could be expected, as subsidies cause an increase in the return to capital in the same way as taxes decrease the return to capital, as demonstrated in Chapter III.

Changes in real incomes due to subsidies (decrease in commodity taxes) for urban and rural households on the uses side of income are presented in Table 5.2a below. With an original income of LE 6673,462, urban households gain LE 244,278, or about 3.6 percent of their initial income on the uses side. This result shows that if the existing net indirect taxes were replaced with the existing commodity subsidies, the distributional effects would be minimal from the uses side of income. This is so primarily because the subsidies levied on domestic commodities in Egypt are not concentrated on necessities, but are spread more equally on goods for which the consumption patterns between urban and rural households do not differ substantially. For example, the lowest rate of domestic subsidies is levied on the agriculture and the food processing sector, the commodities for which consumption patterns differ the most. On the other hand, the highest level of subsidy is levied on oil products, for which consumption patterns between the two household groups do not differ according to the SAM data (Table 5.1a). To test the sensitivity of the model's results with respect to consumption patterns, the next experiment evaluates the distributional effects of a selective increase in taxes for agriculture and food processing.

On the sources side, incomes of urban and rural households are affected in the opposite direction from the previous experiment, because of the decline in the tax revenues. Incomes of urban households decrease from the original LE 6673,461 to LE 6263,598, a decrease of LE 409,863, or 6.1 percent, and rural incomes decline from the initial LE 4321,487 to LE 4081,376, a decrease of LE 240,111, or 5.5 percent. The combined tax incidence is presented in the table below.

Total changes in incomes:

		Sources	Uses	Total
(1)	Urban Households	-409,863 (6.1%)	+244,278 (3.6%)	-165,585 (2.5%)
(2)	Rural Households	-240,111 (5.5%)	+162,268 (3.8%)	-77,843 (1.8%)

The combined tax incidence from the sources and uses of income side results in a larger loss for urban households, whose real income decreases by 2.5 percent, while real income of rural households decreases by 1.8 percent of their initial income.

(c) Selective Increase of Commodity Taxes Levied on Necessities

In the third experiment with the model, the existing indirect taxes are kept the same in all sectors except in agriculture and food processing, where 6 percent tax rates are levied on these two commodities. This experiment is performed for the purpose of evaluating the distributional effects which would arise from taxing necessities. Both agricultural and food-processing products are consumed more heavily by rural households than by urban households. For example, the average consumption propensity for agricultural products is 0.207 for rural households and 0.107 for urban households: and for food processing products, the respective coefficients are 0.224 and 0.163. By raising commodity taxes for these two products, it can be expected that the heaviest burden of the increase in the cost of living (price increase) will fall on the poorer people (rural households), who devote a larger share of their budget to these subsistence items.

Main data parameters (exogenous variables) for this experiment are summarized as follows.

(i) existing net indirect tax rates:

0.32, 4.23, -2.37, -0.24, 0.82, -0.88, 34.41, 8.74, 1.34 %;

(ii) new tax rates:

6.00, 6.00, -2.37, -0.24, 0.82, -0.88, 34.41, 8.74, 1.34 %; and

(iii) $c = 0.61$, $(1-c) = 0.39$.

The results of the model are presented in Appendix 4, Table 5.B3 and in a summary form in Table 5.3a. Because of the tax changes, all commodity prices increased. The largest increases can be observed for agriculture, a 5 percent increase in the initial price, and for food processing, a 4.1 percent increase in the initial price. Price increases for other sectors are relatively small (1 percent), with negligible intersectoral differences. While the commodity prices increased for the two sectors, the return to capital decreased for these two sectors due to the tax increase. The price of capital for other sectors remained approximately the same as that in effect before the tax change. These results are presented in Table 5.3a.

Changes in real incomes for urban and rural households, on the uses side, are presented in Table 5.3a below. With their original income of LE 6673,462, urban households lose LE 109,470, or about 1.6 percent of the initial income. Rural households, who consume a larger proportion of the products for which taxes were increased, lose LE 106,116, or about 2.5 percent

Table 5.3a

Changes in Uses of Incomes for Urban and Rural Households

			Urban households		Rural households	
COMMODITY		$\frac{\Delta P_x}{P'_x}$	X'_{uh} 1/	$\frac{X'_{uh} \Delta P_x}{P'_x}$	X'_{rh}	$\frac{X'_{rh} \Delta P_x}{P'_x}$
23	Agriculture	$\frac{0.05046}{1.05046}$	739,320	-35,514	923,710	-44,371
24	Food proc.	$\frac{0.04124}{1.04124}$	1126,227	-44,606	951,659	-37,692
25	Textiles	$\frac{0.01608}{1.01608}$	517,828	-8,194	385,012	-6,093
26	Other ind.	$\frac{0.01345}{1.01345}$	510,044	-6,768	249,512	-3,311
27	Electricity	$\frac{0.01371}{1.01371}$	24,663	-333	14,827	-201
28	Construction	$\frac{0.00905}{1.00905}$	-	-	-	-
29	Oil Products	$\frac{0.01439}{1.01439}$	141,919	-2,013	85,317	-1,210
30	Transport.	$\frac{0.01289}{1.01289}$	158,985	-1,991	29,990	-376
31	Services	$\frac{0.01258}{1.01258}$	809,086	-10,051	310,824	-3,862
Total			ΔY_{uh} =	-109,470	ΔY_{rh} =	-106,116

1/ X'_{uh} for commodities 23 to 31 were obtained from Table 5.B3 (Appendix IV), p. 2, intersection of rows 23-31 with columns 3 and 4.

X'_{rh}(s) are obtained in the same way as X'_{uh} .

of their initial income. This result shows that, in this case, the distributional effects of selective commodity taxes are not neutral because the taxes were increased for subsistence commodities. As could be expected, a larger burden of taxes falls on rural households who devote a larger share of their income to the taxed commodities.

On the sources side, the incomes of urban households increase by 3.2 percent and that of rural households by 3.0 percent of their initial income, due to an increase in tax revenues.

The combined tax incidence from the sources and uses of income side is presented in the following table.

Total changes in incomes

	Sources	Uses	Total
(1) Urban Households	+218,031 (3.2%)	-109,470 (1.6%)	+108,561 (1.6%)
(2) Rural Households	+131,060 (3.0%)	-106,116 (2.5%)	+24,944 (0.5%)

The combined tax incidence from the sources and uses of income side results in a larger gain for urban households. The income of urban households increases by 1.6 percent of their initial income, while rural households gain only 0.5 percent of their initial income.

(d) Distributional Implications of Alternative Allocation Patterns of Tax Revenues to Households

In this experiment with the model, tax revenues are allocated to urban and rural households in the first case in proportion to income, and in the second case in proportion to population (per capita allocation). In both cases, the existing commodity taxes are replaced by a uniform sales tax of 5 percent. In the same way as discussed in section 2 of this Chapter IV, in order to change the allocation of tax revenues to households, coefficients c and $(1-c)$ of the model have to be changed exogenously. The tax revenues are received by households in the SAM (Table 5.1a) from column 32, rows 4 and 5.

In all of the above experiments, tax revenues were allocated to households in proportion to income, i.e., c = 0.61, and (1-c) = 0.39. When tax revenues are allocated on a per capita basis, these coefficients are c = 0.558 and (1-c) = 0.442 for urban and rural households, respectively.1/

Main data parameters (exogenous variables) for this experiment are summarized as follows:

(i) existing net indirect tax rates:

0.32, 4.23, -2.37, -0.24, 0.82, -0.88, 34.41, 8.74, 1.34 %:

(ii) new tax rates are the same in both cases, i.e.:

5.0, 5.0, 5.0, 5.0, 5.0, 5.0, 5.0, 5.0, 5.0 %;

(iii) in the first case,

c = 0.61, and (1-c) = 0.39 and

(iv) in the second case,

c = 0.558, and (1-c) = 0.442.

The distributional effects for the first case (allocation of tax revenues in proportion to income) are presented in Table 5.4a below and in Table 5.B4 in Appendix 4. The results for the second case (per capita allocation) are presented in Table 5.4b below and in Table 5.B5 in Appendix 4.

The combined tax incidence from the sources and uses of income side is summarized for both cases in the two following tables.

Total changes in incomes

(first case)

	Sources	Uses	Total
(1) Urban households	+452,422 (6.7%)	-201,567 (2.9%)	+250,855 (3.7%)
(2) Rural households	+299,157 (6.4%)	-162,075 (3.7%)	+137,082 (3.2%)

1/ The source for the per capita coefficients: K. Ikram (1980).

Table 5.4a

Changes in Uses of Incomes for Urban and Rural Households

			Urban households		Rural households	
COMMODITY		$\frac{\Delta P_x}{P'_x}$	X'_{uh} 1/	$\frac{X'_{uh}}{P'_x}\Delta P_x$	X'_{rh}	$\frac{X'_{rh}}{P'_x}\Delta P_x$
23	Agriculture	$\frac{0.06691}{1.06691}$	764,466	-47,943	958,583	-60,116
24	Food proc.	$\frac{0.05050}{1.05050}$	1164,532	-55,973	987,587	-47,475
25	Textiles	$\frac{0.11244}{1.11244}$	535,440	-54,120	399,547	-40,384
26	Other ind.	$\frac{0.06661}{1.06661}$	527,391	-32,936	258,932	-16,170
27	Electricity	$\frac{0.03939}{1.03939}$	25,502	-966	15,387	-583
28	Construction	$\frac{0.05091}{1.05091}$	-	-	-	-
29	Oil Products	$\frac{0.17201}{0.82799}$	146,741	+30,485	88,538	+18,393
30	Transport.	$\frac{0.00085}{0.99915}$	164,392	+1,398	31,122	+265
31	Services	$\frac{0.05221}{1.05221}$	836,604	-41,512	322,559	-16,005
Total			ΔY_{uh} =	-201,567	ΔY_{rh} =	-162,075

1/ X'_{uh} for commodities 23 to 31 were obtained from Table 5.B4 (Appendix IV), p. 2, intersection of rows 23-31 with columns 3 and 4.

X'_{rh}(s) are obtained in the same way as X'_{uh} .

Table 5.4b

Changes in Uses of Incomes for Urban and Rural Households

			Urban households		Rural households	
COMMODITY		$\frac{\Delta P_x}{P'_x}$	X'_{uh} 1/	$\frac{X'_{uh}\ \Delta P_x}{P'_x}$	X'_{rh}	$\frac{X'_{rh}\ \Delta P_x}{P'_x}$
23	Agriculture	$\frac{0.06823}{1.06823}$	757,974	-48,413	970,866	-62,011
24	Food proc.	$\frac{0.05122}{1.05122}$	1154,642	-56,259	1000,242	-48,736
25	Textiles	$\frac{0.11250}{1.11250}$	530,893	-53,685	404,667	-40,921
26	Other ind.	$\frac{0.06615}{1.06615}$	522,912	-32,444	262,250	-16,271
27	Electricity	$\frac{0.03897}{1.03897}$	25,286	-948	15,584	-461
28	Construction	$\frac{0.05056}{1.05056}$	-	-	-	-
29	Oil Products	$\frac{0.17243}{0.82757}$	145,494	+30,315	89,673	+18,684
30	Transport.	$\frac{0.00184}{0.99816}$	162,996	+300	31,521	+58
31	Services	$\frac{0.05178}{1.05178}$	829,499	-40,837	326,692	-16,083
Total			ΔY_{uh} =	-201,971	ΔY_{rh} =	-165,741

1/ X'_{uh} for commodities 23 to 31 were obtained from Table 5.B5 (Appendix IV), p. 2, intersection of rows 23-31 with columns 3 and 4.

X'_{rh}(s) are obtained in the same way as X'_{uh} .

Total changes in incomes

(second case)

	Sources	Uses	Total
(1) Urban households	+391,905 (5.8%)	-201,971 (3.0%)	+189,934 (2.9%)
(2) Rural households	+358,365 (8.3%)	-165,741 (3.8%)	+192,624 (4.5%)

As these tables show, the differences in price changes due to the change in coefficients c and (1-c), which in turn affect the real incomes of households from the uses side, are minimal. For that reason, tax burdens for urban and rural households are similar on the uses side of income in both cases, i.e., urban households lose 2.9 percent of their initial income in the first case, and 3.0 percent in the second case. However, differences in the effects from the sources side are substantial, i.e., rural households receive proportionally more income in the second case (6.4 percent vs. 8.4 percent) at the expense of urban households. This means that the results of the model on the sources side of income are dominated by the allocation pattern of the tax income. Consequently, total effects for different experiments have to be evaluated under the same assumptions for the allocation of tax revenues to households.

Analysis of the Results

The above experiments show, in the first instance, that domestic commodity subsidies in Egypt play a minimal redistributive role with respect to urban and rural households. The results of the model show that in both cases, when the subsidies are removed or replaced with net indirect taxes, the distributional effects of these two exercises are close to neutral. The results would probably differ if more household groups were identified, thus allowing for better intrasectoral income distribution data. However, as it appears from the third experiment, the distributional implications are different when necessities (agriculture and food processing sectors) are taxed (or subsidized) more heavily, relative to other sectors. In this experiment, the real income of rural households declines to a larger extent than that of urban households, due to the selective taxes levied on necessities. Taking into account the fact that the domestic subsidies are not concentrated on necessities in Egypt, and taking into consideration the results of the third experiment, it can be concluded that the primary reason for the neutral distributional effect of the domestic subsidies in Egypt is due to the existing structure of these subsidies and the structure of indirect taxes levied on domestic goods.

The fourth experiment with the model, on the other hand, shows the importance of "who gets the tax revenues". When the tax revenues are distributed to households on a per capita basis, as opposed to in proportion to income, rural households benefit substantially on the sources side of income. This could be expected; on the other hand, the results and the experiment are rather crude and of a hypothetical nature. The primary reason for this is due to data constraints, because the ratios in this SAM for the allocation of tax revenues were assumed. To perform this experiment properly, better data on the spending patterns of the government would be required. These data could be obtained from the government accounts and from the household budget survey, or by conducting special surveys, such as that demonstrated by Meerman (1979) for Malaysia.

Several other experiments of a similar nature can be performed with the model. Additional experiments with the model would depend primarily on policy issues. Alternatively, the distributional effects of replacing value added taxes, activity taxes, or commodity taxes of a similar or a different structure, or of generating similar total tax revenues, can be compared. However, it should be noted that the results of the model's applications should be analyzed while taking into consideration all of the restrictive assumptions and limitations of the model. As discussed above, the model is comparatively static and does not allow for evaluation of import tariffs and export taxes. In this model, imports are treated in the same way as complementary imports in an input-output table. Imports are assumed to be a constant share either of final or intermediate consumption, a rather restrictive assumption. Exports, government consumption, and capital accumulation, including balance of payments deficit, are treated in a similar way, i.e., as a constant share of the economic activity, thus practically excluding the influence of these variables on the model's results. Leaving out foreign taxes may be especially restrictive for Egypt, where relatively large subsidies are levied on imported food products. Thus, these restrictions, and the limitations of the assumptions of the model presented in Chapter IV, should be taken into account when comparing the tax incidence of domestic commodity taxes as illustrated above.

On the other hand, the above application, in spite of the data limitations of this particular SAM and the rather restrictive assumptions of the model, nevertheless shows the usefulness of the approach developed in the previous chapters for tax incidence analysis. There are two major advantages of the methodology presented. First, the approach allows for a general equilibrium analysis of tax incidence as opposed to the partial static equilibrium analysis used in the conventional empirical studies of fiscal incidence. Second, by linking the SAM data base with the Harberger-type models, it is possible, as shown above, to take advantage of a data base that is readily available, consistent, and of a relatively good quality with respect to income distribution, consumption, and production structure, as well as with respect to taxation. The SAM data base is in general better than any other one used in the conventional empirical studies, especially for developing countries and with respect to income distribution. It is possible that this point has not been demonstrated to its full extent by using a preliminary SAM2 for Egypt. This SAM was used as an example rather than as the only possible alternative.

