REDISTRIBUTIVE INDIRECT TAXES FOR BRAZIL: AN APPLICATION OF THE THEORY OF OPTIMAL TAXATION

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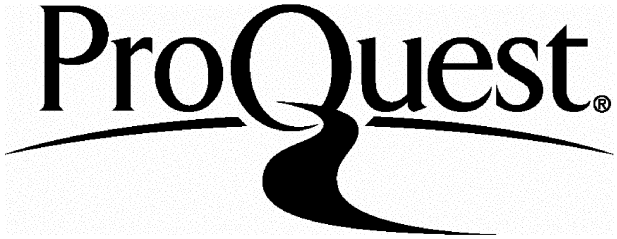
Submitted to the University of London for the Ph.D. degree

UNIVERSITY COLLEGE LONDON

1995



ABSTRACT

The thesis seeks to analyse the optimal design of indirect taxes for Brazil. The analysis is intended to shed some light on the question of how and to what extent redistributive goals can be achieved through the indirect tax system.

A computable model is specified in which households choose consumption goods to maximise their utilities and the government chooses, for the urban and the rural sector separately, a set of commodity taxes and a (uniform) poll subsidy to households so as to maximise a Bergson-Samuelson social welfare function subject to its budget constraint and the restrictions on its ability to tax. It is assumed that producer prices are fixed and there are no profits. The model is solved under alternative assumptions about the extent of the government's concern with inequality, the constraints it may face on taxation possibilities, its revenue requirements and the preferences of households.

The impacts of the optimal taxes on the welfare of households and on the overall level of social welfare are measured and compared with the effects of alternative partial - i.e., non-optimising - tax reform proposals. The results suggest that the potential redistributive power of indirect taxation in Brazil is quite strong though substantial changes in the existing rate structure would be required in order to secure significant improvements in social welfare.

CONTENTS

To my parents,

Expedito and Lourdes

ACKNOWLEDGEMENTS

While writing this thesis I have benefited from the help and encouragement of many people and the support from some institutions. I would like here to acknowledge my gratitude to them.

I am grateful to my supervisor, Dr. Malcolm Pemberton, for the encouragement and intellectual advice provided throughout the development of my thesis. To Professor Christopher Heady, my initial supervisor, I am deeply indebted for his guidance in my early explorations into the optimal taxation literature and for his helpful comments on several occasions.

I am also indebted to the University College Library, the University of London Library, and to the British Library of Political and Economic Science, for access to all their bibliographical material I used while writing my thesis.

Financial support from the Brazilian government, through the Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq, is gratefully acknowledged. My thanks too to my employer in Brazil, Universidade Federal de Pernambuco, for a leave of absence.

I was very lucky in having benefited from the friendship of many marvellous people while in London. I would like specially to thank Viju, Bulbul, Samuel, Esra and Cyunet, and Carlos Osório. Viju had the arduous task of correcting my English, the remaining errors, however, are my own responsibility.

Several people at the Universidade Federal de Pernambuco lent invaluable support to my research. Among others I would like to single out Professor Roberto Gomes Ferreira, Professor Yony Sampaio, Vicenta and Aldecira.

My family in Brazil was always a reassuring source of encouragement and motivation. My sister Rosali, in particular, provided constant stimulus and on several occasions reminded me that "tudo vale a pena quando a alma não é pequena".

Finally, I am very grateful to my husband, Ricardo, without whose help and incentive the completion of this thesis would not have been possible.

INTRODUCTION

The highly regressive nature of the Brazilian tax system has long been a source of concern for both policy makers and the public at large. This concern is reinforced in view of the great disparities in income distribution observed in Brazil. The heavy reliance on indirect taxes as a source of revenue is widely believed to be a major cause of the inequities of the system.

In an attempt to deal with this problem, the Constitution in force since 1988 stablished that the main Brazilian indirect tax - a value-added tax on the circulation of goods and transportation and communication services - could be selective according to the "essentiality of the product".

As might be expected, this has put the issue of selective indirect taxation at the centre of many recent tax policy debates. A number of questions have been raised concerning the consequences of selectivity for efficiency and government revenue and, in particular, about how and to what extent the Brazilian government can achieve its redistributive objectives through the indirect tax system.

The moves towards selectivity have been modest, however, and generally confined to a few states. Moreover, they do not seem always to advance the objective of improving equity. This may in part be due to the vagueness of the "essentiality criterion" and to a lack of a better understanding of the questions involved, reflected by the paucity of formal and sistematic studies of these questions.

To the best of our knowledge, there has been only one study which addresses the problem by applying the tools of modern economic analysis. It is Sampaio de Souza (1993), which makes use of the theory of marginal reform to identify desirable

directions of move from the existing indirect tax system. However, while the marginal reform approach applies only to "small" tax changes, it seems that the achievement of distributional goals is likely to require more substantial changes in the tax structure. Moreover, the marginal analysis generally identifies a whole array of welfare improving directions of reform.

The purpose of the present study is to investigate the above mentioned questions by using the optimal taxation approach. This approach has the advantage of being specific about the direction and magnitude of the desirable change in the tax structure. More precisely, the study attempts to (i) characterise the likely structure of optimal indirect taxes for Brazil, and (ii) indicate the extent of the distributional gains from the implementation of optimal taxes and also from partial changes in the tax system.

The study is organized as follows. Chapter 1 contains a brief description of the Brazilian economy and tax structure with indication of some historical antecedents. The aim is to highlight some important elements that may influence and constrain the choice of tax design in Brazil, and thus provides a foundation for some of the assumptions and arguments set forth in later chapters.

Chapter 2 presents the key concepts and some of the main results in the theory of optimal taxation, and identifies the major factors determining the structure of optimal commodity tax. In Chapter 3 the model to be used to compute the optimal indirect taxes for Brazil and the data utilised are described.

Chapter 4 reports and discusses the optimal tax results for different specifications of the model and for various assumptions concerning the government's distributional preferences and ability to impose taxes. The welfare impacts associated with the implementation of both the optimal taxes and alternative partial tax reforms are

estimated and evaluated in Chapter 5. Finally, the Conclusion draws together some of the important lessons for tax policy emerging from the analysis.

Chapter 1

The Structure of the Brazilian Economy and its Tax System

This chapter briefly outlines the major features of the Brazilian economy and its tax structure as a background to understanding the optimal tax model and tax policies for Brazil developed and discussed in the following chapters. Following a brief account of the historical development of the Brazilian economy in this century, the chapter discusses a major characteristic of Brazilian society, the high degree of wealth inequality among its citizens and regions. The chapter concludes with an overview of the fundamental features of the Brazilian tax system.

1.1. The Structure of the Brazilian Economy

Brazil turned towards industrialisation after the great depression of the 1930s hit its coffee-based export sector.[1] Thereafter government policies strove to foster industrialisation and diversify exports. As a result of these policies and due to the existence of a large internal market and the abundance of natural resources, the economy, although subjected to cyclical downturns, experienced a rapid process of expansion. Between 1947 and 1980 the economy achieved an average annual rate of

[1] Actually, industrialisation had been given a stimulus by the coffee boom which had occurred late in the nineteenth century, so that by "the 1920s the industrial sector was well established" (Nyrop, 1983, p. 164). With the great depression of the 1930s, however, coffee prices fell drastically. Given Brazil's reliance on coffee exports for the bulk of its export revenue and for financing its imports, the result was a "severe contraction of imports, which prompted local manufacturers to produce substitutes for foreign goods no longer available" (idem).

growth of 7 percent. Industrial sector growth in this period nearly always surpassed the overall rate by 2 or 3 percentage points. In 1981 the gross domestic product was the equivalent of US$ 348 billion, which translates to about US$ 2,880 on a per capita basis.

During most of the 1980s, however, Brazil experienced one of its more accentuated periods of economic decline, appropriately dubbed the "lost decade".[2] In the period 1970-81, the years of the so-called "economic miracle", the gross domestic product grew by 118.5 percent, but in the "lost decade" it grew by only 16.9 percent (Rodrigues, 1993, p. 81).[3]

While still possessing many of the characteristics of a less developed and poor country, Brazil has a large and diversified industrial base, ranking as the tenth largest economy in the world. The industrial sector of the country, which contributes a third of gross domestic product and employs some 24 percent of the labour force, produces a wide range of goods. A larger proportion of Brazil's exports now originates from the manufacturing sector.