It should be noted that there is an increasing number of SAMs (over 15) that are being built for developing countries. Most of these SAMs contain additional information on intrasectoral income distribution, regional classification (Pyatt et. al. 1978: Pleskovic 1980), functional income distribution, and so on, and could be used for a similar analysis. In this sense, the methodology developed above is generally applicable to different countries and is not limited to Egypt or to any country in particular. It is obvious, however, that the results would differ each time that a different SAM is used. The approach is also not limited to a particular SAM data base or to the organization of an existing SAM. SAMs are a flexible tool, the accounts of which can either be reorganized or their data improved by collecting more data, or by using techniques for reconciliation and balancing. This pertains to any SAM, including the SAM for Egypt, which is presently being disaggregated to a greater extent.

Thus, from this perspective, the approach developed above should be looked upon primarily as a first attempt to develop a general framework for tax incidence analysis that could combine a modified Harberger model with the advantages of a SAM data framework in order to improve both the data base and the methodology of the conventional empirical fiscal incidence studies. However, the first priority in the future should be focused towards an effort to modify some of the most restricive assumptions of the model, and to take into account the full advantage of the SAM data base. As always, some of the limitations will be more difficult to overcome than others. Several improvements on the data side will be less difficult because of the recent extensive experience with the SAM data framework in various developing countries. A summary of the study and the recommendations for future research are presented in the next chapter.

References

Cairo University (1982). "SAM2 and Documentation." Working Paper No. 7, Development Research and Technological Planning Center (DRTPC).

Dervis, K., et al. (1980). "Domestic Resource Mobilization in Egypt." Washington, D.C The World Bank

Eckaus, R., D. McCarthy, and A. Mohie-Eldin, et al. (1979). "Multisectoral General Equilibrium Models for Egypt." Massachusetts Institute of Technology Working Paper, Department of Economics.

Ikram, K. (1980). Egypt, Economic Management in a Period of Transition. Baltimore, Maryland: The Johns Hopkins University Press.

Pleskovic, B., and M. Crosswell (1981). "Social Accounting Matrices for Egypt: Outlines and Suggestions for Disaggregation of Individual Accounts." Working Paper No. 1, The World Bank, Development Research Center, mimeographed.

Pleskovic, B. (1980). "A Disaggregated Social Accounting Matrix for Thailand." The World Bank, Development Research Center, mimeographed.

Pyatt, G., and A. R. Roe (1977). Social Accounting for Development Planning with Special Reference to Sri Lanka. Cambridge: Cambridge University Press.

Pyatt, G., and J. Round (1978). "The Distribution of Income and Social Accounts: A Study of Malaysia in 1970." The World Bank, Development Research Center, mimeographed.

CHAPTER VI

CONCLUSIONS

Summary and Recommendations for Future Research

In this study, the conventional empirical fiscal incidence studies have been reviewed from a theoretical perspective, relevant policy applications have been made, and a methodology for the improvement of these studies has been proposed. The proposed methodology consists of linking (1) a SAM data framework and (2) the Harberger (1962) general equilibrium model of tax incidence. As demonstrated by the study such an approach, in the first instance, allows the data base of these studies to be improved considerably, i.e., more and improved data can be obtained in this way. On the other hand, some of the important theoretical considerations developed in the theoretical tax incidence literature (such as general equilibrium analysis), so far ignored in the conventional empirical studies, can in this way be incorporated as a consistent part of the methodology of empirical tax incidence studies.

The underlying theory and concepts, the purpose, and the limitations of the conventional empirical fiscal incidence studies are reviewed in Chapter II. As discussed in this chapter, there are several limitations of these studies. One of the major shortcomings of the conventional tax incidence studies is that they do not take into account changes in relative prices that are due to changes in taxes. Consequently, these studies evaluate the tax incidence only from either the sources or uses side of income, thus limiting the incidence to only partial responses of the economy (Devarjan et al. 1980). On the other hand, the expenditures incidence is largely underdeveloped in theory and practice (McLure 1974, Meerman 1978). The empirical studies of the expenditures incidence deal only with benefit incidence, leaving unresolved many important issues that affect the income distribution of household groups from the spending (expenditures) side of the government budget. The budget incidence studies combine the tax and expenditures incidence under one concept, thus compounding the limitations, which are similar for both types of studies in most cases. The second major shortcoming of these empirical studies is due to the inadequate organization and presentation of the statistical data used. The data of these studies are especially inadequate with respect to income distribution. The theory and concepts of these empirical studies are contrasted to the Harberger general equilibrium model of the tax incidence. The Harberger model, in spite of its limiting assumptions, provides a more accurate and a more general framework within which many of the conceptual limitations of the conventional empirical studies, such as their partial static equilibrium analysis, can be overcome analytically as well as empirically.

In Chapter III, the assumptions of the conventional empirical tax incidence studies are evaluated by using the SAM data framework and the Harberger general equilibrium model. This model is at first written in a SAM, presenting both the data and the model within the same accounting framework. The model is then solved analytically and empirically using the SAM concept. Then, four types of taxes: (1) selective commodity taxes, (2) selective factor taxes, (3) general factor taxes, and (4) sales taxes are evaluated analytically and empirically using a hypothetical SAM. As demonstrated by the results of this approach, the assumptions of the conventional empirical tax incidence studies are correct only for general factor and general commodity taxes. On the other hand, the assumptions used in these studies for selective commodity and factor taxes are incorrect, because they are based on a partial equilibrium static analysis of the incidence. The approach shows the importance of considering the general equilibrium effects on both the sources and uses side of income. Using a SAM model, the theoretical concepts of the Harberger model are demonstrated explicitly within a data framework. The usefulness of the SAM framework for the tax incidence analysis is similarly demonstrated.

The methodology of combining the SAM framework with the Harberger model is extended and modified in Chapter IV. There, the standard Harberger model is modified in order to develop a methodology that can be applied to actual SAM data. Because actual SAMs include interindustry transactions and preexisting taxes, the model has been extended to include both of these. Two versions of the modified Harberger model written in a SAM framework are presented. The first version of the model uses the CD production function for both value added and intermediate inputs. In the second version, the production process is split into two parts. The net output is represented by the CD production function, while the gross output is specified by using the IO production function.

These two models are evaluated empirically using hypothetical SAM numbers. The CD version is evaluated by two experiments. One of these includes the input-output table, while in the other, interindustry flows are excluded. The results of these two experiments show the effects of interindustry flows on changes in relative prices. These change in the same direction in both experiments. However, the magnitudes of the relative price changes are different in the two cases, thus affecting real incomes of institutions primarily from the uses side of income.

The second version of the model is applied to the actual SAM for Egypt (SAM2) in Chapter V. In order to fit the accounting structure of the model to the original Egypt SAM, several modifications of the SAM are needed. These modifications involve a reorganization and an aggregation of the SAM accounts, resulting in an aggregate version of the SAM2 (Table 5.1a). This SAM and the model are then used to evaluate the distributional implications of commodity subsidies and indirect taxes on the incomes of urban and rural households.

As shown by the results, the domestic commodity subsidies have approximately neutral effects on income distribution for urban and rural households in Egypt. There are also minimal distributional effects when the existing indirect taxes are replaced by a uniform sales tax. On the other hand, the real income of rural households decreases to a larger extent, in relative terms, for rural households compared to urban households when selective taxes are imposed on necessities (agriculture and food processing). In summary, the results of the model provide some insights into the distributional implications that would arise from various changes in domestic commodity taxes in Egypt. However, these results should be interpreted with care, taking into account the restrictive and simplifying assumptions of the model, as well as limitations due to data availability for this particular (preliminary) SAM.

In summary the advantages of the methodology used in this study are the following. First, the approach allows the analysis of the tax incidence in a general equilibrium framework, taking into account changes in relative prices of factors and commodities. In this way, the basic theoretical principle of the tax incidence, i.e., a distinction between the tax incidence on the sources and uses of household incomes, can be analyzed. Second, on the data side, the approach takes into account several features of the SAM framework. The data of any existing SAM can be used for the tax incidence analysis, involving only minor modifications of the SAM accounts. An important feature of the SAM data framework is that when it is disaggregated and when adequate data are available, it can include information on income distribution, consumption patterns, and production structure, all of which are essential for the tax incidence analysis. Another advantage of the use of the SAM concept for the tax incidence analysis is that its accounting structure facilitates compilation, organization, and presentation of the data on taxation. In addition, the SAM concept facilitates an explicit expression of the relationship between the accounting structure of the model and the accounting structure of the data base. This guarantees consistency between the model and the data base and helps in the analytical formulation of the model.

The methodology of this study also has general limitations with respect to some of its basic assumptions which need to be modified. The study deals only with some aspects of the tax incidence, i.e., the methodology of the fiscal incidence in empirical studies, and makes many simplifying assumptions. Some of the basic assumptions, i.e., perfectly competitive economy, fixed supply of factors, full employment, closed economic system, and no accumulation are the same as of the standard Harberger model. Therefore, the limitations of this model with respect to these assumptions are the same as discussed in detail in Chapter II.

However, because in this study the standard Harberger model has been modified in order to include interindustry transactions, preexisting taxes, and accounts for foreign trade and capital, which are a part of the SAM data base, additional assumptions had to be made. These assumptions are that shares of foreign trade and capital account (including balance of payments) are assumed to stay constant during the process of analysis. These assumptions are restrictive, especially with respect to foreign trade.

Because of this assumption, the model practically excludes the distributional implications of import tariffs and export taxes which may be substantial, especially in developing countries. For this reason, the first priority for future research on this subject should be to modify this assumption.

The conventional tax incidence literature, including the Harberger-type general equilibrium models, does not deal explicitly with the problem of foreign trade. For example, even the most recent applications by tax-incidence analysts deal only with the evaluation of domestic taxes (Ahmad and Stern 1982; Ruggles 1980). On the other hand, the literature that deals explicitly with foreign trade and taxation (export taxes and import tariffs) is the "effective protection" literature. Ideally, the best approach to the tax incidence problem would be to synthesize these two different approaches. This has been outside the scope of this study, but the approach developed above contains the necessary groundwork to achieve such a synthesis. In this respect, one of the possible ways for incorporating the foreign trade as part of the above methodology might be to use the approach developed in the "effective protection" literature, and the approach suggested by Pyatt (1982). The implicit model used in some studies on effective protection (Balassa 1971) is an input-output model, where value added is estimated in the absence of foreign taxes, i.e., these studies estimate what the value added would be if foreign taxes were abolished. This approach could alternatively be combined with the treatment of value added taxes in the SAM framework as developed by Pyatt (1982). In his note on tax incidence, Pyatt developed a simple input-output model in a SAM framework where commodity and activity taxes are translated into value added taxes. Following his procedure, it is possible to regard changes in value added, as derived in effective protection literature, as value added taxes, and to estimate tax incidence of value added in a way similar to that set out in Chapter IV above.

Another critical assumption of the methodology, as applied in Chapter V, is the assumption of consumer behavior. In this model, consumption patterns of the household groups are kept constant during the analysis, thus excluding the possibility of consumption response to price changes. This assumption could be relaxed in the future, for example, by using the linear expenditure system (LES) (Stone 1954, Deaton and Muellbauer 1980) in order to improve the formulation at the demand system.

Several additional improvements of the methodology could be achieved from the data side. As discussed in Chapter V, a SAM for any country could be alternatively used for tax incidence analysis using the approach developed in this study. An immediate improvement could be achieved by disaggregating the factor accounts and the institutional (households) accounts of a SAM. For example, labor incomes, disaggregated by the educational level of workers, could be mapped into household types distinguished by the occupational status of the principal earner. Such disaggregations are possible, as demonstrated by Pyatt et al. (1978) for Malaysia. An advantage of further disaggregation of household groups is that better intrasectoral estimates of income distribution can be obtained. Consequently, tax incidence could be estimated for these groups, whose different incomes and consumption patterns would influence the results. Along the same lines, it would also be desirable to identify household capital incomes received from different sectors, thus allowing sector-specific tax incidence from the sources side of (capital) income to be taken into account for different household groups.

Aside from further disaggregtions of factors and households, various other disaggregations are possible within the SAM framework. For example, activities and commodities can be disaggregated to any desirable level, depending on data availability. Another useful classification of the SAM data base might be to use a SAM distinguished by regions. Regional SAMs have been built for Malaysia, Pyatt et al. (1978) and Thailand, Pleskovic (1980). For example, the Thailand SAM distinguishes two urban and two rural household and factor groups, each distinguished by a particular region. By using such a SAM, it would be possible to estimate tax incidence as it affects the population (household) groups in different regions, thus allowing for an explicit regional tax incidence analysis. However, in general, these disaggregations and modifications of both a particular SAM and of the assumptions of the model will depend primarily on policy issues and development objectives.

References

Ahmad, E., and N. Stern (1982). "Indirect Taxes and Prices in India: The Calculation of Effective Tax Rates Using Input-Output Methods." Discussion Paper No. 14, Warwick University, England.

Balassa, B., and associates (1971). The Structure of Protection in Developing Countries. Johns Hopkins University Press.

Deaton, A. S., and J. Muellbauer (1980). "An Almost Ideal Demand System." American Economic Review, Vol. 70.

Devarjan, S., Don Fullerton, and R. A. Musgrave (1980). "Estimating the Distribution of Tax Burdens, A Comparison of Different Approaches." Journal of Public Economics, 13.

Harberger, A. C. (1962). "The Incidence of the Corporation Income Tax." Journal of Political Economy, No. 3, pp. 215-40.

McLure, C. E., Jr. (1974). "On the Theory and Methodology of Estimating Benefit and Expenditure Incidence." Paper presented at the Workshop on Income Distribution and its Role in Development (Houston, Texas, William Marsh Rice University).

Meerman, J. (1978). "Do Empirical Studies of Budget Incidence Make Sense." Public Finance, Vol. 33, No. 3.

Pleskovic, B (1980). "A Disaggregated Social Accounting Matrix for Thailand." The World Bank, Development Research Center, mimeographed.

Pyatt, G., and G. Round (1978). "The Distribution of Income and Social Accounts: A Study of Malaysia in 1970." The World Bank, Development Research Center, mimeographed.

Pyatt, G. (1982). "Some Elements of Tax Incidence." The World Bank, Development Research Department, World Bank, mimeographed.

Ruggles, P. (1980). "The Allocation of Taxes and Government Expenditures among Households in the United States." Unpublished Ph.D. dissertation, Harvard University.

Stone, R. (1954). "Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand." Economic Journal, 64: 511-527.