Manufactured goods account for some 60 percent of Brazil's exports and cover a large array of products including arms, airplanes, capital equipment and electronic goods. In terms of annual receipts, the most important manufacturing exports are transport equipment and components, steel products, petroleum derivatives, chemicals, machinery, footwear and leather goods.

Brazil continues, nevertheless, to have a huge agricultural sector employing

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[2] This period began with the 1982 foreign debt crisis, which resulted in the cessation of the flow of foreign loans that financed much of Brazil's drive for heavy industrialization in the 1970s.

[3] In per capita terms the corresponding figures are 28.9 percent and -5.5 percent, respectively (Rodrigues, 1993, p. 81).

about 24 percent of the labour force and accounting for around 11 percent of gross domestic product. Agricultural exports remain a major source of foreign exchange earnings representing some 24 percent of total export sales. The major agricultural exports are coffee, soya beans, meat, sugar, orange juice, cocoa and tobacco. Overall, the post-World War II period has witnessed a decline of the agricultural sector vis-a-vis an expanding industrial sector.[4]

Another characteristic of Brazil is its high level of population growth. Although population growth rate has declined of late it still is one of the highest in the world. During the periods 1965-80 and 1980-90 the annual average increase of population was 2.4 percent and 2.2 percent respectively. The problems associated with such a high level of population growth is compounded, in a country like Brazil, by the fact that the growth in population is concentrated in its poorer strata thus aggravating their condition even further. The question of inequalities in Brazilian society is, therefore, an important and relevant issue.

1.2. A Country of Inequalities

Alongside the economic successes Brazil has managed to achieve lies another less positive side, that of sharp socio-economic inequalities. Modernization has been concentrated in certain geographical areas and in certain sections of the population. Although Brazil has grown by a remarkable annual rate of 3 percent from 1960 to

[4] "The contrasting growth patterns of industry and agriculture reflected what some economists called Brazil's dual economy" (Nyrop, 1983, p. 167), meaning a modern sector - including industry, trade, transportation and finance - and a largely backward agricultural sector, using traditional techniques and representing low levels of productivity.

1990, this has been accompanied by a jump in the the Gini index from 0.50 to 0.62 during the same period (Barros and Mendonça, 1992, p. 13), clearly indicating that economic growth has not benefited all the segments of the population in the same way. In fact, some studies show that although all income groups benefited from the process of economic growth in the period 1960-90 the benefits were not evenly distributed. The data reveal that the richest 10 percent benefited the most while the poorest 10 percent of the population was among the groups least benefited. During the "lost decade" in Brazil (the 1980s), recession and macroeconomic adjustment policies caused the poorest 10 percent to suffer a *reduction* in their average annual income by 5.1 percent (idem, p. 22). Overall, the Brazilian average per capita income fell by 5.6 percent during 1980-91.

In 1990, the poorest 20 percent of the population earned on average US$ 631 yearly while the equivalent figure for the richest 20 percent of the population was US$ 17,258. In terms of the national minimum wage those figures corresponded to 0.65 times the minimum wage and 17.86 times the minimum wage respectively (Rodrigues, 1993, p. 49).[5]

Table 1.1 below, depicts the distribution of Brazil's national income among the income-earning population for the period 1960-90. It shows that in 1990 the top 10 percent of the income-earning population appropriated nearly half (48.69 percent) of all income earned, while the share of income accruing to the lowest 10 percent represented

[5] This evidence is reinforced by the fact that in 1990 only 5.1 percent of the income-earning population earned above 17 times the minimum wage. On the other hand, 52 percent of the income-earning population earned up to 2 minimum wages while 8.4 percent worked without any remuneration (Rodrigues, 1993, p. 49).

less than 1 percent of the total.[6]

TABLE 1.1

Proportion of National Income Appropriated by each Decile of the Distribution of the Income-Earning Population

Decile	1960	1970	1980	1990
First	1.17	1.16	1.18	0.81
Second	2.32	2.05	2.03	1.80
Third	3.42	3.00	2.95	2.20
Fourth	4.65	3.81	3.57	3.04
Fifth	6.15	5.02	4.41	4.06
Sixth	7.66	6.17	5.58	5.47
Seventh	9.41	7.21	7.17	7.35
Eighth	10.85	9.95	9.88	10.32
Ninth	14.69	15.15	15.36	16.27
Tenth	39.66	46.47	47.89	48.69

Source Barros and Mendonça (1992), p. 31.

The inequality pattern is replicated amongst the poor populations in different regions. As an illustration, the average annual income of the poorest 20 percent in the north-east (US$ 396) is 37 percent lower than the national average, whereas in the rich south-east the corresponding figure is larger than the national average by 48 percent.

It is thus clear that Brazil's growing wealth has been accompanied by worsening disparities in regional levels of development and living standards. The south-east of the country has been the principal beneficiary of economic growth and has substantially increased its share of the gross domestic product. In 1980, this region accounted for 49

[6] The inequality problem is even worse in the rural sector. A 1982 study by Bresser Pereira, cited in Thiesenhusen and Melmed-Sanjak (1990), shows that the poorer half of the rural work force earned 13 percent of total income in 1980, while the richest 10 percent received 51 percent of total income in the same year.

percent of the country's industrial establishments, 65 percent of industrial employment and 72 percent of the value added by industry. In contrast, the north-east of Brazil had only 20 percent of the manufactured firms, 11 percent of industrial employment and 8 percent of the value added.

In all regions of Brazil land onwnership in the rural area is highly concentrated in a small property-holding class, leaving the vast majority of rural families either without land or with plots too small to support themselves. According to the 1980 Agricultural Census, half of all agricultural properties were less than ten hectares in size yet occupied only 2 percent of the agricultural land in the country. At the other end of the distribution, landholdings in excess of 2,000 hectares comprised less than 1 percent of all farms yet appropriated 35 percent of all land. Analyses of land tenure in Brazil indicate that the degree of concentration of land may have become even more skewed in recent years.

There is a clear dichotomy in the nature of the agricultural technology used by farmers in Brazil. In the densely-populated, drought-prone north-east of Brazil, subsistence farmers largely use traditional practices with a consequent low productivity. Meanwhile, export and commercial farms, especially in south and south-east Brazil, use modern techniques and inputs and attain higher productivity. Modernisation has favoured large-scale commercial agriculture and export crops over the more commom domestic food crops.[7]

[7] As Nyrop (1983, p. 198) observes, the bulk of what Brazilians eat come from small farmers producing on marginal land and under primitive conditions, whereas the export of agricultural goods is dominated by large landowners producing on the best land and using modern agriculture technology. An assessment of agricultural policies in Brazil by the World Bank concluded that: "Brazil has promoted agriculture and has achieved rapid growth in the sector. But its record on poverty is disappointing. One reason is that biases within the agricultural sector, notably taxation and subsidized credit, favor large farmers and work to the disadvantage of labor. These biases interact with the highly inequitable initial land distribution to reduce the gains to the poor from growth" (World Bank, 1990, p. 59).

The difficult conditions in the countryside drive many people to seek employment in the cities. In the last two decades this has led to a rural exodus of unprecedented proportions. By 1970 the proportion of the population residing in urban places for the first time surpassed the number of people living in the countryside. In 1990, 75 percent of Brazilians lived in urban areas. The massive rural to urban migration has strained the capacity of the urban economy to provide productive and well-paid employment to the growing number of job seekers. The result for many migrants is extremely poor living conditions in *favelas* (shantytowns). Brazil has over 3,000 *favelas*, comprising above 1 million households. In Rio de Janeiro in the south-east, 12.4 percent of households are located in *favelas*, and in Recife in the north-east, that proportion is 42.4 percent.[8]

Informal sector jobs, usually the chief source of earnings for the urban poor, has risen considerably in Brazil. Some estimates put the proportion of heads of poor families working in the informal sector at 75 percent (World Bank, 1990, p. 34).[9] Other data show that 4.1 percent of the working population is engaged in street work, mainly as peddlers.

The neglect by the country's social services has served to further promote inequality. Mortality among children is one of the highest in the world, standing at 58.7 per thousand children aged one and below. A large part of the working population (50.1 percent) makes no contribution to the social security system and in the poor north-east that figure is 71.1 percent of the working population. A sad verdict by the World Bank

[8] According to a 1990 report by the World Bank, Brazil's north-east region "has more than 50 percent of the country's poor but only 27 percent of its total population" (World Bank, 1990, p. 29).

[9] For the total population, the figure is 35 percent.

reflects the hardship faced by the poor in Brazil: "In 1987 the incidence of poverty was higher than at the beginning of the decade. The country faced continuing fiscal dificulties and a larger debt burden. Brazil had undergone the recession of 1983 for nothing" (World Bank, 1990, p. 110).

The next sub-section discusses the major features of the Brazilian tax system.

1.3. The Brazilian Tax Structure

The Brazilian Public Sector consists of the federal government, 26 states, more than 4,000 local governments (*municípios*), the Federal District (Brasilia) and a large number of federal and sub-federal semi-autonomous agencies and public enterprises. There is a marked concentration of power to tax in the hands of the federal government, which exerts a tight control over rates, coverage and exemptions of taxes levied by state and local governments.

Up to the early 1950s, when the export model based on primary products still characterised the pattern of the Brazilian economy, the tax system was a secondary instrument of economic policy. Taxes on exports and imports comprised the bulk of tax policy and reflected the significance of the export model on which the economic system rested.

From the 1950s on, however, the level of state intervention in the economy grew enormously with the import-substitution model taking the place of the export model. In the new model, the state was assigned the task of providing the basic infrastructure needed to support an ambitious process of industrialisation. Although government spending mounted as a result, curiously, the tax system was not reformed so as to

permit the government to raise enough tax receipts to finance its spending.

This asymmetry between the centralised process of industrialisation guided by the state and the lack of evolution and development of the tax system went on up to 1965 when a tax reform transformed the Brazilian tax structure into an authentic tool of economic policy that reflected the new role played by the state. The 1965 tax reform, enacted with the 1967 Constitution, was designed to generate the financial resources required to support the process of industrialisation and accumulation led by the state. To that extent, the the basic objectives of the reform were to increase tax revenues and centralise the power to collect taxes.

The modernisation and broadening of the tax system led the state to greatly increase its share of national income. As result of the reform, the government's total revenue as a proportion of the gross domestic product grew from 19.5 percent in 1964 to 29.9 percent in 1979, having reached a peak of 31.4 percent in 1977. The outstanding characteristic of the 1965 tax reform was the centralisation of power and resources in the hands of the federal government. Consequently, states and municipalities began to depend increasingly upon the federal government's resource transfer mechanism.

The tax system established in 1965 assigned to the federal government the following taxes: income tax, import and export taxes, a non-cumulative excise tax on manufactured products, a tax on financial, insurance and exchange transactions, five excise taxes (on fuel and lubricants, on energy, on minerals, on transportation services and on communications services) and a tax on rural land. The state taxes comprised a value-added tax on the circulation of goods, a tax on the ownership of vehicles, and a tax on the transfer of real estate. The municipalities had the power to institute and

collect a tax on services and a tax on urban building and land.

A system of revenue transfers from the federal government to states and municipalities and from states to municipalities, was introduced into the 1965 tax structure to take into account the social and economic imbalances between the rich and poor regions of Brazil (Ulhoa Canto, 1989, p. 380).[10]

The current tax system was introduced by the new 1988 Constitution. In contrast to the former one, the 1988 constitution has as its main feature the pursuit of a greater decentralisation of the collection of taxes among the federal, state and municipal governments. As a result, the new tax system involves a major redistribution of revenue among the three levels of government.[11] This was achieved largely through a strong political campaign on the part of state governors and mayors (Riani, 1992, p. 52).

Apart from the decentralisation and greater autonomy of states and municipalities, the tax reform embodied in the 1988 Constitution had three basic objectives: to redress regional imbalances, to create a more socially-equitable tax structure and to simplify the tax system.

Regional imbalances were attacked mainly via redistributions of the shares of states and municipalites in the fund of tax revenue. In keeping with the goal of a more socially-equitable tax structure, the reform created a tax on "large fortunes" and another on inheritance and gifts. Moreover, it established that the state's value-added tax could be selective according to the degree of essentiality of the products. Some degree of

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[10] As Nóbrega (1989, p. 364) has pointed out, however, the tax system introduced in 1934 "[a]lbeit in rather embryonic form ... implemented a system of distribution of tax revenues from the Federal to the State and Municipal governments".

[11] According to Serra and Afonso (1991, p. 35), the main beneficiaries were the municipalities, with greater power to tax as well as a greater share in the revenue of state governments and of the federal government.

simplification of the tax system was achieved by incorporating the five federal excise taxes into the state value-added tax.

The new tax scheme distributes the power to tax as follows. The federal government keeps the taxes on income, manufactured products, imports and exports, financial, insurance and exchange transactions, rural land, and large fortunes. State taxes comprise those on the circulation of goods, transportation and communication services, inheritance and gifts and ownership of vehicles. Finally, the municipalities have been given the power to tax services in general, urban building and land, *inter vivos* transfer of real estate, and retail sales of liquid and gaseous fuels.

Table 1.2 below shows the tax assingnment under the 1967 and 1988 Constitutions. The main feature of this comparison is that the tax structure under the 1988 Constitution did not significantly change the instruments of tax collection relative to that laid down by the tax structure adopted following the 1965 tax reform.

TABLE 1.2

Tax Assignment under the 1967 and 1988 Constitutions

1967 Constitution	1988 Constitution
I- Federal government: taxes levied on	I- Federal government: taxes levied on
1. imports	1. imports
2. exports	2. exports
3. income	3. income
4. manufactured products	4. manufactured products
5. rural land	5. rural land
6. financial transactions	6. financial transactions
7. minerals	... (c)
8. energy	... (c)
9. fuel and lubricants	... (c)
10. transportation services	... (c)
11. communication services	... (c)
... (a)	7. Tax on large fortunes
II- States: taxes levied on	II- States: taxes levied on
12. circulation of goods	8. circulation of goods and transp. and commun.services
13. ownership of vehicles	9. ownership of vehicles
14. real estate transfers	
... (a)	10. inheritance and gifts
III- Municipalities: taxes levied on	III- Municipalities: taxes levied on
15. services	11. services
16. urban building and land	12. urban building and land
... (b)	13. real estate transfers
... (a)	14. retail sales of fuels

Notes (a) lacking in the 1967 constitution.
(b) the competence to tax *inter-vivos* transfers of real state changed from states to municipalities.
(c) these taxes were included in the state VAT.

Source Rosa, 1988, p. 120.

The structure of these taxes and the main changes brought about by the 1988 Constitution are discussed in greater detail below.

1.3.1. Income tax

Personal income tax has only a minor role in the financing of government expeditures in Brazil, accounting for about only 6 percent of total tax revenue and comprising less than one-third of total income tax receipts. Of Brazil's 60 million economically-active individuals, it is estimated that just 6 million regularly report personal earnings. Of that total, only 3 million effectively pay income tax (Exame, 1993).

The 1988 tax reform replaced a system of eight tax rates, ranging from 5 percent to 50 percent, by a two-rate system: 10 percent and 25 percent. Not long after the 1988 Constitution had been enacted, the lower rate was raised to 15 percent. In order to restore some progressivity to income taxation, a recent reform implemented a three-rate schedule: 15 percent, 26.5 percent and 35 percent, with income below a certain level (the figure for 1993 was an annual income of less than US$ 6,000) being exempt from the tax. While the reduction in the number of rates may have achieved greater administrative simplicity, these measures represent a retrogression in terms of equity objectives of the 1988 Constitution.

Corporate income tax, which contributes two-thirds of total income tax receipts, is levied at a basic rate of 30 percent, with an additional 10 percent on profits above a certain level,[12] and 8 percent on distributed profits.

[12] For financial entities this figure is 15 percent.

1.3.2. Indirect taxes

Of the indirect taxes, the state tax on the circulation of goods and transportation and communication services and the federal tax on manufacturing products are by far the most important financially, accounting for the bulk of indirect tax receipts. This can be seen from the revenue shares of various indirect taxes presented in Table 1.3 below. Consequently, the analysis that follows will focus on these indirect taxes.

TABLE 1.3

Revenue Shares of Indirect Taxes

Type of Indirect Tax	Revenue from Tax as a Percentage of	
	Gross Domestic Product	Total Tax Revenue
Tax on the circulation of Goods and on Transportation and Communication Services	6.5	27.4
Tax on Manufactured Products	2.1	8.6
Tax on Financial Transactions	0.6	2.4
Tax on Services	0.4	1.7
Tax on Imports	0.4	1.7
Tax on Retail Sales and Fuels	0.1	0.2
Total	10.1	42.0

Source Rezende (1993).