APPENDIX I

APPENDIX 1

Derivation of the Equations (11) to (16)

To derive X_x , X_y , L_x , L_y , Y_x , Y_y , K_x , and K_y , the following profit functions are used for X and Y :

$$\text{Max:} \quad (P_x - t_x)X - P_xX_x - P_yY_x - wL_x - rK_x$$

with respect to

X_x , Y_x , L_x , and K_x

Substituting for X ,

$$(P_x - t_x)[A(L_x)^{\alpha_1} (K_x)^{\alpha_2} (X_x)^{\alpha_3} (Y_x)^{\alpha_4}] - P_xX_x - P_yY_x - wL_x - rK_x$$

$$\frac{\partial X}{\partial X_x} = \alpha_3 A(L_x)^{\alpha_1} (K_x)^{\alpha_2} (Y_x)^{\alpha_4} (X_x)^{\alpha_3 - 1} = \frac{\alpha_3 X}{X_x}$$

$$(P_x - t_x)\frac{\alpha_3 X}{X_x} - P_x = 0$$

$$X_x = \frac{(P_x - t_x)\alpha_3 X}{P_x}$$

$$(P_x - t_x)\frac{\alpha_4 X}{Y_x} - P_y = 0$$

$$Y_x = \frac{(P_x - t_x)\alpha_4 X}{P_y}$$

$$(P_x - t_x)\frac{\alpha_1 X}{L_x} - w = 0$$

$$L_x = \frac{(P_x - t_x)\alpha_1 X}{w}$$

$$(P_x - t_x)\frac{\alpha_2 X}{K_x} - r = 0$$

$$K_x = \frac{(P_x - t_x)\alpha_2 X}{r}$$

Max: $(P_y - t_y)Y - P_x X_y - P_y Y_y - wL_y - rK_y$

with respect to

$X_y, \ Y_y, \ L_y, \ K_y$

Substituting for Y ,

$$(P_y - t_y)[A(L_y)^{\beta_1} (K_y)^{\beta_2} (X_y)^{\beta_3} (Y_y)^{\beta_4}] - P_x X_y - P_y Y_y - wL_y - rK_y$$

$$\frac{\partial Y}{\partial X_y} = \beta_3 \, B(L_y)^{\beta_1} (K_y)^{\beta_2} (Y_y)^{\beta_4} (X_y)^{\beta_{3-1}} = \frac{\beta_3 Y}{X_y}$$

$$(P_y - t_y) \frac{\beta_3 Y}{X_y} - P_x = 0$$

$$X_y = \frac{(P_y - t_y)\beta_3 Y}{P_x}$$

$$(P_y - t_y) \frac{\beta_4 y}{Y_y} - P_y = 0$$

$$Y_y = \frac{(P_y - t_y)\beta_4 Y}{P_y}$$

$$(P_y - t_y) \frac{\beta_1 Y}{L_y} - w = 0$$

$$L_y = \frac{(P_y - t_y)\beta_1 Y}{w}$$

$$(P_y - t_y) \frac{\beta_2 Y}{K_y} - r = 0$$

$$K_y = \frac{(P_y - t_y)\beta_2 Y}{r}$$

Substituting for L_x , L_y , K_x , K_y , X_x , X_y , Y_x , and Y_y , in equations (3) and (4), (7) and (8), and (9) and (10) obtained above, gives six simultaneous equations:

$$L = L_x + L_y = \frac{(P_x - t_x)\alpha_1 X}{w} + \frac{(P_y - t_y)\beta_1 Y}{w} \quad (11)$$

$$K = K_x + K_y = \frac{(P_x - t_x)\alpha_2 X}{r} + \frac{(P_y - t_y)\beta_2 Y}{r} \quad (12)$$

$$c[a(wL) + b(rK)] + d[(1-a)(wL) + (1-b)(rK)] + e(t_x X + t_y Y)$$

$$= P_x[X - \frac{(P_x - t_x)\alpha_3 X}{P_x} - \frac{(P_x - t_x)\alpha_4 X}{P_x}]$$

$$c[a(wL) + b(rK)] + d[(1-a)(wL) + (1-b)(rK)] + e(t_x X + t_y Y)$$

$$= P_x X - (P_x - t_x)\alpha_3 X - (P_x - t_x)\alpha_4 X \quad (13)$$

$$(1-c)[a(wL) + b(rK)] + (1-d)[(1-a)(wL) + (1-b)(rK)]$$

$$+ (1-e)(t_x X + t_y Y) = P_y[Y - \frac{(P_x - t_x)\alpha_4 x}{P_y} - \frac{(P_y - t_y)\beta_4 Y}{P_y}]$$

$$(1-c)[a(wL) + (b(rK)] + (1-a)(wL) + (1-b)(rK)] + (1-e)(t_x + t_y Y) \quad (14)$$

$$= P_y Y - (P_x - t_x)\alpha_4 X - (P_y - t_y)\beta_4 Y$$

$$(P_x - t_x)X = P_x\left[\frac{(P_x - t_x)\alpha_3 X}{P_x}\right] + P_y\left[\frac{(P_x - t_x)\alpha_4 X}{P_y}\right] \qquad (15)$$

$$+ (P_x - t_x)\alpha_1 X + (P_x - t_x)\alpha_2 X$$

$$(P_y - t_y)Y = P_x\left[\frac{(P_y - t_y)\beta_3 Y}{P_x}\right] + P_y\left[\frac{(P_y - t_y)\beta_4 Y}{P_y}\right] \qquad (16)$$

$$+ (P_x - t_y)\beta_1 Y + (P_y - t_y)\beta_2 Y$$

APPENDIX II

APPENDIX 2

Analytical Structure of the Second Version of the Model

A procedure for derivation of the equations of this model is similar to the procedure used for the CD version of the model presented in section 1 above.

Consumption expenditures are defined in this model by the following equations (notations are taken from the SAM in Table 4.2b.):

$$dY_{uh} + eY_{rh} = P_{10}(X_{10} - X_x - X_y) \quad \text{(from row 10 in Table 4.2b)} \quad (1)$$

$$(1-d)Y_{uh} + (1-e)Y_{rh} = P_{11}(Y_{11} - Y_x - Y_y) \quad \text{(from row 11 in Table 4.2b)} \quad (2)$$

The equations (1) and (2) mean that the final demand is equal to the intermediate demand plus the consumption demand by urban and rural households for good X and Y . Values for X_x , X_y , Y_x , and Y_y indicate intermediate inputs in the same was as in the CD version of the model. Values for Y_{uh} and Y_{rh} define incomes of urban and rural households. Coefficients d and e mean that urban and rural households spend proportions d and e of their total income on good X , and (1-d) and (1-e) on good Y . Values for P_{10} and P_{11} are market prices for commodities X and Y , and X_{10} and Y_{11} are quantities of the two commodities.

Incomes of urban and rural households are derived from their endowments of labor and capital in the same way as described in section 1 of this chapter. Urban households receive a proportion 'a' of total labor income, and a proportion 'b' of total capital income. Rural households receive the remaining shares, i.e., (1-a) and (1-b). In addition to factor incomes, both households receive income from indirect taxes in the form of transfer income. Urban households receive a proportion 'c' and rural households a proportion (1-c) of total indirect tax revenues. Taking into account these definitions, urban and rural household incomes are defined as follows:

$$Y_{uh} = a(wL) + b(rK) + cY_t \qquad \text{(from row 4)}^{1/}$$

$$Y_{rh} = (1-a)(wL) + (1-b)(rK) + (1-c)Y_t \qquad \text{(from row 5)}$$

where: w = wage, r = price of capital, and

$$Y_t = (t_6X_6 + t_7Y_7 + t_8X_8 + t_9Y_9 + t_{10}X_{10} + t_{11}Y_{11}) = \text{tax revenue} \quad \text{(from row 3)}$$

Substituting for Y_{uh} and Y_{rh} in equations (1) and (2) gives demand equations for commodities X_{10} and Y_{11},

$$d[a(wL) + b(rK) + c(t_6X_6 + t_7Y_7 + t_8X_8 + t_9Y_9 + t_{10}X_{10} + t_{11}Y_{11})] +$$

$$+ e[(1-a)(wL) + (1-b)(rK) + (1-c)(t_6X_6 + t_7Y_7 + t_8X_8 + t_9Y_9 + t_{10}X_{10} + t_{11}Y_{11})] =$$

$$= P_{10}(X_{10} - X_x - X_y) \qquad (3)$$

1/ Rows and columns in parentheses refer to the SAM in Table 4.2b.

$$(1-d)[a(wL) + b(rK) + c(t_6X_6 + t_7Y_7 + t_8X_8 + t_9Y_9 + t_{10}X_{10} + t_{11}Y_{11})] +$$
$$+ (1-e)[(1-a)(wL) + (1-b)(rK) +$$
$$+ (1-c)(t_6X_6 + t_7Y_7 + t_8X_8 + t_9Y_9 + t_{10}X_{10} + t_{11}Y_{11})] =$$
$$= P_{11}(Y_{11} - Y_x - Y_y) \qquad (4)$$

On the supply side, prices and quantities for expenditures by activities and commodities are determined by the following equations:

$$P_6X_6 = wL_x + rK_x + t_6X_6 \qquad \text{(from column 6)} \qquad (5)$$

$$P_7Y_7 = wL_y + rK_y + t_7X_7 \qquad \text{(from column 7)} \qquad (6)$$

where P_6 and P_7 represent net output prices, and where production functions for X_6 and X_7 are equal to

$$X_6 = A(L_x)^{\alpha} (K_x)^{(1-\alpha)} \qquad (7)$$

$$\alpha, b > 0$$

$$Y_7 = B(L_y)^{\beta} (K_y)^{(1-\beta)} \qquad (8)$$

Values for P_6 and P_7 can be obtained from the SAM in a generalized form by expressing columns of the SAM as before- and after-tax price equations and rows of the SAM as quantity equations. Price equations for P_6 and P_7 can therefore be obtained in the same way as demonstrated in Chapter 3 above.

Columns 6 and 7 of the net activities account can be written as:

$$a^o_{ij}\left(\frac{P_i}{P_j}\right)^{1-\sigma_j} + a^o_{ij}\left(\frac{P_i}{P_j}\right)^{1-\sigma_j} + \frac{\Theta_j(\tau)}{(1+\Theta_j)(\tau)} = 1$$

where a^o_{ij} is the value of a_{ij} in the base period, derived from T^o (in this case $a^o_{ij} = \alpha$, $(1-\alpha)$, and β, $(1-\beta)$;

σ_j is a parameter (elasticity of substitution), in this case, because of Cobb-Douglas assumptions, $\sigma_j = 1$, and $\lim_{\sigma_j \to 1} P_j$;

$\Theta_j(\tau)$ is a tax rate in period τ .

This model assumes fixed aggregate factor supply, so that

$$L = L_x + L_y \qquad \text{(from row 1)} \qquad (9)$$

$$K = K_x + K_y \qquad \text{(from row 2)} \qquad (10)$$

However, as discussed above, in this model fixed stock of capital is assumed in each sector, which means that the price equations for P_6 and P_7 are derived in the following way:

Activity	X		
Wages	αV_x	=	$\alpha P_6 X_6$
Capital	$(1-\alpha)V_x$	=	$(1-\alpha)P_6X_6$
Tax	ΘV_x	=	t_6X_6
Σ	$(1+\Theta)V_x$	=	$(1+t_6)P_6X_6$

$$\alpha V_x = wL_x$$

$$X = AL_x^{\alpha} K_x^{1-\alpha}$$

$$V_x = X\Pi_x$$

$P_x = (1+\Theta)\Pi_x$, where Π_x is the price of value added net of taxes

$$\alpha X\Pi_x = wL_x$$

$$\Pi_x = \frac{wL_x}{\alpha X} = \frac{wL}{\alpha AL^{\alpha} K^{1-\alpha}} = \frac{wL^{1-\alpha}}{\alpha AK^{1-\alpha}}$$

$$V_x = \frac{w}{\alpha} L_x$$

$$V_x^{\alpha} = \left(\frac{w}{\alpha} \right)^{\alpha} L_x^{\alpha} = \left(\frac{w}{\alpha} \right)^{\alpha} \left(\frac{X}{AK_x^{1-\alpha}} \right) = \left(\frac{w}{\alpha} \right)^{\alpha} \left(\frac{V_x}{\Pi_x AK_x^{1-\alpha}} \right)$$

$$\Pi_x = \left(\frac{w}{\alpha} \right)^{\alpha} \frac{V_x^{1-\alpha}}{AK_x^{1-\alpha}} = (\text{Const.})\ w^{\alpha} V_X^{1-\alpha}$$

$$P_6 = (1 + t_6)\ \Pi_6$$

$$X_6 \Pi_6 = V_x$$

$$\frac{\Pi_6}{\Pi_6^o} = \frac{(\text{Const.})}{(\text{Const.})} \left(\frac{w}{w^o} \right)^{\alpha} \left(\frac{V_x}{V_x^o} \right)^{1-\alpha}$$

$$\Pi_6 = \left(\frac{V_x}{V_x^o} \right)^{1-\alpha}$$

For the rest of the columns (8, 9, 10, and 11), the following equations determine gross output prices and commodity prices:

$$P_8X_8 = t_8X_8 + P_6X_6 + P_{10}X_x + P_{11}Y_x \qquad \text{(from column 8)} \qquad (11)$$

$$P_9Y_9 = t_9X_9 + P_7Y_7 + P_{10}X_y + P_{11}Y_y \qquad \text{(from column 9)} \qquad (12)$$

$$P_{10}X_{10} = t_{10}X_{10} + P_8X_8 + P_9X_9 \qquad \text{(from column 10)} \qquad (13)$$

$$P_{11}X_{11} = t_{11}Y_{11} + P_9Y_9 \qquad \text{(from column 11)} \qquad (14)$$

The above equations can be expressed in a generalized form as

$$a_{ij}^{o} \left(\frac{P_i}{P_j} \right)^{1-\sigma_j} + a_{ij} \left(\frac{P_i}{P_j} \right)^{1-\sigma_j} + \frac{\Theta_j(\tau)}{(1+\Theta_j)(\tau)} = 1$$

The definition of the terms in these equations is the same as for columns 6 and 7. However, for columns 8, 9, 10, and 11, input-output specifications are assumed. Consequently, $\sigma_j = 0$, and the above equation can be expressed as

$$a_{ij}^{o} \left(\frac{P_i}{P_j} \right) + a_{ij}^{o} \left(\frac{P_i}{P_j} \right) + \frac{\Theta_j(\tau)}{(1+\Theta_j)(\tau)} = 1$$

By normalizing the wage rate to one and using the above specifications, the model can be solved in the same way as the CD version of the model. In this model, variables a, b, c, d, e, α_1, α_2, β_1 and β_2 are obtained from the base SAM as in the previous model. While prices for labor, capital, and commodities are endogenously determined by the model, tax rates and the allocation of the tax revenue to households, i.e., c , and $(1-c)$, are exogenous variables. By changing these exogenous variables, the tax and benefit incidence can be determined from the results of the model. This is demonstrated numerically, first for a hypothetical SAM in section 2 of Chapter 4, and then in the next section for a SAM for Egypt, 1979.

APPENDIX III

APPENDIX III

DERIVATION OF TABLE 5.1a AN AGGREGATION OF SAM2 ACCOUNTS

As discussed in the first part of Chapter V, several modifications of the original SAM2 (Table 5.A1) were necessary to derive a version of SAM2 that fits the accounting structure of the model and of the aggregate SAM presented in Table 5.1a. These modifications consist of an aggregation of the capital account, the rest of the world account, and the institutions account into one consolidated account, "consolidated government". Table 5.1a, a base SAM which is used for the model's application, was derived from two major steps. The first step is summarized in Table 5.A2, and the second step is presented in Table 5.A3. Both steps are described in detail below.

The following accounts were aggregated to derive Table 5.A2. Rows and columns 2 and 3 of the original SAM2 (Table 5.A1) were added to derive two factors: one factor for capital and another for labor. Direct taxes, $T_{93.4}$ to $T_{93.8}$, were added to "other government", row 12, and netted out in colum 93. These taxes were incorporated into the government account because the model is designed for the analysis of indirect taxes only. The government trade subsidies were removed from row 9 to row 92; at the same time, row 92 and column 92 (government trade) were eliminated in order to keep all subsidies in one account. The companies account, rows and columns 6, 7, and 8, were aggregated into one row and one column in order to derive one account for companies. The government accounts, rows and columns 10 to 13, were aggregated to derive one row and one column for the government account. The capital account, rows and columns 14 to 17, were aggregated to derive a consolidated capital account. Public and private activities, rows and columns 18 to 36 of SAM2, were aggregated to derive one account for activities comprising nine sectors. Government-traded commodities were aggregated with nongovernment-traded commodities to derive a one-to-one correspondence between activities and domestic commodities. Imported and exported commodities were aggregated into one row and one column for each of the two types of commodities. The rows and columns of the tax account, 91, 92, 94, and 95, were aggregated into one row and one column to derive one account for indirect taxes. Rows and columns 96 and 97 were aggregated into one row and one column to derive one account for the rest of the world.

The result of these aggregations is presented in Table 5.A2. The accounting structure of Table 5.A2 is one step closer to the accounting structure of the model than the original SAM2. However, several additional accounts exist in Table 5.A2 which are not part of the model's accounting structure, i.e., the consolidated capital account, companies, rest of the world, imported and exported commodities, and the government account. These accounts are consolidated into one single account in Table 5.A3 by using the same elimination procedure as above. This means that the rows and columns of these accounts were added together into one row and one column. The resulting SAM (Table 5.A3) consists of: two factors of production, labor and capital; two institutions, urban and rural households; nine activities; nine commodities: an indirect tax account; and a consolidated government account. It should be noted that an additional modification distinguishes the SAM in Table 5.A3 from the SAM in Table 5.A2. This modification involves the distribution of indirect tax revenues to urban and rural households, instead of allocating these revenues to the government account. This was achieved by subtracting the tax revenues from the government row, adding these revenues to households in proportion to their income, and then rebalancing the SAM. The end result is a balanced SAM, as presented in Table 5.A3. This SAM was then used as a basis to derive the SAM presented in Table 5.1a.