The tax on the circulation of goods and on transportation and communication services (ICMS) is the major indirect tax, contributing 65 percent of the total indirect tax revenue in 1991. It is a general sales tax which applies the value-added technique and is imposed on the transfer of goods at all stages of production and distribution

including retail.[13] The ICMS is based on the origin principle for interstate transactions. However, in order to increase the revenue share of the less developed states (usually net importers), the tax rate for internal (intrastate) transactions is higher than for out-of-state sales. This scheme allows the importing state to collect the tax correspondent to the difference between the internal and the interstate rates.

The ICMS is regulated by the federal government, which establishes the rates to be charged on interstate and on export transactions and sets maximum and minimum rates on internal transactions.

Although the 1988 Constitution permits the ICMS rates to be selective, it is still essentially uniform across commodities and exemptions are few. The current ICMS rate is 17 percent on sales within states, 13 percent on exports, and 12 percent on interstate transactions - except in the case of sales from the (more developed) south and south-east regions to the other regions, in which case the rate is 9 percent.[14] Table 1.4 overleaf shows the evolution of the ICMS rates since its introduction in 1967.

[13] For a more detailed discussion about this tax see Guerard (1975) and Longo (1990).

[14] The effective rates are higher because the ICMS itself is included in the tax base. For example, the 17 percent rate is equivalent to a 20.48 percent effective rate (0.17/0.83 = 0.2048).

Table 1.4

State VAT Rates: 1967 to 1993

Year	North, North-East and Middle-East			South and South-East		
	Internal Sales	Interstate Sales	Export Sales	Import Sales	Interstate Sales	Export Sales
1967	15.0	15.0	15.0	15.0	15.0	15.0
1968	18.0	18.0	18.0	15.0	15.0	15.0
1969	18.0	18.0	17.0	15.0	15.0	15.0
1970	18.0	15.0	15.0	17.0	15.0	15.0
1971	17.5	14.5	14.5	16.5	14.5	14.5
1972	17.0	14.0	14.0	16.0	14.0	14.0
1973	16.5	13.5	13.5	15.5	13.5	13.5
1974	16.0	13.0	13.0	15.0	13.0	13.0
1975	15.5	12.0	13.0	14.5	12.0	13.0
1976	15.0	11.0	13.0	14.0	11.0	13.0
1977	15.0	11.0	13.0	14.0	11.0	13.0
1978	15.0	11.0	13.0	14.0	11.0	13.0
1979	15.0	11.0	13.0	14.0	11.0	13.0
1980	15.0	11.0	13.0	15.0	11.0 and 10.0 (a)	13.0
1981	16.0	11.0	13.0	15.5	11.0 and 9.5 (a)	13.0
1982	16.0	11.0	13.0	16.0	11.0 and 9.0 (a)	13.0
1983	16.0	11.0	13.0	16.0	11.0 and 9.0 (a)	13.0
1984/ 1993	17.0	12.0	13.0	17.0	12.0 and 9.0 (a)	13.0

Note (a) The first rate applies on interstate sales within the south and the south-east; the second on sales to states in the north, north-east, and middle-east.

Source Longo (1990).

Exports of manufactured goods, as well as books, newspapers, printed paper and a limited number of unprocessed foodstuffs, including fruits, vegetables and dairy products, are exempt from the ICMS. The construction sector and services other than

transportation and communication, are not covered by the ICMS.[15]

Agriculture is not exempt from the ICMS in principle, although the difficulties encountered in imposing the tax on a large number of small-scale farmers have led some states to exempt direct sales of unprocessed agricultural products by farmers. Even in states where farm sales are not legally exempted, tax collection is commonly postponed until agricultural goods reach the manufacturing or trade sector.

The manufacturing sector contributes about 68 percent of ICMS revenue while agriculture contributes only 6 percent, even though these sectors account for 35 percent and 11 percent of national income respectively (Longo, 1990, p. 125). The relatively low contribution of agriculture to ICMS revenue is due not only to the exemptions mentioned above, but also to the extreme difficulty of taxing own consumption of agricultural goods (because they do not involve market transactions) and to the ease of evasion in this sector.[16]

Turning to the federal tax on manufactured products (IPI), it is also of the value-added type but with various rates and levied on sales by manufacturers only. At first it was a quite comprehensive tax on manufactured production, although, on grounds of equity a zero rate was imposed on a great number of products considered as being necessities, such as foodstuffs and clothing (Varsano, 1987). More than 60 percent of the IPI revenue comes from the taxation of cigarettes, beverages, and automobiles - whose rates are 365 percent, 75 percent and 30 percent respectively. Most other products are taxed at rates not higher than 25 percent. Exports are constitutionally

[15] Services in general, including entertainment, health, education, professional services, and maintenance, as well as the construction sector, are covered by the tax on services (ISS).

[16] This point is highlighted by the fact that according to data from a family expenditure survey, 52 percent of the expenditure on food in rural areas is acquired through non-cash expenditure. The corresponding figure for the cities is 9 percent.

exempted from the IPI, as well as books, newspapers and printing paper.

Having examined the development of the tax structure in Brazil, the distributional issue is re-examined below in the context of the distribution of the tax burden in Brazil.

1.3.3. Distribution of the tax burden

It is widely recognized that the Brazilian tax system is highly regressive. One major reason explaining that high level of regressivity is its heavy dependence on indirect taxes as a source of revenue.[17] As Table 1.5 below indicates, indirect taxes have so far accounted for more than half of the total tax burden.[18]

Table 1.5

Direct and Indirect[19] Taxes as a Percentage of GDP

Type of Tax	1970	1975	1980	1985	1991
Direct	9.2	11.8	10.9	11.7	11.8
Indirect	16.7	14.5	13.3	10.3	12.1
Total	25.9	26.3	24.2	22.0	23.9

Source Riani (1990) and Rezende (1993).

[17] See, for instance, Serra (1983, pp. 9-10).

[18] The change which occurred in 1985 is due, as Riani (1990, p. 137) has pointed out, to the economic crisis Brazil was facing then, rather than to changes in the tax legislation.

[19] Including some social contributions, based on the firms' wage bill, which are passed on to consumer prices.

Table 1.6 below shows, for 1975, the amount of indirect taxes paid as a proportion of income decreased continuously from 25.2 percent for the lowest income bracket to 5.8 percent for the highest income bracket.

Table 1.6

Tax Burden by Income Class

Monthly Income*	Tax Burden (percentage)	
	Indirect Taxes	All Taxes
0 - 1	25.2	33.5
1 - 2	22.0	29.3
2 - 5	18.9	30.9
5 - 10	17.2	31.9
10 - 15	15.8	34.2
15 - 20	14.9	33.9
20 - 30	14.0	33.4
30 - 40	12.4	33.1
40 - 50	11.1	29.6
50 - 75	10.2	25.8
75 - 100	8.6	21.0
100 +	5.8	15.0
Total	19.4	31.5

Note * Expressed in units of the 1975 minimum wage, Cr$ 480.80.

Source Eris et al (1983), p. 128.

The data also show that the total of all taxes taken together falls more heavily on low- and middle-income classes than on high-income classes.[20] Nevertheless, the tax system as a whole is much less regressive than indirect taxation taken separately.

Of all the taxes, the ICMS is the most regressive since it has the broadest base of all Brazilian taxes and is levied, with few exemptions, at virtually a uniform rate on all goods. Essential items such as rice and beans, two of the most basic products of the Brazilian diet, are taxed at the full rate, although some unprocessed foodstuffs are exempt from the ICMS on claimed equity grounds.[21] The regressive nature of the ICMS is intensified by the fact that services in general, which are usually consumed by those relatively better off, are not included in its base.[22]

Another reason for the poor performance of the Brazilian tax system in terms of equity is the limited capacity of direct taxation to promote redistribution, given that it falls mainly on profits and given that individual income tax has a very narrow base. Furthermore, the tax on property has a negligible role, with a share of around 1 percent in total tax revenue (or 0.3 percent of GDP).

In their turn, public expenditures on social security programmes have notoriously failed to reach the most in need, who also happen to be those who bear the highest tax burden. Those programmes, which link benefits to contributions, cover only

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[20] Although the figures in Table 1.6 refer to a 1975 study, they are still regarded as being representative of the impact of the tax system on the different income classes. As Rezende (1993, p. 11) remarks, the changes in the tax system since 1975 have not contributed to attenuate the burden falling on the poor in relation to the rich.

[21] Administrative reasons underly most of the exemptions granted to unprocessed foodstuffs. Typically, the exempted items are produced by myriads of small-scale farms which offer severe constraints to taxation efforts.

[22] Services are instead taxed by a separate levy, the service tax (ISS), whose rates are substantially lower than that of the ICMS, ranging from 2 percent to 5 percent.

employees in the formal sector, thus excluding most of those employed in the informal sector and in rural areas. Moreover, the size of social security benefits is directly related to time of employment and to earning levels.

In the light of the situation described above, the majority of public sector economists in Brazil has pointed up the crucial importance of introducing some progressivity in the indirect tax system as a means of achieving a more equitable distribution of the tax burden. And it was with that goal in mind that the new tax code allowed ICMS rates to vary, as in the case of the IPI, with respect to the degree of essentiality of each product. But which particular pattern of rates would most effectively and efficiently achieve the distributional goals set remains to be investigated.

Chapter 2

The Theory of Optimal Commodity Taxation

The purpose of this chapter is to present an overview of the methods and main results of the theory of optimal commodity taxation and thus provide a foundation for the applications and discussions of the later chapters.

The chapter is divided into three sections. Section 1 presents the view that the main reason underlying the use of commodity taxes is a concern for equity, and that the central feature of the modern optimal tax theory is its ability to deal with the tradeoff between equity and efficiency that is inherent in taxation. Section 2 sets out some of the most important results of the theory and explains their implications for the question of whether or not taxing all goods at a uniform rate is desirable. It also enumerates the major elements influencing the optimal design of commodity taxes and comments on some limitations of the optimal tax approach. Section 3 contains a brief account of formal methods to analyse partial tax reforms (that is, tax changes that do not attain the design optimum) and emphasizes the relationship between the theory of reform and that of optimality.

2.1. The Redistributive Nature of Commodity Taxation

The second fundamental theorem of welfare economics states that, under certain conditions, any Pareto-efficient allocation can be achieved as a competitive equilibrium

provided that the government can redistribute income (resources) among individuals through lump-sum taxes and transfers (i.e., taxes and transfers which do not affect the decisions of economic agents).

Yet it is widely recognized by economists that lump-sum taxes or transfers capable of generating the most desired (optimal) distribution of income are not feasible. The reason for this is that individuals have an incentive not to reveal information about their personal characteristics (e.g., ability levels) which is required for the implementation of those policies. This means that tax liability has to be determined on the basis of observable elements, such as income and expenditure, and consequently the resulting tax system is inevitably non-lump-sum, that is, distortionary.[23]

On the other hand, if redistribution were not a concern, the distortionary effects of taxation could be avoided by imposing a uniform lump-sum tax consisting of equal payments by all individuals irrespective of their characteristics. This has led some writers to the conclusion that it is a concern for income distribution that explains the use of distortionary taxes such as income and commodity taxes.[24] There is then a basic trade-off between equity and efficiency in taxation, in the sense that distributional goals may only be achieved at some cost in terms of economic efficiency. This naturally leads to the view that the analysis of taxation should be inherently concerned with both equity and efficiency aspects.

It is therefore surprising that it was not until 1971 with the work of Diamond and Mirrlees that the formal and systematic analysis of the trade-off between equity and

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[23] For a detailed discussion of the information problem underlying the use of distortionary taxation see Mirrlees (1986).

[24] See, for instance, Heady (1988, p. 187) and Stiglitz (1988, p. 481).

efficiency was initiated.

In the earlier literature, only the efficiency aspect of taxation had received a formal treatment, with the Kaldor-Hicks compensation principle underlying an artificial dichotomy between efficiency and distributional issues.

A crucial aspect of the Diamond-Mirrlees analysis (Diamond and Mirrlees, 1971), and one that has characterised the modern literature on taxation, is the use of the so-called Bergson-Samuelson individualistic social welfare function[25] as the criterion for judging the appropriate combination of equity improvements and efficiency losses due to taxation. This social welfare function criterion has been widely applied to the problem of characterising the best (optimal) structure of a tax system as well as to identify possible improvements to some given tax system. In the first case the problem is usually interpreted as one of *tax design* and is the subject of the theory of optimal taxation, whereas the second case is concerned with questions of *tax reforms*.[26]

2.2. Optimal Tax Design and the Question of Uniformity

The optimal structure of commodity taxes was first investigated, in the context of a single-person economy (or equivalently, an economy of identical individuals) by Ramsey (1927). The problem he examined was one of choosing a set of commodity taxes that raised a given amount of government revenue with the least possible reduction in consumer utility.

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[25] This social welfare function describes social welfare as a function of the utility levels of individuals in society.

[26] The difference as well as the relationship between the two approaches have been discussed by, among others, Feldstein (1976), Guesnerie (1977) and Stern (1984).

Note however that the analysis of optimal taxation in the case of an one-consumer economy is at variance with what was said in section 2.1, for if distributional concerns are non-existent, the best way to raise revenue is by means of a uniform lump-sum tax.[27] This renders Ramsey's analysis unsatisfactory for deriving rules for tax policy although his results serve as a valuable reference in clarifying the discussion of certain questions of tax.

The analysis of optimal commodity taxes in a many-consumer economy began with the seminal work of Diamond and Mirrlees who extended Ramsey's formulation to take account of the redistributive effects of taxation. The optimal tax problem as set out by them essentially involves choosing the optimal tax rates to maximise a Bergson-Samuelson social welfare function subject to the government's budget constraint.

The period since the publication of this pioneering research has seen much progress in the theoretical and empirical analysis of the optimal tax problem and currently a voluminous literature exists on the subject.[28] A key feature of this literature is the discussion of whether or not a uniform system of commodity taxes - which applies the same percentage rate to all consumer goods and services - is preferable to a differential system.[29]

Ramsey (1927)'s results provide important insights into this question. The so-called Ramsey rule establishes that the optimal set of commodity taxes reduces the

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[27] This has been acknowledged frequently in the literature. See, for example, Mirrlees (1975, p. 27) and Atkinson (1977, p. 598).

[28] Comprehensive surveys of the theory of optimal taxation are Auerbach (1985) and Stiglitz (1987). A more introductory account of the theory as well as examples of its practical applications is Newbery and Stern (1987).

[29] An account of the theoretical results and arguments concerning this issue is to be found in Stern (1990).

compensated demand for every commodity by (approximately) the same proportion.[30] Clearly, this rule stands in contrast to the conventional view that a uniform rate of tax on all consumer goods is necessarily best at promoting economic efficiency. There are only two cases where uniform taxation is consistent with the Ramsey criterion: first, where labour (the untaxed numeraire) is in completely inelastic supply[31], and second, where labour (leisure) is implicitly separable from all goods.[32] Apart from these special cases, however, the Ramsey rule does not prescribe uniform taxation and instead indicates that taxes should be higher on goods whose demands are relatively insensitive to price changes. In fact, under the assumption of independent compensated demands for consumer goods, the Ramsey result simplifies to the so-called "inverse elasticity rule" which says that the tax rate should be inversely proportional to the price elasticity of demand of a commodity.

It has been recognized, however, that the imposition of efficiency cost-minimising commodity taxes will in general have a regressive impact on income distribution, for goods with price-insensitive demands are in many cases necessities such as food.[33] This reinforces the argument that the single-consumer analytical framework in inadequate for the formulation of policy-relevant propositions.

The way distributional considerations modify the design of optimal commodity

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[30] This result depends on the optimal taxes being small.

[31] In this case the classic rule is to tax labour alone, which is equivalent to taxing all goods at the same rate. See Atkinson and Stiglitz (1972), for example, for a demonstration of the optimality of this solution.

[32] Implicit separability requires that the marginal rate of substitution between any two goods be independent from the demand for leisure at constant utility, and means that all goods complement leisure equally. The implication of this feature for the Ramsey rule is shown in Deaton (1981).