The SAM presented in Table 5.1a is essentially the same as the SAM in Table 5.A3. The only difference between the two SAMs is that the former is a reorganized version of the latter. The SAM in Table 5.1a was derived by the simple procedure of dividing the activities account into two accounts, net and gross activity accounts. This procedure requires the formation of block diagonal matrices (make up matrix for activities). The same procedure was used in section two of Chapter IV in order to derive Tables 4.2a and 4.2c. Table 5.1a coincides with the accounting structure of the model, whose applications are developed in Chapter V.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

		1 FCT-PROD LABOUR	2 FCT-PROD CAPITAL	3 FCT-PROD LAND	4 INST-CUA HOUSEHOL URBAN	5 INST-CUA HOUSEHOL RURAL	6 INST-CUA PRIVATE COMPANY	7 INST-CUA PUBCOMPA E.G.P.C.	8 INST-CUA PUBCOMPA OTHERS	9 INST-CUA GOVERNMT TRADE
1	FCT-PROD LABOUR									
2	FCT-PROD CAPITAL									
3	FCT-PROD LAND									
4	INST-CUA HOUSEHOL URBAN	4072230.	1542242.	36500.		21000.	14900.	9600.	162000.	
5	INST-CUA HOUSEHOL RURAL	1506175.	2044360.	270000.	28700.				4600.	
6	INST-CUA PRIVATE COMPANY		412800.		1000.				800.	
7	INST-CUA PUBCOMPA E.G.P.C.		1637400.						99800.	
8	INST-CUA PUBCOMPA OTHERS		2013700.	10200.	29200.		3200.	58000.		
9	INST-CUA GOVERNMT TRADE									
10	INST-CUA GOVTCONV EDUCATIO									
11	INST-CUA GOVTCONV HEALTH									
12	INST-CUA GOVTCONV OTHERS		27000.		1000.	500.		729000.	720700.	-925834.
13	INST-CUA SOCIAL SECURITY				441100.	71800.			181400.	
14	INST-CAA HOUSEHOL				327707.	253316.				
15	INST-CAA PRIVATE COMPANY						282977.			
16	INST-CAA PUBLIC COMPANY				255162.	197245.	87223.	109000.	975100.	
17	INST-CAA GOVERNMT									
18	R.O.W.									
19	ACTIVITY PRIVATE AGRICULT									
20	ACTIVITY PRIVATE FOODPROS									
21	ACTIVITY PRIVATE TEXTILES									
22	ACTIVITY PRIVATE OTRINDUS									
23	ACTIVITY PRIVATE ELECTRIC									
24	ACTIVITY PRIVATE OILPRODU									
25	ACTIVITY PRIVATE CONSTRUC									
26	ACTIVITY PRIVATE TRANSCOM									
27	ACTIVITY PRIVATE SERVICES									
28	ACTIVITY PUBLIC AGRICULT									
29	ACTIVITY PUBLIC FOODPROS									
30	ACTIVITY PUBLIC TEXTILES									
31	ACTIVITY PUBLIC OTRINDUS									
32	ACTIVITY PUBLIC ELECTRIC									
33	ACTIVITY PUBLIC CONSTRUC									
34	ACTIVITY PUBLIC OILPRODU									
35	ACTIVITY PUBLIC TRANSCOM									
36	ACTIVITY PUBLIC SERVICES									
37	COMMODIT GOVTDOME AGRICULT				23805.	29809.				
38	COMMODIT GOVTDOME FOODPROS				77624.	66124.				
39	COMMODIT GOVTDOME TEXTILES									
40	COMMODIT GOVTDOME OTHINDU									
41	COMMODIT GOVTDOME ELECTRIC									
42	COMMODIT GOVTDOME CONSTRUC									
43	COMMODIT GOVTDOME OILPRODU									
44	COMMODIT GOVTDOME TRANSCOM									
45	COMMODIT GOVTDOME SERVICES				47.	18.				
46	COMMODIT GOVTIMPO AGRICULT				14163.	17735.				
47	COMMODIT GOVTIMPO FOODPROS				122258.	104146.				
48	COMMODIT GOVTIMPO TEXTILES									
49	COMMODIT GOVTIMPO OTRINDUS				331.	163.				

Table 5.A1

SAM 2 for Egypt

PRINT OF MATRIX

50	COMMODIT	GOVTIMPO	ELECTRIC									
51	COMMODIT	GOVTIMPO	CONSTRUC									
52	COMMODIT	GOVTIMPO	OILPRODU									
53	COMMODIT	GOVTIMPO	TRANSCOM									
54	COMMODIT	GOVTIMPO	SERVICES									
55	COMMODIT	GOVTEXPO	AGRICULT									
56	COMMODIT	GOVTEXPO	FOODPROS									
57	COMMODIT	GOVTEXPO	TEXTILES									
58	COMMODIT	GOVTEXPO	OTHINDU									
59	COMMODIT	GOVTEXPO	ELECTRIC									
60	COMMODIT	GOVTEXPO	CONSTRUC									
61	COMMODIT	GOVTEXPO	OILPRODU									
62	COMMODIT	GOVTEXPO	TRANSCOM									
63	COMMODIT	GOVTEXPO	SERVICES									
64	COMMODIT	PRIVDOME	AGRICULT				692125.	866712.				
65	COMMODIT	PRIVDOME	FOODPROS				1012972.	857523.				
66	COMMODIT	PRIVDOME	TEXTILES				501445.	373679.				
67	COMMODIT	PRIVDOME	OTRINDUS				493907.	242168.				
68	COMMODIT	PRIVDOME	ELECTRIC				23883.	14391.				
69	COMMODIT	PRIVDOME	CONSTRUC									
70	COMMODIT	PRIVDOME	OILPRODU				137424.	82806.				
71	COMMODIT	PRIVDOME	TRANSCOM				153955.	29107.				
72	COMMODIT	PRIVDOME	SERVICES				783441.	301657.				
73	COMMODIT	PRIVIMPO	AGRICULT				37655.	47155.				
74	COMMODIT	PRIVIMPO	FOODPROS				24693.	26410.				
75	COMMODIT	PRIVIMPO	TEXTILES				19822.	14771.				
76	COMMODIT	PRIVIMPO	OTRINDUS				300572.	147376.				
77	COMMODIT	PRIVIMPO	ELECTRIC									
78	COMMODIT	PRIVIMPO	CONSTRUC									
79	COMMODIT	PRIVIMPO	OILPRODU				20769.	12514.				
80	COMMODIT	PRIVIMPO	TRANSCOM				14236.	2692.				
81	COMMODIT	PRIVIMPO	SERVICES				382582.	147312.				
82	COMMODIT	PRIVEXPO	AGRICULT									
83	COMMODIT	PRIVEXPO	FOODPROS									
84	COMMODIT	PRIVEXPO	TEXTILES									
85	COMMODIT	PRIVEXPO	OTRINDUS									
86	COMMODIT	PRIVEXPO	ELECTRIC									
87	COMMODIT	PRIVEXPO	CONSTRUC									
88	COMMODIT	PRIVEXPO	OILPRODU									
89	COMMODIT	PRIVEXPO	TRANSCOM									
90	COMMODIT	PRIVEXPO	SERVICES									
91	TAXES	INDIRECT										
92	TAXES	SUBSIDY					191394.	60906.	26300.	501600.	171500.	
93	TAXES	DIRECT										
94	TAXES	TARIFF										
95	TAXES	EXPORT										
96	R.O.W.	FOREIGN	XCHANGE	86500.			141400.	61600.		407500.	291200.	
97	R.O.W.	OWN	XCHANGE									
98	TOTAL			15664905.	7477502.	316703.	6254372.	4050035.	414600.	1814700.	2607100.	-925834.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

10	11	12	13	14	15	16	17	18	19	20	21	22
INST-CUA GOVTCONV EDUCATIO	INST-CUA GOVTCONV HEALTH	INST-CUA GOVTCONV OTHERS	INST-CUA SOCIAL SECURITY	INST-CAA HOUSEHOL	INST-CAA PRIVATE COMPANY	INST-CAA PUBLIC COMPANY	INST-CAA GOVERNMT	R.O.W.	ACTIVITY PRIVATE AGRICULT	ACTIVITY PRIVATE FOODPROS	ACTIVITY PRIVATE TEXTILES	ACTIVITY PRIVATE OTRINDUS
364900.	96600.	770900.	10400.						46800.	77611.	180810.	262117.
									23100.	104071.	70337.	350340.
									10200.			
		39800.	229000.									
		40500.	119900.									
		77500.										
		484500.	2500.									
		430560.										
		156690.										
		27000.										
		219300.										
			121913.									
		145542.	422887.									
79.	369.	8151.					12165.			238.		
37.	174.	1941.										
		457.					-5110.			79937.		
		954.					-491.			8145.		
									3094.			

Table 5.A1

SAM 2 for Egypt

PRINT OF MATRIX

1236.	5785.	64180.				101557.	86600.		36275.	405331.	126017.	39267.
933.	4365.	48450.				82900.			444.	74134.	3984.	71368.
765.	3580.	30755.				109800.			169.	216.	292744.	5707.
2064.	9662.	107274.		50408.	24550.	271222.	24248.		2374.	4364.	15087.	426903.
415.	1940.	21545.							12.	474.	2689.	20882.
1301.	6089.	67610.		237591.	115719.	852898.	306800.		21.	354.	1634.	5985.
591.	2769.	30740.				61150.			933.	676.	6240.	62487.
506.	2371.	24323.		14133.	6883.	62186.	6998.		145.	1746.	8439.	13298.
13070.	5440.	128590.		46485.	22635.	204521.	22424.		1818.	22037.	48267.	111290.
1257.	453.	3851.		2880.	1403.	17783.	1385.		635.	109403.	42473.	317.
357.	129.	269.				491.				25211.		47227.
3744.	1350.	15824.							448.	201.	3249.	4348.
10620.	3829.	34380.		225983.	110062.	1023860.	108704.		3465.	2924.	27231.	354779.
8850.	3190.	30319.							166.	656.	1104.	7789.
556.	200.	1904.		3543.	1729.	16075.	1706.					
23279.	8395.	74733.										
									1149.	10146.	7143.	15370.
		155500.										
434560.	150690.	3253042.	906600.	581023.	282977.	2807443.	565429.	0.	131248.	1017875.	837448.	1799474.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

23	24	25	26	27	28	29	30	31	32	33	34	35
ACTIVITY PRIVATE ELECTRIC	ACTIVITY PRIVATE OILPRODU	ACTIVITY PRIVATE CONSTRUC	ACTIVITY PRIVATE TRANSCOM	ACTIVITY PRIVATE SERVICES	ACTIVITY PUBLIC AGRICULT	ACTIVITY PUBLIC FOODPROS	ACTIVITY PUBLIC TEXTILES	ACTIVITY PUBLIC OTHINDUS	ACTIVITY PUBLIC ELECTRIC	ACTIVITY PUBLIC CONSTRUC	ACTIVITY PUBLIC OILPRODU	ACTIVITY PUBLIC TRANSCOM
35700.	212700.	43900.	191500.	373600.	593003.	52419.	53190.	67131.		36100.		28200.
66582.	417539.	1863567.	566467.	438920.	1709500.	107665.	194833.	107125.		54661.		112836.
					306500.							
						3832.						
					18303.	68181.						
						14757.						
					48688.							

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

			22999.	173025.	720907.	702818.	30718.	19075.				5396.
			2070.	149277.	24786.	98078.	971.	35212.				485.
	264.	1296.	608.	23886.	1307.	433.	282442.	1208.		69.		142.
870.	156557.	136764.	32728.	187666.	34678.	1065.	54826.	84451.		40872.		7678.
	53.	5667.	5754.	17491.	91.	239.	1312.	5130.		14.		1350.
571.	127.	14313.	20389.	26503.	682.	141.	1370.	1511.		33.		4783.
11265.	4624.	167409.	35603.	90290.	9607.	393.	2230.	9050.		1207.		8352.
2245.	1983.	4864.	20196.	163092.	1850.	557.	4659.	4725.		518.		1712.
5191.	132252.	141208.	80323.	362764.	28017.	17512.	85089.	33962.		34527.		21869.
				33.	7361.	93512.	31665.	80.				
			1613.	7752.		6520.		17024.				839.
				19958.	7047.	188.	2423.	1096.				
6296.	578858.	97020.	16849.	83825.	9158.	36740.	20302.	89414.		11815.		8761.
8004.	9042.	54043.	3435.	2625.	2615.	615.	823.	1963.		185.		1787.
			23158.									12042.
			707.	59044.								367.
1214.	13397.	25535.	9062.	28378.	31939.	10526.	6728.	4109.		1591.		1920.
137938.	1527396.	2554586.	1033467.	2208129.	5556039.	1216191.	773581.	482266.	0.	181592.	0.	218519.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

36	37	38	39	40	41	42	43	44	45	46	47	48
ACTIVITY PUBLIC SERVICES	COMMODIT GOVTDOME AGRICULT	COMMODIT GOVTDOME FOODPROS	COMMODIT GOVTDOME TEXTILES	COMMODIT GOVTDOME OTHINDU	COMMODIT GOVTDOME ELECTRIC	COMMODIT GOVTDOME CONSTRUC	COMMODIT GOVTDOME OILPRODU	COMMODIT GOVTDOME TRANSCOM	COMMODIT GOVTDOME SERVICES	COMMODIT GOVTIMPO AGRICULT	COMMODIT GOVTIMPO FOODPROS	COMMODIT GOVTIMPO TEXTILES
617A24.												
1448359.												
	-8236.	-4319.							65.	-504166.	-389643.	
		24472.										
		4372.										
	57879.											
		84531.										
	24805.	24844.										

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

154674.												
129714.												
21373.												
167833.												
15741.												
27579.												
80047.												
157169.												
313870.												
29.												
6930.												
17842.												
70935.												
2347.												
52782.												
27393.												
										72364.	58911.	
										625468.	580501.	
3316441.	74448.	145900.	0.	0.	0.	0.	0.	0.	65.	193666.	249769.	0.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

49	50	51	52	53	54	55	56	57	58	59	60	61
COMMODIT GOVTIMPO OTRINDUS	COMMODIT GOVTIMPO ELECTRIC	COMMODIT GOVTIMPO CONSTRUC	COMMODIT GOVTIMPO OILPRODU	COMMODIT GOVTIMPO TRANSCOM	COMMODIT GOVTIMPO SERVICES	COMMODIT GOVTEXPO AGRICULT	COMMODIT GOVTEXPO FOODPROS	COMMODIT GOVTEXPO TEXTILES	COMMODIT GOVTEXPO OTHINDU	COMMODIT GOVTEXPO ELECTRIC	COMMODIT GOVTEXPO CONSTRUC	COMMODIT GOVTEXPO OILPRODU
-20535.												
						200000.						

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

572.												
						86600.						
72239.												
52276.	0.	0.	0.	0.	0.	286600.	0.	0.	0.	0.	0.	0.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

62 COMMODIT GOVTEXPO TRANSCOM	63 COMMODIT GOVTEXPO SERVICES	64 COMMODIT PRIVDOME AGRICULT	65 COMMODIT PRIVDOME FOODPROS	66 COMMODIT PRIVDOME TEXTILES	67 COMMODIT PRIVDOME OTRINDUS	68 COMMODIT PRIVDOME ELECTRIC	69 COMMODIT PRIVDOME CONSTRUC	70 COMMODIT PRIVDOME OILPRODU	71 COMMODIT PRIVDOME TRANSCOM	72 COMMODIT PRIVDOME SERVICES	73 COMMODIT PRIVIMPO AGRICULT	74 COMMODIT PRIVIMPO FOODPROS
		94548.										
			953483.									
				644748.								
					1730756.							
						137938.						
							1527396.					
								545084.				
									493861.			
		28365.	165288.	116055.	311536.			54509.		1321620.		
		3254160.										
			1121286.									
				752281.								
					437684.							
							181592.					
									140319.			
		944301.	243014.	188070.	109421.					1607270.		