[33] Calculations of tax rates based on the Ramsey rule using empirically-estimated elasticities provide some evidence for this supposition. See Atkinson and Stiglitz (1972), Harris and Mackinnon (1979) and Kaiser and Spahn (1989).

taxes is captured by the so-called many-person Ramsey rule (also referred to as the Diamond-Mirrlees rule). It says that the proportional reduction in compensated demand resulting from taxation should be lower for that good that is consumed more by people whose social marginal valuation of income is high (generally the poor).[34]

Thus, while efficiency considerations point towards the taxation of necessities, the introduction of distributional concerns indicates that some progression in the taxation of commodities may be desirable.

The case for employing commodity taxes to promote redistribution depends, however, on the extent to which income tax tools can be used to achieve the same objective. For it has been shown that under certain circumstances the presence of an income tax implies that commodity taxes should be uniform. The conditions for uniformity, nevertheless, depend on the type of income tax available. If there is an optimal non-linear income tax, then uniform commodity taxation is optimal provided that individuals have identical preferences (differing only in their wage rates) and that goods are weakly separable from leisure.[35]

With an optimal linear income tax, which comprises a uniform poll subsidy or tax and a constant marginal rate of tax on wage income, Deaton (1979) has shown that linear Engel curves for goods in addition to identical preferences and weak separability between goods and leisure implies the optimality of uniform commodity taxes.[36] Deaton and Stern (1986) have extended this result to show that if the government can

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[34] See Atkinson and Stiglitz (1976) for the derivation of this rule.

[35] Weak separability from leisure means that the marginal rate of substitution between any two goods is independent of leisure. This result is due to Atkinson and Stiglitz (1976).

[36] This is a generalisation of the result obtained by Atkinson (1977) who established the desirability of uniform commodity taxation, given an optimal linear income tax, for the case where preferences are represented by the Linear Expenditure System.

make lump-sum transfers that vary with (observable) household characteristics, then the uniformity result holds also where households are allowed to differ in tastes, provided that the differences are fully captured by different Engel curve intercepts.

It is clear that it is not possible to derive general statements from optimal taxation rules about the desirable degree of non-uniformity in the tax system or about the commodities that should bear higher taxes than others. As the results stated above indicate, the answer for these issues depends crucially on the combination of four factors, namely:

(1) the set of tax tools at the disposal of the government;

(2) the way consumers differ from each other;

(3) the structure of preferences; and

(4) the social weights assigned to the welfare of different consumers and income groups.

Further insights into the design of optimal taxation can be obtained by the specification and solution of numerical models whose structure and parameters reflect particular assumptions concerning each of the factors enumerated above. Obviously, the choice of assumptions should be influenced by the specific circumstances of the country under consideration.

The numerical approach can provide an idea of the magnitude of optimal taxes as well as a scheme for the analysis of the sensitivity of these magnitudes to the assumptions underlying the model.

It has been suggested that for developing countries the distributional argument for a differentiated indirect tax structure is stronger than for developed countries. This is on account of the fact that most developing countries have to rely on indirect taxes

as their main fiscal instruments since they face severe constraints on the implementation of progressive income taxation policies and income support systems. In developed countries, on the other hand, personal income taxes along with social security systems are the primary redistributive tools of the fiscal system.

Among the common features of developing countries that constrain the enforcement of income taxation are inadequate administrative and accounting systems, concentration of employment in the agricultural and informal sectors, large numbers of small-scale enterprises and a highly unequal distribution of income.[37] Another factor sometimes pointed out as confounding the taxation of income in developing countries is the particularly adverse attitude of individuals towards paying taxes. It is claimed that income taxes create more resistence than indirect taxes since they are more visible and offer taxpayers less opportunities to influence the amount they pay.

It is worth noting too that great inequality in the distribution of income is likely to be accompanied by sharp differences in consumption patterns across income groups. While this serves to highlight possible distributional objectives, it also suggests that discriminatory commodity taxation can play a useful role in achieving these objectives. However, the institutional characteristics of developing countries also impose restrictions on the structure of commodity taxes. In particular, it may not be possible to tax food consumed by farm households. Note that in this case, uniformity is obviously ruled out as a feasible alternative.

In the early quantitative models of optimal taxation the choice of assumptions about the problem faced by the government was essentially dictated by the need to use

[37] For an account of the special characteristics of developing countries and their influence on tax design see, among others, Newbery (1987).

relatively simple computational techniques. Examples of these are Atkinson and Stiglitz (1972) and Deaton (1977) which assume that the only policy tools available to the government are commodity taxes, that all goods are taxable and that all consumers have identical tastes (Atkinson and Stiglitz also assume identical individuals). Subsequent theoretical and quantitative developments have made it possible to devise and implement models that are considerably more elaborate and which capture critical aspects of real economies. For example, Heady and Mitra (1982) deal with restrictions on the possible patterns of taxation, while Heady and Mitra (1986 and 1987) explore the consequences of viewing such restrictions as a reflection of the dualism characteristic of developing economies - which represents the significant differences between the urban (modern) sector and the rural (traditional) sector.[38] In Ebrahimi and Heady (1988) households are allowed to differ in their size and age structure and the government can pay a poll subsidy (along with commodity taxes) that varies across household groups.

Although considerable progress has been made in the analysis of optimal tax design, there is a basic aspect of that approach that limits its practical applicability. This concerns the fact that the approach derives the desired tax structure without considering the existing tax system - so that the former often represents a great departure from the latter. This means that computing optimal tax rates may require estimates of demand and supply responses at points well beyond those that have been observed in practice. Typically, this implies that one has to make the unrealistic assumption that certain behavioural parameters (e.g., price and income elasticites) are constant over a wide range of prices. In addition, the imposition of the optimal tax structure may entail

[38] Earlier analyses of optimal restricted taxation are purely theoretical, such as Stiglitz and Dasgupta (1971) and Munk (1980).

considerable administrative and political costs.

In view of this, the full implementation of the optimal tax system may be undesirable or infeasible. Yet, for any given tax system, there is likely to be a number of politically- and administratively-acceptable partial reforms that would improve social welfare. The problem of specifying such reforms has been addressed in many papers, which constitute another large body of the tax literature, that of partial tax reforms.

2.3. The Analysis of Partial Tax Reforms

Rather than seeking to characterise the best tax design, the analysis of tax reform is concerned with the identification of feasible welfare-improving changes to some given tax system. It therefore tends to focus on smaller movements away from the status quo than would result from optimisation.

The importance of the formal analysis of reforms lies in that the direction in which taxes should be moved is not in general obvious, since changes towards some optimum do not necessarily result in an improvement in social welfare if optimality is not achieved.[39]

A technique for analysing marginal tax reforms is provided by Ahmad and Stern (1984 and 1987).[40] Their approach applies the framework of the Diamond-Mirrlees model to search for those directions of tax moves that can increase social welfare

[39] This applies to any second-best policy. See Lipsey and Lancaster (1956).

[40] See also Dreze and Stern (1987). The theory of marginal tax reform was initiated by Guesnerie (1977).

without decreasing tax revenue.[41]

There exists a close theoretical relationship between the reform problem and that of optimisation, since it can be shown that the conditions under which no welfare-improving tax reform is possible are equivalent to the necessary conditions for the optimality of the tax system.

Dealing with marginal reforms has the advantage of avoiding the difficulties of predicting demand responses at points far away from the status quo. On the other hand, it has the disadvantage of leaving out of the analysis more substantial changes, normally associated with actual reforms.

In its turn, the study of non-marginal tax reforms involves comparing the outcome from the reform with the starting situation. This requires a more detailed framework of analysis than that of marginal reforms, since now one must take account the general equilibrium effects of the reform. Computable general equilibrium models of the kind surveyed by Shoven (1983) and Shoven and Whalley (1984) have been widely used by economists to simulate the consequences of non-marginal tax changes in particular economies. In assuming a representative consumer or only a small number of them, however, the practitioners of this technique have traditionally concentrated on the efficiency analysis of taxation.

Other authors have developed models and procedures designed to focus on the effects of (non-marginal) tax changes on the welfare of the different households in a society. Examples of these are King (1983, 1987) and Atkinson and Sutherland (1988) whose models simplify the production sector of the economy and are thus capable of

[41] As noted in the introduction to this work, this approach has been used by Sampaio de Souza (1993) to identify beneficial directions of reform in the Brazilian indirect tax system.

dealing with a large sample of households and using actual observations from survey data.

An important aspect of the non-marginal methods of analysis is that they can provide information on the distribution of welfare gains and losses among households. The change in a household's welfare from a proposed tax reform is commonly measured using the Hicksian equivalent or compensating variations, which are based on the household's utility function. In order to evaluate reform proposals and identify the most socially desirable one, distributional weights need to be assigned to the change in the welfare of different households. This is equivalent to using an explicit social welfare function, as in the optimal taxation approach.[42]

The specific advantages and limitations of the different methods of tax analysis point to the importance of carrying them out simultaneously, in which case, the analyses can complement each other in a number of ways. For example, optimal tax calculations can guide the formulation or selection of particular proposals for reform as follows. First, the computed optimal tax rates can provide insights into the direction as well as the extent of worthwhile tax changes. Second, the estimated social welfare gains from the implementation of the optimal tax structure can give an idea of the appropriate compromise between the objectives incorporated into the optimal tax model (i.e., equity and efficiency) and those objectives that are exogenous to the model's framework (e.g., administrative convenience). In turn, the reform approach, by not involving optimisation, allows a greater disaggregation of consumers and commodities, providing supplementary information to the analysis. It can also be used to check whether a

[42] One example of the application of the social welfare function criterion to evaluate tax reform options is Rosen (1976).

particular partial reform could be improved upon without violating existing political constraints, as suggested by Heady and Mitra (1986) and by Ahmad and Stern (1987).

Chapter 3

An Optimal Tax Model For Brazil

3.1. Introduction

The discussion on the theory of optimal taxation carried out in the preceding chapter suggests that the appropriate structure of commodity taxation crucially depends on the circumstances of each particular country. This chapter sets out a model to compute optimal taxes, which seeks to capture some critical aspects of the problems faced by the Brazilian tax authorities. In particular, the model is designed to represent a situation where the government, constrained in its ability to tax, wishes to levy commodity taxes not only to raise revenue but also to promote redistribution. Further, the chapter describes the data used to solve the model and also the specification of its behavioural parameters.

3.2. The Model

The assumptions regarding the production side of the economy are kept deliberately simple in order to concentrate on the twin concerns of consumer welfare and revenue collection. Consequently, there are no profits and producer prices are constant. This means that the effect of commodity taxes on consumer welfare works entirely through changes in consumer prices, ignoring all effects from changes in factor

prices and profits.[43]

The following two sections detail the behaviour of households and the taxation problem faced by the government.

3.2.1. Households

The model distinguishes between urban and rural populations, a division that highlights two aspects of the dualism inherent in the Brazilian economy which may crucially influence tax design, namely: (1) the severe constraints on the taxation of transactions within the rural sector, and (2) the disparities in the living standards of rural and urban residents.

The rural and urban populations are each divided into nine groups of households according to household expenditure. All households in a given expenditure group are assumed to be identical, so that each group's behaviour may be described by a "representative" household.

Further, the absence of wage and earnings data makes it imperative to assume that each household takes consumption expenditure as exogenously given. In addition, it is supposed that there are no savings, so that income and total consumption expenditure are interchangeable.[44]

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[43] Another reason for making these assumptions is the lack of reliable data on profits and factor returns. In the empirical literature in this area the traditional procedure used to exclude pure profits is to assume either constant returns to scale (and competitive conditions in production) or 100 percent taxes on profits. Although the constancy of producer prices involves more restrictive conditions (Stern, 1987), the assumption of full shifting of commodity taxes into consumer prices is adopted in most incidence analyses, including the only one existing for Brazil, namely, Eris et al (1983). For a discussion of the role of these assumptions in optimal tax models, see Stiglitz and Dasgupta (1971).

[44] Together these assumptions imply that the supply of labour is inelastic.

In addition, while households may also receive lump-sum payments from the government, these payments are assumed to be the same for all households within a sector.

The model is now specified as follows. Urban households, indexed by l, face a vector of urban consumer prices, q, and rural households, indexed by m, face a vector of rural consumer prices, s. The budget constraint for each representative household in urban and rural areas then is

$$\sum_{i=1}^{n} q_i x_i^l = y^l + I = Y^l \tag{3.1}$$

and

$$\sum_{i=1}^{n} s_i x_i^m = y^m + I' = Y^m \tag{3.2}$$

respectively, where

i	=	index over the consumption goods;
x_i^l (x_i^m)	=	consumption of good i by household l (m);
y^l (y^m)	=	fixed labour income of household l (m);
I (I')	=	lump-sum transfer received by each household in urban (rural) locations;
Y^l (Y^m)	=	total income received by household l (m).

Each household l and each household m is assumed to choose consumption goods so as to maximise their utilities subject to (3.1) and (3.2), respectively. This leads to the demand functions

$$x_i^l(q,I) \text{ and } x_i^m(s,I')$$

and the indirect utility functions

$$v^l(q,I) \text{ and } v^m(s,I').$$

These functions are written in terms of the prices and the lump-sum transfers

alone because these are the variables subject to government control, in the model, while household incomes y are fixed.

3.2.2. Government

The government is assumed to be interested in using taxes both to raise a certain amount of revenue and to redistribute income.

In view of the characteristics of the Brazilian economy and tax system described in Chapter 1, the case where commodity taxes are the only policy instruments at the disposal of the government is emphasised. However, this situation will be compared with the more general case where, in addition to commodity taxes, the government can also grant lump-sum subsidies to households which may differ across rural and urban locations (although they must still be identical to all households within the same sector).

It is interesting to note that allowing for poll transfer payments to households is equivalent to allowing a linear income tax characterised by an exemption level and a constant marginal rate of tax both above and below this level.[45]

Finally, the model incorporates actual constraints on taxation possibilities as restrictions in the formulation of the government's tax problem.

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[45] Since there are no savings, a uniform tax on all commodities is equivalent to a proportional tax on income. Below the exemption level this tax is lower than the poll subsidy received by a household. However, it must be noted that the difficulties associated with administering lump-sum transfers to all households in the economy (or indeed any income tax scheme with full coverage) in a country like Brazil, where a large part of the population has no direct contact with government agencies, mean that the implementation of such a policy may well be impractical.

3.2.2.1. The social welfare function

It is assumed that the government's distributional objectives can be expressed through a social welfare function, W, based on the households' utility levels. In keeping with most studies, it is supposed that this function has the following specific form:

$$W = \frac{1}{(1-\epsilon)}\left[\sum_{l=1}^{9} h^l v^l(q,I)^{1-\epsilon} + \sum_{m=1}^{9} h^m v^m(s,I')^{1-\epsilon}\right] \qquad (3.3)$$

when ϵ is not equal to 1, and

$$W = \sum_{l=1}^{9} h^l \log v^l(q,I) + \sum_{m=1}^{9} h^m \log v^m(s,I') \qquad (3.3')$$

when ϵ is equal to 1

where

$h^l(h^m)$ = fraction of households in the group represented by household l (m)

and ϵ = a parameter reflecting the government's aversion to inequality (Atkinson, 1970), with $\epsilon \geq 0$.

When ϵ is zero, (3.3) corresponds to the classical utilitarian welfare function, which places equal weights on the utility changes of all households. As ϵ increases, higher weights are attached to changes in the utilities of the less well-off households. For example, a value of 1 for ϵ implies that if the utility of household l is twice that of household m, then a marginal increase in the utility of household m is worth twice the marginal increase in the utility of l; a value of 5 for ϵ indicates that a marginal increase in the utility of household m is worth 32 times a marginal increase in the utility of household l.

As ϵ approaches infinity, the social welfare function (3.3) approximates the Ralwsian "maximin" criterion, by considering the utility only of the worst-off household.

Optimal taxes are computed for values of ϵ of 0.1, 0.5, 1, 2, and 5 in order to cover a broad range of distributional judgements.

It is also worth noting that the value of ϵ reflects the degree of aversion to the inequality of utility, and that the degree of aversion to inequality of income depends on both the value of ϵ and on the particular cardinalisation chosen for the indirect utility function. The indirect utility functions used assume a constant marginal utility of income.

Furthermore, in order to make some allowance for the problem of comparing the welfare of households of different sizes, results are reported for the same welfare function but with the households' utilities replaced by the utilities of individuals.

3.2.2.2. The Government's budget constraint

Since the government raises revenue to cover its expenditures, R, on some given activities, and also to finance the lump-sum payments to households, it faces a budget constraint:

$$R + I\sum_{l=1}^{9} H^l + I'\sum_{m=1}^{9} H^m = \sum_{i=1}^{n} t_i \sum_{l=1}^{9} H^l x_i^l + \sum_{i=1}^{n} t'_i \sum_{m=1}^{9} H^m x_i^m \quad (3.4)$$

where

H^l (H^m) = number of households in group l (m);
t_i (t'_i) = value of the tax on good i in urban (rural) areas.