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

		25323.	114601.	10334.	55670.	1135.	20053.	246300.	82980.	80604.		
				-50600.	-59848.		-35041.	-40000.	-27500.	-41235.		
											260553.	66864.
											127915.	4474.
											10862.	94127.
0.	0.	4340697.	2597666.	1660888.	2583219.	139073.	1694000.	805893.	689660.	2968259.	399330.	165465.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

75	76	77	78	79	80	81	82	83	84	85	86	87
COMMODIT PRIVIMPO TEXTILES	COMMODIT PRIVIMPO OTHINDUS	COMMODIT PRIVIMPO ELECTRIC	COMMODIT PRIVIMPO CONSTRUC	COMMODIT PRIVIMPO OILPRODU	COMMODIT PRIVIMPO TRANSCOM	COMMODIT PRIVIMPO SERVICES	COMMODIT PRIVEXPO AGRICULT	COMMODIT PRIVEXPO FOODPROS	COMMODIT PRIVEXPO TEXTILES	COMMODIT PRIVEXPO OTHINDUS	COMMODIT PRIVEXPO ELECTRIC	COMMODIT PRIVEXPO CONSTRUC
							36700.					
								39920.				
									192700.			
										68718.		
							43000.					
								7380.				
									21300.			
										44582.		

Table 5.A1

SAM 2 for Egypt

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37046.	433816.			29274.								
55007.	2197092.			149364.	77841.	754201.						
17258.	760850.			203.								
109311.	3391758.	0.	0.	174841.	77841.	754201.	79700.	47300.	214000.	113300.	0.	0.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

88	89	90	91	92	93	94	95	96	97	98
COMMODIT PRIVEXPO OILPRODU	COMMODIT PRIVEXPO TRANSCOM	COMMODIT PRIVEXPO SERVICES	TAXES INDIRECT	TAXES SUBSIDY	TAXES DIRECT	TAXES TARIFFS	TAXES EXPORT	R.O.W. FOREIGN XCHANGE	R.O.W. OWN XCHANGE	TOTAL
								666200.	883300.	5664905.
								41600.		7677502.
										316700.
								127100.		6254372.
								31800.		4050035.
										414600.
										1814700.
								3800.		2607100.
										-925834.
										434560.
										156690.
			824600.	-254224.	951700.	959400.	86600.	104600.		3252042.
										906600.
										581023.
										282977.
								1061800.		2807443.
										565429.
										131248.
										1017875.
										837448.
										1799474.
										137938.
										1527396.
2009502.										2554586.
	539600.									1033461.
		204384.								2208129.
										3556039.
										1218191.
										773581.
										482266.
										181592.
	78200.									218519.
		166716.								3316441.
										74448.
										145900.
										65.
										193666.
										249769.
										52276.

Table 5.A1

PRINT OF MATRIX

SAM 2 for Egypt

								286600.		286600.
										4344697.
										2597666.
										1660888.
										2583219.
										139073.
										1694000.
										805893.
										689560.
										2968259.
										399330.
										165465.
										109311.
										3391758.
										174841.
										77841.
										754201.
								79700.		79700.
								47300.		47300.
								214000.		214000.
								113300.		113300.
								2009502.		2009502.
								617800.		617800.
								375100.		375100.
										824600.
										-254224.
										951700.
										959400.
										86600.
										5780202.
										883300.
2009502.	617800.	375100.	824600.	-254224.	951700.	959400.	86600.	5780202.	883300.	

Source: "SAM2 and Documentation," Working Paper No. 7, DRTPC, Cairo University.

Aggregated SAM 2 (first step)

	FACTOR-LAB	FACTOR-CAP	INST-URBAN	INST-RURAL	INST-CO	INST-GOVT	CONS-CAP	A-AGRIC	A-FDPROC
FACTOR-LAB						1742800		639803	130630
FACTOR-CAP								2049300	211736
INST-URBAN	4072230	1578742		21000	186500	268800			
INST-RURAL	1506175	2314360	28700		4600	160400			
INST-CO		4074100	30200		161800	566500			
INST-GOVT		27000	633494	133206	2330500	830550			
CONS-CAP			582869	450561	1454300	687392			
A-AGRIC									
A-FDPROC									
A-TEXTL									
A-OT-IND									
A-ELEC									
A-CONSTRN									
A-COILPRD									
A-TRANS									
A-SERV									
C-AGRIC			715930	896521		75800	200322	757182	1202219
C-FDPROC			1090596	923647		55900	82900	25230	172212
C-TEXTL			501445	373679		44100	109800	1476	649
C-OT-IND			493907	242168		119000	373428	37052	5429
C-ELEC			23883	14391		23900		103	713
C-CONSTRN						75000	1513004	703	495
C-COILPRD			137424	82806		34100	61150	10540	1069
C-TRANS			153955	29107		29200	90200	1995	2303
C-SERV			783488	301675		147100	296065	29835	39549
C-IMPORTS			937081	520274		232900	1510003	100980	448990
C-EXPORTS									
INDR-TAX								33088	20672
R-ROW	86500		141400	61000	698700	152500			
TOTAL	5664905	7994202	6254372	4050035	4836400	4749892	4236872	3687287	2236366

	A-TEXTL	A-OT-IND	A-ELEC	A-CONSTRN	A-COILPRD	A-TRANS	A-SERV	C-AGRIC	C-FDPROC
FACTOR-LAB	234000	329248	35700	248800	43900	219700	991424		
FACTOR-CAP	265170	457465	66582	472200	1863567	679303	1887279		
INST-URBAN									
INST-RURAL									
INST-CO									
INST-GOVT									
CONS-CAP									
A-AGRIC								3407587	
A-FDPROC									2180766
A-TEXTL									
A-OT-IND									
A-ELEC									
A-CONSTRN									
A-COILPRD									
A-TRANS									
A-SERV								997471	443518
C-AGRIC	156735	59342				28395	327699		
C-FDPROC	4955	106580				2555	278991		
C-TEXTL	575186	6915		333	1276	750	45259		
C-OT-IND	69913	511354	870	197429	136744	40606	355499		
C-ELEC	4001	26012		67	5647	7104	33232		
C-CONSTRN	3004	7496	571	160	14313	25172	54082		
C-COILPRD	8470	71537	11265	5831	167409	43955	170337		
C-TRANS	13098	18023	2245	2501	4844	21908	320261		
C-SERV	133356	145252	5191	166779	141208	102192	676634		
C-IMPORTS	129270	524037	14300	599900	153063	69558	328102		
C-EXPORTS									
INDR-TAX	13871	14479	1214	14988	22535	10982	55771	14087	111282
R-ROW									
TOTAL	1611029	2281740	137938	1708988	2554516	1251980	5524570	4419145	2783566

Table 5.A2 (continued)

•	C-TEXTL	C-OT-IND	C-ELEC	C-CONSTRN	C-COILPRD	C-TRANS	C-SERV	C-IMPORTS	C-EXPORTS
FACTOR-LAB									
FACTOR-CAP									
INST-URBAN									
INST-RURAL									
INST-CO									
INST-GOVT									
CONS-CAP									
A-AGRIC									279700
A-FDPROC									67300
A-TEXTL	1397029								214000
A-OT-IND		2168440							113300
A-ELEC			137938						
A-CONSTRN				1708988					
A-COILPRD					545084				2009502
A-TRANS						634180			617800
A-SERV	304125	420957			54509		2028890		375100
C-AGRIC									
C-FDPROC									
C-TEXTL									
C-OT-IND									
C-ELEC									
C-CONSTRN									
C-COILPRD									
C-TRANS									
C-SERV									
C-IMPORTS									
C-EXPORTS									
INDR-TAX	-40266	-6178	1135	-14988	206300	55480	39434	45056	86600
R-O-W								5523402	
TOTAL	1660888	2583219	139073	1694000	805893	689660	2968324	5568458	3743302

•	INDR-TAX	R-O-W	TOTAL
FACTOR-LAB		1549500	5664905
FACTOR-CAP		41600	7994202
INST-URBAN		127100	6254372
INST-RURAL		31800	4050035
INST-CO		3800	4836490
INST-GOVT	690542	104600	4749892
CONS-CAP		1061600	4236872
A-AGRIC			3647287
A-FDPROC			2236066
A-TEXTL			1611029
A-OT-IND			2281740
A-ELEC			137938
A-CONSTRN			1708988
A-COILPRD			2554586
A-TRANS			1251980
A-SERV			5524570
C-AGRIC			4419145
C-FDPROC			2743566
C-TEXTL			1660888
C-OT-IND			2583219
C-ELEC			139073
C-CONSTRN			1694000
C-COILPRD			805893
C-TRANS			689660
C-SERV			2968324
C-IMPORTS			5568458
C-EXPORTS		3743302	3743302
INDR-TAX			690542
R-O-W			6663502
TOTAL	690542	6663502	

Table 5.A3

Aggregated SAM 2 (second step)

	FACTOR-LAB	FACTOR-CAP	INST-URBAN	INST-RURAL	A-AGRIC	A-FDPROC	A-TEXTL	A-OT-IND	A-ELEC	A-CONSTRN	A-CHILPRD
FACTOR-LAB					639003	130030	234000	329240	35700	248800	43900
FACTOR-CAP					2049300	211736	265170	457405	60502	472200	1003507
INST-URBAN	4072230	1574742		21040							
INST-RURAL	1586175	2314360	28700								
A-AGRIC											
A-FDPROC											
A-TEXTL											
A-OT-IND											
A-ELEC											
A-CONSTRN											
A-CHILPRD											
A-TRANS											
A-SERV											
C-AGRIC			715930	996521	757182	1202219	156735	58342			
C-FDPROC			1030590	923667	25238	172212	4955	184500			
C-TEXTL			501465	373679	1476	649	575186	6915		333	1296
C-OT-IND			601907	242140	37052	5429	69913	911350	870	197429	134768
C-ELEC			23883	14301	103	713	4001	26012		67	5447
C-CONSTRN					703	495	3004	7496	571	140	10313
C-CHILPRD			137470	82406	10500	1069	8470	71537	11265	5431	167490
C-TRANS			153955	29187	1095	2303	13098	10023	2245	2501	4846
C-SERV			783600	301675	29035	39549	133356	105252	5191	144779	141298
INDR-TAX					33088	20672	13871	19479	1210	14088	22535
CONS-GOVT	86540	6101108	2744130	1430493	108940	440990	129270	524037	14380	509960	153963
TOTAL	5000945	7994282	6673462	4321487	3607287	2236066	1011620	2281740	137930	1780988	2550590

	A-TRANS	A-SERV	C-AGRIC	C-FDPROC	C-TEXTL	C-OT-IND	C-ELEC	C-CONSTRN	C-CHILPRD	C-TRANS	C-SERV	INDR-TAX	CONS-GOVT	TOTAL
FACTOR-LAB	210780	991424											2792300	5000945
FACTOR-CAP	670303	1887479											41600	7994282
INST-URBAN												419090	582400	6673462
INST-RURAL												271452	200800	4321487
A-AGRIC			3607587										279700	3607287
A-FDPROC				2180766									47300	2236066
A-TEXTL					1397020								214000	1011620
A-OT-IND						2180440							113300	2281740
A-ELEC							137936							137936
A-CONSTRN								1780980						1780988
A-CHILPRD									545090				2009502	2550546
A-TRANS										634100			617800	1251080
A-SERV			997471	403510	384125	820957			94500		2928000		575100	5524570
C-AGRIC	28305	327409											276172	4019145
C-FDPROC	2555	278301											134808	2743566
C-TEXTL	750	45350											153900	1000888
C-OT-IND	80880	355309											892428	2583219
C-ELEC	7180	33232											23950	139073
C-CONSTRN	25172	50382											1598004	1694000
C-CHILPRD	63955	170337											95250	805493
C-TRANS	21988	320361											119400	689660
C-SERV	182182	676438											843165	2940320
INDR-TAX	18082	55771	18087	111208	-40706	-60170	1135	-14988	206300	55080	39434		131650	690502
CONS-GOVT	60558	320182											19861999	29794626
TOTAL	1251980	5524570	4019145	2743566	1000888	2583219	139073	1694000	805493	689660	2940324	690502	29794620	

APPENDIX IV

Table 5.B1

Increase in Indirect Taxes by Removing Existing Commodity Subsidies

	ACCOUNT		PRICE	VALUE	QUANTITY
1	FACTORS	LABOR		5699216.4	
2	FACTORS	CAPITAL		8022712.5	
3	INST.	URBAN		6876088.6	
4	INST.	RURAL		4448788.5	
5	NET-AC	AGRICULT	1.01748	2854287.0	2805217.2
6	NET-AC	FOODPROS	1.01427	809055.1	797668.9
7	NET-AC	TEXTILES	.98324	608762.3	619137.6
8	NET-AC	OTH-INDU	.99210	1292993.5	1303289.3
9	NET-AC	ELECTRIC	1.00617	117689.5	116967.4
10	NET-AC	CONSTRUC	.98893	1298646.5	1313178.1
11	NET-AC	OILPROD.	1.00157	2063838.3	2060606.1
12	NET-AC	TRANSPO.	.99682	964485.9	967563.6
13	NET-AC	SERVICES	.99919	3202828.9	3205435.1
14	GROSS-AC	AGRICULT	1.01806	3774248.9	3707287.9
15	GROSS-AC	FOODPROS	1.01715	2294308.1	2255613.9
16	GROSS-AC	TEXTILES	1.01629	1613036.3	1587181.9
17	GROSS-AC	OTH-INDU	1.00820	2287353.5	2268752.4
18	GROSS-AC	ELECTRIC	1.01211	140069.2	138394.0
19	GROSS-AC	CONSTRUC	.99792	1695457.1	1698997.4
20	GROSS-AC	OILPROD.	1.00858	2576594.5	2554680.3
21	GROSS-AC	TRANSPO.	1.00448	1256291.0	1250690.7
22	GROSS-AC	SERVICES	1.01187	5587735.5	5522210.0
23	COMMODIT	AGRICULT	1.01855	4529651.1	4447140.6
24	COMMODIT	FOODPROS	1.01749	2816779.0	2768352.5
25	COMMODIT	TEXTILES	1.04644	1709394.2	1633538.6
26	COMMODIT	OTH-INDU	1.03217	2649778.0	2567199.8
27	COMMODIT	ELECTRIC	1.01211	141221.8	139532.7
28	COMMODIT	CONSTRUC	1.01856	1715351.3	1684097.0
29	COMMODIT	OILPROD.	1.05895	841977.4	795104.5
30	COMMODIT	TRANSPO.	1.04453	713450.4	683034.1
31	COMMODIT	SERVICES	1.02556	3039514.2	2963769.2
32	INDR.	TAXES		961684.5	
33	CONS.	GOVERNMT		30164582.9	
34	CAPITAL	AGRICULT	1.02300	2096428.2	2049300.0
35	CAPITAL	FOODPROS	1.02314	216635.8	211736.0
36	CAPITAL	TEXTILES	.96869	256867.0	265170.0
37	CAPITAL	OTH-INDU	.98645	451267.8	457465.0
38	CAPITAL	ELECTRIC	1.00950	67214.5	66582.0
39	CAPITAL	CONSTRUC	.98315	464244.8	472200.0
40	CAPITAL	OILPROD.	1.00161	1866559.1	1863567.0
41	CAPITAL	TRANSPO.	.99579	676445.0	679303.0
42	CAPITAL	SERVICES	.99870	1884939.1	1887279.0
43	CONS.	LABOR	1.00000	2872605.0	2872605.0

Table 5.B1 (continued)

PRINT OF MATRIX

			1	2	3	4	5	6	7	8	9
			FACTORS LABOR	FACTORS CAPITAL	INST. URBAN	INST. RURAL	NET-AC AGRICULT	NET-AC FOODPROS	NET-AC TEXTILES	NET-AC OTH-INDU	NET-AC ELECTRIC
1	FACTORS	LABOR									
2	FACTORS	CAPITAL									
3	INST.	URBAN	4096895.	1584372.		21619.					
4	INST.	RURAL	1515298.	2322614.	29571.						
5	NET-AC	AGRICULT									
6	NET-AC	FOODPROS									
7	NET-AC	TEXTILES									
8	NET-AC	OTH-INDU									
9	NET-AC	ELECTRIC									
10	NET-AC	CONSTRUC									
11	NET-AC	OILPROD.									
12	NET-AC	TRANSPO.									
13	NET-AC	SERVICES									
14	GROSS-AC	AGRICULT									
15	GROSS-AC	FOODPROS									
16	GROSS-AC	TEXTILES									
17	GROSS-AC	OTH-INDU									
18	GROSS-AC	ELECTRIC									
19	GROSS-AC	CONSTRUC									
20	GROSS-AC	OILPROD.									
21	GROSS-AC	TRANSPO.									
22	GROSS-AC	SERVICES									
23	COMMODIT	AGRICULT			737668.	922931.					
24	COMMODIT	FOODPROS			1123710.	950856.					
25	COMMODIT	TEXTILES			516670.	384687.					
26	COMMODIT	OTH-INDU			508904.	249302.					
27	COMMODIT	ELECTRIC			24608.	14815.					
28	COMMODIT	CONSTRUC									
29	COMMODIT	OILPROD.			141597.	85245.					
30	COMMODIT	TRANSPO.			158630.	29964.					
31	COMMODIT	SERVICES			807277.	310562.					
32	INDR.	TAXES					0.	0.	0.	0.	0.
33	CONS.	GOVERNMT	87024.	4115726.	2827454.	1478809.	103302.	459380.	125222.	516938.	14436.
34	CAPITAL	AGRICULT					2096428.				
35	CAPITAL	FOODPROS						216636.			
36	CAPITAL	TEXTILES							256867.		
37	CAPITAL	OTH-INDU								451268.	
38	CAPITAL	ELECTRIC									67215.
39	CAPITAL	CONSTRUC									
40	CAPITAL	OILPROD.									
41	CAPITAL	TRANSPO.									
42	CAPITAL	SERVICES									
43	CONS.	LABOR					654517.	133039.	226673.	324788.	36039.
44	TOTAL		5699216.	8022712.	6876089.	4448788.	2854247.	809055.	608762.	1292994.	117669.

Table 5.B1 (continued)

PRINT OF MATRIX

10 NET-AC CONSTRUC	11 NET-AC OILPROD.	12 NET-AC TRANSPO.	13 NET-AC SERVICES	14 GROSS-AC AGRICULT	15 GROSS-AC FOODPROC	16 GROSS-AC TEXTILES	17 GROSS-AC OTH-INDU	18 GROSS-AC ELECTRIC	19 GROSS-AC CONSTRUC	20 GROSS-AC OILPROD.
				2854247.						
					809055.					
						608762.				
							1292994.			
								117689.		
									1298647.	
										2063838.
				775414.	1235229.	157280.	59086.			
				25811.	176756.	4967.	107827.			
				1553.	685.	592986.	7195.		346.	1356.
				38451.	5653.	71094.	524798.	901.	202588.	141168.
				105.	728.	3989.	26177.		67.	5736.
				720.	509.	3014.	7592.	584.	162.	14579.
				11222.	1142.	8837.	75323.	11969.	6139.	177285.
				2095.	2427.	13479.	18718.	2353.	2597.	5081.
				30763.	40914.	134740.	148116.	5341.	170041.	144822.
0.	0.	0.	0.	33868.	21210.	13888.	19527.	1233.	14869.	22729.
589793.	153309.	69265.	327695.							
464245.										
	1866559.									
		676445.								
			1884939.							
244608.	43970.	218776.	990195.							
1298647.	2063838.	964486.	3202829.	3774249.	2294308.	1613036.	2287353.	140069.	1695457.	2576594.

Table 5.B1 (continued)

PRINT OF MATRIX

21	22	23	24	25	26	27	28	29	30	31
GROSS-AC TRANSPO.	GROSS-AC SERVICES	COMMODIT AGRICULT	COMMODIT FOODPROS	COMMODIT TEXTILES	COMMODIT OTH-INDU	COMMODIT ELECTRIC	COMMODIT CONSTRUC	COMMODIT OILPROD.	COMMODIT TRANSPO.	COMMODIT SERVICES
964486.										
	3202829.									
		3491112.								
			2246427.							
				1396407.						
					2172661.					
						180069.				
							1695457.			
								542400.		
									630900.	
		1015701.	452835.	302666.	423311.			54417.		2959096.
28892.	333636.									
2597.	283750.									
784.	47340.									
41663.	366777.									
7183.	33620.									
25613.	55062.									
46498.	180302.									
22860.	334380.									
104696.	693630.									
11020.	56408.	22838.	117517.	10321.	53806.	1153.	19894.	245160.	82551.	80418.
1256291.	5587735.	4529651.	2816779.	1709394.	2649778.	181222.	1715351.	841977.	713450.	3039514.

Table 5.B1 (continued)

PRINT OF MATRIX

32	33	34	35	36	37	38	39	40	41	42
INDR. TAXES	CONS. GOVERNMT	CAPITAL AGRICULT	CAPITAL FOODPROS	CAPITAL TEXTILES	CAPITAL OTH-INDU	CAPITAL ELECTRIC	CAPITAL CONSTRUC	CAPITAL OILPROD.	CAPITAL TRANSPO.	CAPITAL SERVICES
	2026611.									
	42111.	2096428.	216636.	256867.	451268.	67215.	464245.	1866559.	676445.	1884939.
583646.	589556.									
378038.	203267.									
	283137.									
	47881.									
	216630.									
	114692.									
	2034194.									
	625391.									
	379709.									
	279515.									
	149506.									
	155791.									
	498479.									
	24194.									
	1007517.									
	96420.									
	120867.									
	448611.									
	133274.									
	19296229.									
961684.	30164583.	2096428.	216636.	256867.	451268.	67215.	464245.	1866559.	676445.	1884939.

Table 5.B1 (continued)

PRINT OF MATRIX

43	44
CONS. LAPOR	TOTAL
2872605.	5699216.
	6022712.
	6576089.
	4448788.
	2654247.
	609055.
	608762.
	1292994.
	117689.
	1298647.
	2053838.
	964486.
	3202829.
	3774249.
	2293308.
	1613036.
	2287353.
	140069.
	1695457.
	2576594.
	1256291.
	5587735.
	4529651.
	2816779.
	1709394.
	2649778.
	141222.
	1715351.
	641977.
	713450.
	3039514.
	961684.
	30164583.
	2096428.
	216636.
	256807.
	451268.
	67215.
	464245.
	1666559.
	676445.
	1684939.
	2672605.
2872605.	

Table 5.B2

Decrease in Indirect Taxes by Replacing Existing Indirect Taxes with Subsidies

	ACCOUNT		PRICE	VALUE	QUANTITY
1	FACTORS	LABOR		5617618.4	
2	FACTORS	CAPITAL		8080466.5	
3	INST.	URBAN		6263597.8	
4	INST.	RURAL		4081375.9	
5	NET-AC	AGRICULT	.97680	2705463.0	2769713.0
6	NET-AC	FOODPROS	1.00958	803013.6	795397.4
7	NET-AC	TEXTILES	.98725	613446.2	621366.1
8	NET-AC	OTH-INDU	1.00429	1320430.4	1314792.7
9	NET-AC	ELECTRIC	.99823	116265.9	116471.6
10	NET-AC	CONSTRUC	1.00489	1330772.0	1324298.3
11	NET-AC	OILPROD.	1.05481	2176209.3	2063121.9
12	NET-AC	TRANSPO.	1.02813	1004783.7	977290.8
13	NET-AC	SERVICES	1.00535	3232993.3	3215800.2
14	GROSS-AC	AGRICULT	.97343	3563119.9	3660366.6
15	GROSS-AC	FOODPROS	.97994	2204074.6	2249190.7
16	GROSS-AC	TEXTILES	.96988	1544913.7	1592894.9
17	GROSS-AC	OTH-INDU	.97412	2229533.9	2288777.6
18	GROSS-AC	ELECTRIC	.97014	133692.2	137807.3
19	GROSS-AC	CONSTRUC	.99194	1699573.1	1713384.7
20	GROSS-AC	OILPROD.	1.01937	2607336.4	2557799.4
21	GROSS-AC	TRANSPO.	1.00216	1265994.9	1263264.3
22	GROSS-AC	SERVICES	.97189	5380342.3	5540066.7
23	COMMODIT	AGRICULT	.96818	4241240.4	4380643.7
24	COMMODIT	FOODPROS	.93771	2587917.0	2759828.5
25	COMMODIT	TEXTILES	.96489	1578436.3	1635869.6
26	COMMODIT	OTH-INDU	.95403	2471290.4	2590362.6
27	COMMODIT	ELECTRIC	.96222	133692.2	138941.3
28	COMMODIT	CONSTRUC	.98061	1665426.7	1698358.2
29	COMMODIT	OILPROD.	.70801	648852.0	916447.0
30	COMMODIT	TRANSPO.	.88621	633404.2	714733.5
31	COMMODIT	SERVICES	.94584	2820203.3	2981680.3
32	INDR.	TAXES		61313.9	
33	CONS.	GOVERNMT		29293800.7	
34	CAPITAL	AGRICULT	.96967	1987147.2	2049300.0
35	CAPITAL	FOODPROS	1.01550	215018.1	211736.0
36	CAPITAL	TEXTILES	.97614	258843.4	265170.0
37	CAPITAL	OTH-INDU	1.00739	460843.6	457465.0
38	CAPITAL	ELECTRIC	.99729	66401.5	66582.0
39	CAPITAL	CONSTRUC	1.00747	475729.1	472200.0
40	CAPITAL	OILPROD.	1.05614	1968188.7	1863567.0
41	CAPITAL	TRANSPO.	1.03740	704707.9	679303.0
42	CAPITAL	SERVICES	1.00817	1902691.5	1887279.0
43	CONS.	LABOR	1.00000	2872605.0	2872605.0

Table 5.B2 (continued)

PRINT OF MATRIX

			1	2	3	4	5	6	7	8	9
			FACTORS LABOR	FACTORS CAPITAL	INST. URBAN	INST. RURAL	NET-AC AGRICULT	NET-AC FOODPROS	NET-AC TEXTILES	NET-AC OTH-INDU	NET-AC ELECTRIC
1	FACTORS	LABOR									
2	FACTORS	CAPITAL									
3	INST.	URBAN	4038238.	1595778.		19833.					
4	INST.	RURAL	1493603.	2339334.	26937.						
5	NET-AC	AGRICULT									
6	NET-AC	FOODPROS									
7	NET-AC	TEXTILES									
8	NET-AC	OTH-INDU									
9	NET-AC	ELECTRIC									
10	NET-AC	CONSTRUC									
11	NET-AC	OILPROD.									
12	NET-AC	TRANSPO.									
13	NET-AC	SERVICES									
14	GROSS-AC	AGRICULT									
15	GROSS-AC	FOODPROS									
16	GROSS-AC	TEXTILES									
17	GROSS-AC	OTH-INDU									
18	GROSS-AC	ELECTRIC									
19	GROSS-AC	CONSTRUC									
20	GROSS-AC	OILPROD.									
21	GROSS-AC	TRANSPO.									
22	GROSS-AC	SERVICES									
23	COMMODIT	AGRICULT			671960.	846708.					
24	COMMODIT	FOODPROS			1023615.	872327.					
25	COMMODIT	TEXTILES			470648.	352917.					
26	COMMODIT	OTH-INDU			463573.	228713.					
27	COMMODIT	ELECTRIC			22416.	13591.					
28	COMMODIT	CONSTRUC									
29	COMMODIT	OILPROD.			128984.	78205.					
30	COMMODIT	TRANSPO.			144500.	27490.					
31	COMMODIT	SERVICES			735369.	284913.					
32	INDR.	TAXES					0.	0.	0.	0.	0.
33	CONS.	GOVERNMT	85778.	4145354.	2575597.	1356678.	97917.	455950.	126186.	527907.	14261.
34	CAPITAL	AGRICULT					1987147.				
35	CAPITAL	FOODPROS						215018.			
36	CAPITAL	TEXTILES							258843.		
37	CAPITAL	OTH-INDU								460844.	
38	CAPITAL	ELECTRIC									66401.
39	CAPITAL	CONSTRUC									
40	CAPITAL	OILPROD.									
41	CAPITAL	TRANSPO.									
42	CAPITAL	SERVICES									
43	CONS.	LABOR					620399.	132046.	228417.	331680.	35603.
44	TOTAL		5617618.	8080466.	6263598.	4081376.	2705463.	803014.	613446.	1320430.	116266.

Table 5.B2 (continued)

PRINT OF MATRIX

10	11	12	13	14	15	16	17	18	19	20
NET-AC CONSTRUC	NET-AC OILPROD.	NET-AC TRANSPO.	NET-AC SERVICES	GROSS-AC AGRICULT	GROSS-AC FOODPROS	GROSS-AC TEXTILES	GROSS-AC OTH-INDU	GROSS-AC ELECTRIC	GROSS-AC CONSTRUC	GROSS-AC OILPROD.
				2705463.						
					803014.					
						613446.				
							1320430.			
								116266.		
									1330772.	
										2176209.
				727734.	1170793.	150039.	56660.			
				23486.	162433.	4594.	100249.			
				1414.	630.	548745.	6693.		322.	1252.
				35091.	5210.	65949.	489353.	829.	188838.	130641.
				98.	690.	3807.	25106.		65.	5460.
				684.	488.	2913.	7373.	559.	157.	14053.
				7408.	761.	5929.	50805.	7968.	4139.	118676.
				1755.	2053.	11477.	16021.	1988.	2222.	4316.
				28013.	37627.	124714.	137809.	4905.	158152.	133728.
0.	0.	0.	0.	31973.	20376.	13302.	19033.	1177.	14905.	23000.
604383.	161656.	72159.	330781.							
475729.										
	1968189.									
		704708.								
			1902691.							
250659.	46365.	227916.	999520.							
1330772.	2176209.	1004784.	3232993.	3563120.	2204074.	1544914.	2229534.	133692.	1699573.	2607336.

Table 5.B2 (continued)

PRINT OF MATRIX

21	22	23	24	25	26	27	28	29	30	31
GROSS-AC TRANSPO.	GROSS-AC SERVICES	COMMODIT AGRICULT	COMMODIT FOODPROS	COMMODIT TEXTILES	COMMODIT OTH-INDU	COMMODIT ELECTRIC	COMMODIT CONSTRUC	COMMODIT OILPROD.	COMMODIT TRANSPO.	COMMODIT SERVICES
1004784.										
	3232993.									
		3288157.								
			2157576.							
				1334538.						
					2118153.					
						133692.				
							1699573.			
								631865.		
									658657.	
		960987.	433606.	291124.	410256.			60244.		2859377.
27739.	318161.									
2417.	262346.									
730.	43793.									
38896.	340109.									
6897.	32066.									
24906.	53182.									
31401.	120938.									
19590.	284015.									
97529.	641784.									
11105.	54355.	-7903.	-3265.	-47225.	-57118.	0.	-34144.	-43257.	-25253.	-39173.
1265995.	5384342.	4241240.	2587917.	1578436.	2471290.	133692.	1665429.	648852.	633404.	2820203.

Table 5.B2 (continued)

PRINT OF MATRIX

32	33	34	35	36	37	38	39	40	41	42
INDR. TAXES	CONS. GOVERNMT	CAPITAL AGRICULT	CAPITAL FOODPROS	CAPITAL TEXTILES	CAPITAL OTH-INDU	CAPITAL ELECTRIC	CAPITAL CONSTRUC	CAPITAL OILPROD.	CAPITAL TRANSPO.	CAPITAL SERVICES
	2745013.									
	40896.	1987147.	215018.	258843.	460844.	66401.	475729.	1968189.	704708.	1902691.
37211.	572537.									
24102.	197400.									
	274963.									
	46499.									
	210376.									
	111381.									
	1975472.									
	607338.									
	368748.									
	271446.									
	136449.									
	151294.									
	484089.									
	23495.									
	1561112.									
	93637.									
	117378.									
	435660.									
	129426.									
	18739191.									
61314.	29293801.	1987147.	215018.	258843.	460844.	66401.	475729.	1968189.	704708.	1902691.

Table 5.B2 (continued)

PRINT OF MATRIX

43	44
CONS. LABOR	TOTAL
2872605.	5017618.
	8080466.
	6263598.
	4041376.
	2705463.
	593014.
	613446.
	1320430.
	116266.
	1330772.
	2176209.
	1094789.
	3232993.
	3563120.
	2234075.
	1544914.
	2229534.
	133692.
	1099573.
	2067336.
	1265995.
	5384342.
	4241240.
	2587917.
	1578436.
	2471290.
	133692.
	1065429.
	648852.
	633404.
	2020203.
	61314.
	29293801.
	1987147.
	215018.
	258843.
	469844.
	66401.
	475729.
	1968189.
	704708.
	1902691.
	2872605.
2872605.	

Table 5.B3

Selective Increase of Commodity Taxes Levied on Necessities

	ACCOUNT		PRICE	VALUE	QUANTITY
1	FACTORS	LABOR		5702052.6	
2	FACTORS	CAPITAL		7988503.8	
3	INST.	URBAN		6891492.9	
4	INST.	RURAL		4452547.1	
5	NET-AC	AGRICULT	.97086	2683873.6	2764438.3
6	NET-AC	FOODPROS	.98663	773760.1	784246.1
7	NET-AC	TEXTILES	1.01041	640612.2	634209.8
8	NET-AC	OTH-INDU	1.00989	1333127.6	1320069.2
9	NET-AC	ELECTRIC	1.01374	119051.5	117438.1
10	NET-AC	CONSTRUC	1.00791	1336884.8	1326394.3
11	NET-AC	OILPROD.	1.01484	2091835.9	2061245.2
12	NET-AC	TRANSPO.	1.01175	983654.0	972228.0
13	NET-AC	SERVICES	1.00598	3236124.3	3216872.5
14	GROSS-AC	AGRICULT	.98879	3612425.6	3653395.8
15	GROSS-AC	FOODPROS	1.02611	2275553.7	2217657.6
16	GROSS-AC	TEXTILES	1.01684	1653195.7	1625820.1
17	GROSS-AC	OTH-INDU	1.01362	2329255.5	2297962.8
18	GROSS-AC	ELECTRIC	1.01371	140856.3	138950.9
19	GROSS-AC	CONSTRUC	1.00905	1731619.7	1716096.5
20	GROSS-AC	OILPROD.	1.01457	2592708.7	2555472.7
21	GROSS-AC	TRANSPO.	1.01289	1272924.6	1256720.0
22	GROSS-AC	SERVICES	1.01258	5611610.2	5541913.9
23	COMMODIT	AGRICULT	1.05046	4586534.0	4366198.8
24	COMMODIT	FOODPROS	1.04124	2833448.1	2721231.3
25	COMMODIT	TEXTILES	1.01608	1706354.6	1679357.0
26	COMMODIT	OTH-INDU	1.01345	2637587.2	2602586.7
27	COMMODIT	ELECTRIC	1.01371	142015.3	140094.2
28	COMMODIT	CONSTRUC	1.00905	1716433.3	1701046.2
29	COMMODIT	OILPROD.	1.01439	822584.5	810915.7
30	COMMODIT	TRANSPO.	1.01289	703498.0	694543.3
31	COMMODIT	SERVICES	1.01258	3032087.5	2994428.9
32	INDR.	TAXES		993833.7	
33	CONS.	GOVERNMT		30194850.4	
34	CAPITAL	AGRICULT	.96193	1971289.9	2049300.0
35	CAPITAL	FOODPROS	.97851	207185.1	211736.0
36	CAPITAL	TEXTILES	1.01969	270390.5	265170.0
37	CAPITAL	OTH-INDU	1.01707	465275.0	457465.0
38	CAPITAL	ELECTRIC	1.02118	67992.4	66582.0
39	CAPITAL	CONSTRUC	1.01210	477914.3	472200.0
40	CAPITAL	OILPROD.	1.01519	1891880.5	1863567.0
41	CAPITAL	TRANSPO.	1.01558	689888.6	679303.0
42	CAPITAL	SERVICES	1.00914	1904534.2	1887279.0
43	CONS.	LABOR	1.00000	2872605.0	2872605.0

Table 5.B3 (continued)

PRINT OF MATRIX

			1	2	3	4	5	6	7	8	9
			FACTORS LABOR	FACTORS CAPITAL	INST. URBAN	INST. RURAL	NET-AC AGRICULT	NET-AC FOODPROS	NET-AC TEXTILES	NET-AC OTH-INDU	NET-AC ELECTRIC
1	FACTORS	LABOR									
2	FACTORS	CAPITAL									
3	INST.	URBAN	4098934.	1577617.		21637.					
4	INST.	RURAL	1516052.	2312710.	29638.						
5	NET-AC	AGRICULT									
6	NET-AC	FOODPROS									
7	NET-AC	TEXTILES									
8	NET-AC	OTH-INDU									
9	NET-AC	ELECTRIC									
10	NET-AC	CONSTRUC									
11	NET-AC	OILPROD.									
12	NET-AC	TRANSPO.									
13	NET-AC	SERVICES									
14	GROSS-AC	AGRICULT									
15	GROSS-AC	FOODPROS									
16	GROSS-AC	TEXTILES									
17	GROSS-AC	OTH-INDU									
18	GROSS-AC	ELECTRIC									
19	GROSS-AC	CONSTRUC									
20	GROSS-AC	OILPROD.									
21	GROSS-AC	TRANSPO.									
22	GROSS-AC	SERVICES									
23	COMMODIT	AGRICULT			739320.	923710.					
24	COMMODIT	FOODPROS			1126227.	951659.					
25	COMMODIT	TEXTILES			517828.	385012.					
26	COMMODIT	OTH-INDU			510044.	249512.					
27	COMMODIT	ELECTRIC			24663.	14827.					
28	COMMODIT	CONSTRUC									
29	COMMODIT	OILPROD.			141914.	85317.					
30	COMMODIT	TRANSPO.			158985.	29940.					
31	COMMODIT	SERVICES			809086.	310824.					
32	INDR.	TAXES					0.	0.	0.	0.	0.
33	CONS.	GOVERNMT	87067.	4098177.	2833789.	1480058.	97136.	439340.	131815.	532984.	14603.
34	CAPITAL	AGRICULT					1971290.				
35	CAPITAL	FOODPROS						207185.			
36	CAPITAL	TEXTILES							270390.		
37	CAPITAL	OTH-INDU								465275.	
38	CAPITAL	ELECTRIC									67992.
39	CAPITAL	CONSTRUC									
40	CAPITAL	OILPROD.									
41	CAPITAL	TRANSPO.									
42	CAPITAL	SERVICES									
43	CONS.	LABOR					615448.	127235.	238607.	334869.	36456.
44	TOTAL		5702053.	7988504.	6891493.	4452587.	2683874.	773760.	640812.	1333128.	119051.

Table 5.B3 (continued)

PRINT OF MATRIX

10	11	12	13	14	15	16	17	18	19	20
NET-AC CONSTRUC	NET-AC OILPROD.	NET-AC TRANSPO.	NET-AC SERVICES	GROSS-AC AGRICULT	GROSS-AC FOODPROS	GROSS-AC TEXTILES	GROSS-AC OTH-INDU	GROSS-AC ELECTRIC	GROSS-AC CONSTRUC	GROSS-AC OILPROD.
				2683874.						
					773760.					
						640812.				
							1333128.			
								119051.		
									1336885.	
										2091836.
				788082.	1252491.	166156.	61722.			
				26029.	177837.	5207.	111764.			
				1486.	654.	589799.	7076.		340.	1317.
				37205.	5457.	71504.	521915.	888.	200916.	138651.
				103.	717.	4093.	26556.		68.	5747.
				703.	495.	3059.	7618.	580.	162.	14447.
				10593.	1075.	8671.	73082.	11511.	5940.	169877.
				2002.	2313.	13389.	18385.	2291.	2544.	4928.
				29933.	39717.	136273.	148124.	5295.	169579.	143033.
0.	0.	0.	0.	32416.	21037.	14234.	19885.	1240.	15186.	22871.
607160.	155388.	70642.	331102.							
477914.										
	1691880.									
		689889.								
			1904534.							
251811.	44567.	223124.	1000488.							
1336885.	2091836.	983654.	3236124.	3612426.	2275554.	1653196.	2329255.	140856.	1731620.	2592709.

Table 5.B3 (continued)

PRINT OF MATRIX

21	22	23	24	25	26	27	28	29	30	31
GROSS-AC TRANSPO.	GROSS-AC SERVICES	COMMODIT AGRICULT	COMMODIT FOODPROS	COMMODIT TEXTILES	COMMODIT OTH-INDU	COMMODIT ELECTRIC	COMMODIT CONSTRUC	COMMODIT OILPROD.	COMMODIT TRANSPO.	COMMODIT SERVICES
983654.										
	3236124.									
		3329005.								
			2227624.							
				1436349.						
					2214448.					
						140856.				
							1731620.			
								556473.		
									646906.	
29941.	345317.	997914.	445440.	311374.	429447.			55539.		2991806.
2670.	291408.									
765.	46131.									
41104.	361411.									
7229.	33793.									
25496.	54743.									
44756.	173331.									
22275.	325409.									
103869.	687294.									
11166.	56049.	259615.	160384.	-41568.	-6308.	1159.	-15186.	210573.	56593.	40281.
1272925.	5011610.	4586534.	2833448.	1706355.	2637587.	142015.	1716433.	822585.	703499.	3032087.

Table 5.B3 (continued)

PRINT OF MATRIX

32 INDR. TAXES	33 CONS. GOVERNMT	34 CAPITAL AGRICULT	35 CAPITAL FOODPROS	36 CAPITAL TEXTILES	37 CAPITAL OTH-INDU	38 CAPITAL ELECTRIC	39 CAPITAL CONSTRUC	40 CAPITAL OILPROD.	41 CAPITAL TRANSPO.	42 CAPITAL SERVICES
	2829447.									
	42153.	1971290.	207185.	270590.	465275.	67992.	477914.	1891880.	689889.	1904534.
603158.	590148.									
390676.	203471.									
	283421.									
	47929.									
	216847.									
	114807.									
	2036235.									
	626019.									
	340090.									
	279795.									
	140647.									
	155947.									
	498979.									
	24218.									
	1009130.									
	96517.									
	120988.									
	449061.									
	133407.									
	19315591.									
993834.	30194850.	1971290.	207185.	270390.	465275.	67992.	477914.	1891880.	689889.	1904534.

Table 5.B3 (continued)

PRINT OF MATRIX

43	44
CONS. LABOR	TOTAL
2872605.	5792052.
	7968504.
	6091493.
	4452547.
	2653874.
	773760.
	640812.
	1333128.
	119051.
	1356845.
	2091835.
	963054.
	3236124.
	3612426.
	2275554.
	1053196.
	2329255.
	140856.
	1731620.
	2592709.
	1272925.
	5011610.
	4586534.
	2833448.
	1706355.
	2637597.
	142915.
	1716433.
	622585.
	703499.
	3032087.
	993834.
	30194850.
	1971290.
	207185.
	270390.
	465275.
	67492.
	477914.
	1691880.
	689889.
	1904534.
	2872605.
2872605.	

Table 5.B4

Distribution of Tax Revenues in Proportion to Income (5% sales tax)

	ACCOUNT		PRICE	VALUE	QUANTITY
1	FACTORS	LABOR		5763416.4	
2	FACTORS	CAPITAL		8186117.7	
3	INST.	URBAN		7125883.9	
4	INST.	RURAL		4620643.8	
5	NET-AC	AGRICULT	1.00731	2816878.1	2796435.0
6	NET-AC	FOODPROS	1.01952	815621.6	800200.5
7	NET-AC	TEXTILES	.96115	583271.8	606846.4
8	NET-AC	OTH-INDU	.99125	1291099.3	1302489.9
9	NET-AC	ELECTRIC	1.01127	118606.4	117284.6
10	NET-AC	CONSTRUC	.97404	1268891.9	1302716.7
11	NET-AC	OILPROD.	1.08446	2238843.2	2064469.7
12	NET-AC	TRANSPO.	1.04036	1020627.3	981034.5
13	NET-AC	SERVICES	1.00334	3223155.8	3212426.9
14	GROSS-AC	AGRICULT	1.02046	3771282.5	3695681.7
15	GROSS-AC	FOODPROS	1.04827	2372003.2	2262772.8
16	GROSS-AC	TEXTILES	1.03848	1615538.2	1555673.0
17	GROSS-AC	OTH-INDU	1.01297	2296757.3	2267360.9
18	GROSS-AC	ELECTRIC	.99804	138497.6	138769.3
19	GROSS-AC	CONSTRUC	.99209	1672134.3	1685462.3
20	GROSS-AC	OILPROD.	1.06430	2724053.4	2559470.3
21	GROSS-AC	TRANSPO.	1.03482	1312259.1	1268103.5
22	GROSS-AC	SERVICES	1.01560	5620589.4	5534255.1
23	COMMODIT	AGRICULT	1.06691	4720835.8	4424762.7
24	COMMODIT	FOODPROS	1.05050	2918042.5	2777777.2
25	COMMODIT	TEXTILES	1.11244	1775303.2	1595861.4
26	COMMODIT	OTH-INDU	1.06661	2733839.9	2563116.1
27	COMMODIT	ELECTRIC	1.03939	145422.5	139911.2
28	COMMODIT	CONSTRUC	1.05091	1755741.0	1670680.7
29	COMMODIT	OILPROD.	.82799	740331.7	894134.5
30	COMMODIT	TRANSPO.	.99915	706296.5	706895.7
31	COMMODIT	SERVICES	1.05221	3128463.1	2973221.7
32	INDR.	TAXES		1220622.0	
33	CONS.	GOVERNMT		30849703.3	
34	CAPITAL	AGRICULT	1.00960	2068980.9	2049300.0
35	CAPITAL	FOODPROS	1.03170	218447.7	211736.0
36	CAPITAL	TEXTILES	.92813	246111.3	265170.0
37	CAPITAL	OTH-INDU	.98501	450606.7	457465.0
38	CAPITAL	ELECTRIC	1.01736	67738.2	66582.0
39	CAPITAL	CONSTRUC	.96063	453608.0	472200.0
40	CAPITAL	OILPROD.	1.08654	2024835.5	1863567.0
41	CAPITAL	TRANSPO.	1.05376	715819.9	679303.0
42	CAPITAL	SERVICES	1.00510	1896901.9	1887279.0
43	CONS.	LABOR	1.00000	2872605.0	2872605.0

Table 5.B4 (continued)

PRINT OF MATRIX

			1 FACTORS LABOR	2 FACTORS CAPITAL	3 INST. URBAN	4 INST. RURAL	5 NET-AC AGRICULT	6 NET-AC FOODPROS	7 NET-AC TEXTILES	8 NET-AC OTH-INDU	9 NET-AC ELECTRIC
1	FACTORS	LABOR									
2	FACTORS	CAPITAL									
3	INST.	URBAN	4143045.	1616643.		22454.					
4	INST.	RURAL	1532367.	2369921.	30646.						
5	NET-AC	AGRICULT									
6	NET-AC	FOODPROS									
7	NET-AC	TEXTILES									
8	NET-AC	OTH-INDU									
9	NET-AC	ELECTRIC									
10	NET-AC	CONSTRUC									
11	NET-AC	OILPROD.									
12	NET-AC	TRANSPO.									
13	NET-AC	SERVICES									
14	GROSS-AC	AGRICULT									
15	GROSS-AC	FOODPROS									
16	GROSS-AC	TEXTILES									
17	GROSS-AC	OTH-INDU									
18	GROSS-AC	ELECTRIC									
19	GROSS-AC	CONSTRUC									
20	GROSS-AC	OILPROD.									
21	GROSS-AC	TRANSPO.									
22	GROSS-AC	SERVICES									
23	COMMODIT	AGRICULT			764466.	958583.					
24	COMMODIT	FOODPROS			1164532.	987587.					
25	COMMODIT	TEXTILES			535440.	399547.					
26	COMMODIT	OTH-INDU			527391.	258932.					
27	COMMODIT	ELECTRIC			25502.	15387.					
28	COMMODIT	CONSTRUC									
29	COMMODIT	OILPROD.			146741.	88538.					
30	COMMODIT	TRANSPO.			164392.	31122.					
31	COMMODIT	SERVICES			836604.	322559.					
32	INDR.	TAXES					0.	0.	0.	0.	0.
33	CONS.	GOVERNMT	88004.	4199555.	2930170.	1535935.	101950.	463222.	119979.	516181.	14548.
34	CAPITAL	AGRICULT					2068981.				
35	CAPITAL	FOODPROS						218448.			
36	CAPITAL	TEXTILES							246111.		
37	CAPITAL	OTH-INDU								450607.	
38	CAPITAL	ELECTRIC									67738.
39	CAPITAL	CONSTRUC									
40	CAPITAL	OILPROD.									
41	CAPITAL	TRANSPO.									
42	CAPITAL	SERVICES									
43	CONS.	LABOR					645948.	134152.	217182.	324312.	36320.
44	TOTAL		5763416.	8186118.	7125884.	4620644.	2816878.	815822.	583272.	1291099.	118606.

Table 5.B4 (continued)

PRINT OF MATRIX

10	11	12	13	14	15	16	17	18	19	20
NET-AC CONSTRUC	NET-AC OILPROD.	NET-AC TRANSPO.	NET-AC SERVICES	GROSS-AC AGRICULT	GROSS-AC FOODPROS	GROSS-AC TEXTILES	GROSS-AC OTH-INDU	GROSS-AC ELECTRIC	GROSS-AC CONSTRUC	GROSS-AC OILPROD.
				2816878.						
					815822.					
						583272.				
							1291099.			
								118606.		
									1268892.	
										2238843.
				809686.	1297932.	161477.	61854.			
				26564.	183059.	5026.	111256.			
				1646.	731.	617875.	7644.		365.	1444.
				39610.	5860.	72007.	541977.	934.	207681.	146152.
				107.	750.	4016.	26866.		69.	5901.
				740.	526.	3048.	7828.	604.	166.	15070.
				8747.	896.	6772.	58858.	9383.	4762.	138877.
				1998.	2329.	12637.	17894.	2257.	2464.	4869.
				31464.	42111.	135498.	151873.	5495.	173071.	148865.
0.	0.	0.	0.	33841.	21929.	13910.	19607.	1219.	14665.	24030.
576280.	166309.	73297.	329775.							
453608.										
	2024836.									
		715820.								
			1896902.							
239004.	47699.	231510.	996479.							
1268892.	2238843.	1020627.	3223156.	3771283.	2372003.	1615536.	2296757.	138498.	1672134.	2724053.

Table 5.84 (continued)

PRINT OF MATRIX

21 GROSS-AC TRANSFD.	22 GROSS-AC SERVICES	23 COMMODIT AGRICULT	24 COMMODIT FOODPROS	25 COMMODIT TEXTILES	26 COMMODIT OTH-INDU	27 COMMODIT ELECTRIC	28 COMMODIT CONSTRUC	29 COMMODIT OILPROD.	30 COMMODIT TRANSPO.	31 COMMODIT SERVICES
1020627.										
	3223156.									
		3481715.								
			2323034.							
				1393988.						
					2179460.					
						138498.				
							1672134.			
								643657.		
									672663.	
		1014319.	456054.	296777.	424197.			61421.		2979489.
30685.	350239.									
2719.	293593.									
845.	50436.									
43652.	379843.									
7479.	34602.									
26794.	56935.									
36863.	141284.									
22171.	320551.									
104913.	713211.									
11511.	56740.	224802.	138954.	84938.	130183.	6925.	83607.	35254.	33633.	148974.
1312259.	5020589.	4720836.	2918043.	1775303.	2733840.	145422.	1755741.	740332.	706297.	3128463.

Table 5.B4 (continued)

PRINT OF MATRIX

	32	33	34	35	36	37	38	39	40	41	42
	INDR. TAXES	CONS. GOVERNMT	CAPITAL AGRICULT	CAPITAL FOODPROS	CAPITAL TEXTILES	CAPITAL OTH-INDU	CAPITAL ELECTRIC	CAPITAL CONSTRUC	CAPITAL OILPROD.	CAPITAL TRANSPO.	CAPITAL SERVICES
1		2890811.									
2		43606.	2066981.	218448.	246111.	4506(7.	67738.	453608.	2024836.	715820.	1896902.
3	740796.	602947.									
4	479820.	207884.									
5											
6											
7											
8											
9											
10											
11											
12											
13											
14		289568.									
15		44969.									
16		221550.									
17		117297.									
18											
19											
20		2050396.									
21		637596.									
22		388333.									
23		265863.									
24		143697.									
25		159330.									
26		509801.									
27		24743.									
28		1044028.									
29		96610.									
30		123612.									
31		458600.									
32		136301.									
33		19734499.									
34											
35											
36											
37											
38											
39											
40											
41											
42											
	1220622.	30849703.	2066981.	218448.	246111.	450607.	67738.	453608.	2024836.	715820.	1896902.

Table 5.84 (continued)

PRINT OF MATRIX

43	44
CONS. LABOR	TOTAL
2872605.	5763416.
	8186118.
	7125884.
	4620644.
	2616878.
	615822.
	583272.
	1291099.
	118606.
	1268892.
	2238843.
	1620627.
	3223156.
	3771283.
	2372093.
	1615538.
	2296757.
	138498.
	1672134.
	2724053.
	1312259.
	5620589.
	4720836.
	2418042.
	1775303.
	2733840.
	145422.
	1755741.
	740332.
	796297.
	3128463.
	1220622.
	30649703.
	2066981.
	218446.
	246111.
	450697.
	67738.
	453608.
	2024836.
	715820.
	1696902.
	2872605.
2872605.	

Table 5.B5

Per Capita Distribution of Tax Revenues (5% sales tax)

	ACCOUNT		PRICE	VALUE	QUANTITY
1	FACTORS	LABOR		5761982.1	
2	FACTORS	CAPITAL		8186827.5	
3	INST.	URBAN		7065367.2	
4	INST.	RURAL		4672851.7	
5	NET-AC	AGRICULT	1.00925	2823994.3	2798114.3
6	NET-AC	FOODPROS	1.02005	816505.3	800455.6
7	NET-AC	TEXTILES	.96133	583476.1	606946.1
8	NET-AC	OTH-INDU	.99066	1289762.7	1301925.4
9	NET-AC	ELECTRIC	1.01088	118535.9	117260.3
10	NET-AC	CONSTRUC	.97373	1269284.3	1302501.4
11	NET-AC	OILPROD.	1.08389	2237638.0	2064444.1
12	NET-AC	TRANSPO.	1.03912	1019022.1	980657.2
13	NET-AC	SERVICES	1.00271	3220054.5	3211362.0
14	GROSS-AC	AGRICULT	1.02220	3780012.3	3697900.9
15	GROSS-AC	FOODPROS	1.04922	2374909.6	2263494.1
16	GROSS-AC	TEXTILES	1.03864	1616044.0	1555928.5
17	GROSS-AC	OTH-INDU	1.01253	2294776.4	2266378.2
18	GROSS-AC	ELECTRIC	.99764	138412.7	138740.5
19	GROSS-AC	CONSTRUC	.99176	1671291.1	1685183.8
20	GROSS-AC	OILPROD.	1.06376	2722624.8	2559438.6
21	GROSS-AC	TRANSPO.	1.03379	1310454.5	1267615.8
22	GROSS-AC	SERVICES	1.01519	5616433.3	5532420.6
23	COMMODIT	AGRICULT	1.06823	4730606.0	4428452.3
24	COMMODIT	FOODPROS	1.05122	2921094.3	2778763.4
25	COMMODIT	TEXTILES	1.11250	1775913.7	1596328.6
26	COMMODIT	OTH-INDU	1.06615	2731437.5	2561954.7
27	COMMODIT	ELECTRIC	1.03897	145333.3	139882.1
28	COMMODIT	CONSTRUC	1.05056	1754855.7	1670404.6
29	COMMODIT	OILPROD.	.82757	739882.4	894041.5
30	COMMODIT	TRANSPO.	.99816	704734.9	706032.4
31	COMMODIT	SERVICES	1.05178	3124325.4	2970502.5
32	INDR.	TAXES		1220754.7	
33	CONS.	GOVERNMT		30834398.4	
34	CAPITAL	AGRICULT	1.01215	2074207.8	2049300.0
35	CAPITAL	FOODPROS	1.03256	218630.8	211736.0
36	CAPITAL	TEXTILES	.92845	246197.5	265170.0
37	CAPITAL	OTH-INDU	.98399	450140.2	457465.0
38	CAPITAL	ELECTRIC	1.01676	67697.9	66582.0
39	CAPITAL	CONSTRUC	.96017	453390.8	472200.0
40	CAPITAL	OILPROD.	1.08595	2023745.5	1863567.0
41	CAPITAL	TRANSPO.	1.05210	714694.1	679303.0
42	CAPITAL	SERVICES	1.00413	1895076.7	1887279.0
43	CONS.	LABOR	1.00000	2872605.0	2872605.0

Table 5.B5 (continued)

PRINT OF MATRIX

			1	2	3	4	5	6	7	8	9
			FACTORS LABOR	FACTORS CAPITAL	INST. URBAN	INST. RURAL	NET-AC AGRICULT	NET-AC FOODPROS	NET-AC TEXTILES	NET-AC OTH-INDU	NET-AC ELECTRIC
1	FACTORS	LABOR									
2	FACTORS	CAPITAL									
3	INST.	URBAN	4142014.	1616783.		22741.					
4	INST.	RURAL	1531986.	2370126.	30385.						
5	NET-AC	AGRICULT									
6	NET-AC	FOODPROS									
7	NET-AC	TEXTILES									
8	NET-AC	OTH-INDU									
9	NET-AC	ELECTRIC									
10	NET-AC	CONSTRUC									
11	NET-AC	OILPROD.									
12	NET-AC	TRANSPO.									
13	NET-AC	SERVICES									
14	GROSS-AC	AGRICULT									
15	GROSS-AC	FOODPROS									
16	GROSS-AC	TEXTILES									
17	GROSS-AC	OTH-INDU									
18	GROSS-AC	ELECTRIC									
19	GROSS-AC	CONSTRUC									
20	GROSS-AC	OILPROD.									
21	GROSS-AC	TRANSPO.									
22	GROSS-AC	SERVICES									
23	COMMODIT	AGRICULT			757974.	970866.					
24	COMMODIT	FOODPROS			1154642.	1000242.					
25	COMMODIT	TEXTILES			530893.	404667.					
26	COMMODIT	OTH-INDU			522912.	262250.					
27	COMMODIT	ELECTRIC			25286.	15584.					
28	COMMODIT	CONSTRUC									
29	COMMODIT	OILPROD.			145494.	89673.					
30	COMMODIT	TRANSPO.			162996.	31521.					
31	COMMODIT	SERVICES			829499.	326692.					
32	INDR.	TAXES					0.	0.	0.	0.	0.
33	CONS.	GOVERNMT	87982.	4199919.	2905286.	1555616.	102207.	463610.	120021.	515646.	14540.
34	CAPITAL	AGRICULT					2074208.				
35	CAPITAL	FOODPROS						218631.			
36	CAPITAL	TEXTILES							246198.		
37	CAPITAL	OTH-INDU								450140.	
38	CAPITAL	ELECTRIC									67698.
39	CAPITAL	CONSTRUC									
40	CAPITAL	OILPROD.									
41	CAPITAL	TRANSPO.									
42	CAPITAL	SERVICES									
43	CONS.	LABOR					647579.	134264.	217258.	323976.	36298.
44	TOTAL		5761982.	8186827.	7065367.	4679852.	2823994.	816505.	583476.	1289763.	118536.

Table 5.B5 (continued)

PRINT OF MATRIX

10	11	12	13	14	15	16	17	18	19	20
NET-AC CONSTRUC	NET-AC OILPROD.	NET-AC TRANSPO.	NET-AC SERVICES	GROSS-AC AGRICULT	GROSS-AC FOODPROS	GROSS-AC TEXTILES	GROSS-AC OTH-INDU	GROSS-AC ELECTRIC	GROSS-AC CONSTRUC	GROSS-AC OILPROD.
				2823994.						
					816505.					
						583476.				
							1289763.			
								118536.		
									1268284.	
										2237638.
				811173.	1299999.	161703.	61903.			
				26599.	183253.	5031.	111285.			
				1647.	731.	610008.	7641.		365.	1445.
				39617.	5859.	71989.	541512.	933.	207558.	146088.
				107.	750.	4015.	26844.		69.	5899.
				741.	526.	3048.	7822.	603.	166.	15065.
				8748.	896.	6770.	58803.	9377.	4758.	138806.
				1997.	2327.	12627.	17869.	2254.	2462.	4864.
				31470.	42107.	135464.	151745.	5492.	172972.	148802.
0.	0.	0.	0.	33920.	21955.	13914.	19590.	1218.	14657.	24017.
576004.	166219.	73182.	329458.							
453391.										
	2023746.									
		714694.								
			1895077.							
238890.	47673.	231146.	995520.							
1268284.	2237638.	1019022.	3220055.	3780012.	2374910.	1616044.	2294776.	138413.	1671291.	2722625.

Table 5.B5 (continued)

PRINT OF MATRIX

21 GROSS-AC TRANSPO.	22 GROSS-AC SERVICES	23 COMMODIT AGRICULT	24 COMMODIT FOODPROS	25 COMMODIT TEXTILES	26 COMMODIT OTH-INDU	27 COMMODIT ELECTRIC	28 COMMODIT CONSTRUC	29 COMMODIT OILPROD.	30 COMMODIT TRANSPO.	31 COMMODIT SERVICES
1019022.										
	3220055.									
		3490588.								
			2325965.							
				1394604.						
					2177537.					
						138413.				
							1671291.			
								643260.		
									671176.	
		1014751.	456029.	296742.	423832.			61389.		2975549.
30711.	350555.									
2719.	293098.									
845.	50422.									
43617.	379555.									
7473.	34576.									
26775.	56697.									
36830.	141160.									
22141.	320127.									
108826.	712684.									
11495.	50098.	225207.	139100.	84567.	130068.	6921.	83565.	35232.	33559.	148777.
1310454.	5016433.	4730606.	2921094.	1775914.	2731438.	145333.	1754856.	739882.	704735.	3124326.

Table 5.85 (continued)

PRINT OF MATRIX

32	33	34	35	36	37	38	39	40	41	42
INDR. TAXES	CONS. GOVERNMT	CAPITAL AGRICULT	CAPITAL FOODPROS	CAPITAL TEXTILES	CAPITAL OTH-INDU	CAPITAL ELECTRIC	CAPITAL CONSTRUC	CAPITAL OILPROD.	CAPITAL TRANSPO.	CAPITAL SERVICES
	2889377.									
	43046.	2074208.	218631.	246198.	450140.	67698.	453391.	2023746.	714694.	1895077.
661181.	602648.									
539574.	207781.									
	289424.									
	48944.									
	221440.									
	117239.									
	2079364.									
	639278.									
	388141.									
	285722.									
	143626.									
	159250.									
	509545.									
	24731.									
	1643213.									
	98561.									
	123551.									
	458572.									
	136233.									
	19724709.									
1220755.	30834398.	2074208.	218631.	246198.	450140.	67698.	453391.	2023746.	714694.	1895077.

Table 5.85 (continued)

PRINT OF MATRIX

43	44
CONS. LABOR	TOTAL
2872605.	5761982.
	8186828.
	7065307.
	4079852.
	2023994.
	810525.
	583476.
	1289763.
	118536.
	1268284.
	2237638.
	1019022.
	3220055.
	3780012.
	2374910.
	1010044.
	2294776.
	138413.
	1071291.
	2722625.
	1310455.
	5016433.
	4730606.
	2921074.
	1775914.
	2731438.
	145333.
	1754650.
	739882.
	704735.
	3124326.
	1220755.
	30034398.
	2074208.
	216631.
	246196.
	450140.
	67698.
	453391.
	2023746.
	714694.
	1695077.
	2872605.
2872605.	