Under the assumptions of the model:

$$t_i = q_i - p_i \tag{3.5}$$

$$t_i' = s_i - p_i \tag{3.6}$$

for $i = 1,\ldots,n$, where p_i is the (fixed) producer price of good i, which is to be normalised at unity.

3.2.2.3. Tax restrictions

The model recognises that the government may not be able to tax all goods at will. In particular, it allows for the fact that the conventional features of agriculture in Brazil have effectively prevented the government from taxing internal trade within that sector (see Chapter 1).

In addition, it admits that due to the possibility of arbitrage between the urban and rural sectors the government may be constrained to tax certain goods in both sectors at the same rate.

Accordingly, two kinds of restrictions on the possible structure of commodity taxes are considered: (i) goods produced and consumed within the rural area cannot be taxed or subsidised, and (ii) some goods must be taxed at the same rate in rural and urban areas.

Following Heady and Mitra (1986), these restrictions are represented as:

$$\boldsymbol{Cs = Cp} \tag{3.7}$$

$$\boldsymbol{Dq = Ds} \tag{3.8}$$

respectively, where $\boldsymbol{C}$ and $\boldsymbol{D}$ are diagonal matrices with elements of 1 and 0, which

select the prices for which the restriction must hold.

In order to examine the effects of constraints on the government's ability to make lump-sum transfers, the following additional conditions are imposed:

$$I = I' \tag{3.9}$$

$$I = 0 \tag{3.10}$$

Expression (3.9) reflects the case where the government is constrained to set the value of the poll subsidies uniformly across rural-urban locations, whereas the combination of (3.9) and (3.10) reduces the model to the case where no lump-sum transfers are possible.

3.2.2.4. The Government's problem

The government's problem is then defined as one of choosing commodity tax rates (or, equivalently, consumer prices) and poll subsidies to maximise the social welfare function (3.3) subject to the budget constraint (3.4) and the tax restrictions (3.7), (3.8), (3.9) and (3.10).

The Lagrangian for this problem is:

$$\begin{aligned} L = {} & \frac{1}{1-\epsilon}\left[\sum_{l=1}^{9} h^l (v^l)^{1-\epsilon} + \sum_{m=1}^{9} h^m (v^m)^{1-\epsilon}\right] \\ & + \lambda\left[\sum_{i=1}^{n}(q_i - p_i)\sum_{l=1}^{9} H^l x_i^l + \sum_{i=1}^{n}(s_i - p_i)\sum_{m=1}^{9} H^m x_i^m - I\sum_{l=1}^{9} H^l - I'\sum_{m=1}^{9} H^m - R\right] \\ & + \phi^T [\,Cs - Cp\,] + \mu^T [\,Dq - Ds\,] + \nu\,[\,I - I'\,] + \omega\, I \end{aligned} \tag{3.11}$$

where (3.5) and (3.6) have been substituted for t_i and t_i' in (3.4), respectively; λ, ν and ω are scalar multipliers corresponding to (3.4), (3.9) and (3.10), respectively; ϕ and μ are vectors of multipliers corresponding to (3.7) and (3.8), respectively; and T denotes the transpose operation.

The first-order conditions for q_i, s_i, I and I' are:

$$\frac{\delta L}{\delta q_i} = \sum_{l=1}^{9} h^l (v^l)^{-e} \left(\frac{\delta v^l}{\delta q_i} \right) + \lambda \left[\sum_{l=1}^{9} H^l x_i^l + \sum_{j=1}^{n} (q_j - p_j) \sum_{l=1}^{9} H^l \left(\frac{\delta x_j^l}{\delta q_i} \right) \right] + \mu_i d_i = 0, \qquad i = 1,\ldots,n \tag{3.12}$$

$$\frac{\delta L}{\delta s_i} = \sum_{m=1}^{9} h^m (v^m)^{-e} \left(\frac{\delta v^m}{\delta s_i} \right) + \lambda \left[\sum_{m=1}^{9} H^m x_i^m + \sum_{j=1}^{n} (s_j - p_j) \sum_{m=1}^{9} H^m \left(\frac{\delta x_j^m}{\delta s_i} \right) \right] + \phi_i c_i - \mu_i d_i = 0 \qquad i = 1,\ldots,n \tag{3.13}$$

$$\frac{\delta L}{\delta I} = \sum_{l=1}^{9} h^l (v^l)^{-e} \left(\frac{\delta v^l}{\delta I} \right) + \lambda \left[\sum_{i=1}^{n} (q_i - p_i) \sum_{l=1}^{9} H^l \left(\frac{\delta x_i^l}{\delta I} \right) - \sum_{l=1}^{9} H^l \right] + \nu + \omega = 0 \tag{3.14}$$

$$\frac{\delta L}{\delta I'} = \sum_{m=1}^{9} h^m (v^m)^{-e} \left(\frac{\delta v^m}{\delta I'} \right) + \lambda \left[\sum_{i=1}^{n} (s_i - p_i) \sum_{m=1}^{9} H^m \left(\frac{\delta x_i^m}{\delta I'} \right) - \sum_{m=1}^{9} H^m \right] - \nu = 0 \tag{3.15}$$

where c_i=1 when the rural tax rate on good i must be zero and c_i=0 otherwise; d_i=1 when good i must have the same consumer price in rural and urban areas and d_i=0 otherwise.

For those goods not subject to a tax restriction, equation (3.12) [and (3.13)] is the standard optimal commodity tax formula in a many-person economy. This equation can be transformed to generate the "many-person Ramsey tax rule" mentioned in Chapter 2. Using equation (3.14) [(3.15)], one can show how this rule is modified by the presence of an optimal linear income tax.[46]

3.3. Household Utility and Demand Functions

The main set of results are derived using the Linear Expenditure System (LES) to specify the households' demand and utility functions. For purposes of comparison, some results for the Cobb-Douglas specification are also presented.

There are three reasons for choosing these functional forms. Firstly, the simplicity of the LES and Cobb-Douglas formulations permits their parameterisation using the available (cross-sectional) data.[47] The second reason is that these simplify calculations, since the computational cost associated with solving the first-order conditions for an optimal tax structure (equations 3.12-3.15) is not trivial. Finally, LES and Cobb-Douglas demand functions are derivable from constrained utility maximisation and are thus theoretically consistent with the assumptions of the model.

As is well known, the price of the mathematical convenience of the LES and Cobb-Douglas functions is that certain restrictions are placed on consumer behaviour. In the LES case, these restrictions are a consequence of the fact that the underlying

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[46] See, for example, Diamond and Mirrlees (1971) and Atkinson and Stiglitz (1976). Appendix A at the end of this chapter presents conditions (3.12)-(3.15) in the transformed form in order to indicate how the standard rule is changed by the introduction of tax restrictions.

[47] In the case of LES, assumed values were necessary for full parameterisation (see below).

utility function is additive and quasi-homothetic. Additivity rules out inferior goods and implies that all goods are net (i.e., Hicksian) substitutes. Quasi-homotheticity implies linear Engel curves, so that marginal expenditure shares are independent of total expenditure.

In turn, Cobb-Douglas utility functions are homothetic, which means that Engel curves are straight lines through the origin and entails unitary income and own-price elasticities as well as zero cross-price elasticities.

Both additivity and linearity of Engel curves are more acceptable working hypotheses for broad groups of commodities (than for single commodities) and for a limited range of total expenditure variation. In view of this, consumption goods are classified in nine broad categories in our model,[48] and the slopes of the Engel curves used are separately estimated by income class.

The demand equations corresponding to the LES can be written as:

$$x_i = \alpha_i + \frac{\beta_i}{q_i}\left(Y - \sum_{j=1}^{n} q_j \alpha_j\right), \quad i=1,\ldots,n \tag{3.16}$$

or as

$$q_i x_i = q_i \alpha_i + \beta_i\left(Y - \sum_{j=1}^{n} q_j \alpha_j\right), \quad i=1,\ldots,n \tag{3.16'}$$

where x_i is the quantity of the ith good consumed, q_i its price, Y total expenditure on the n goods, and α_i and β_i are parameters that satisfy the constraints:

[48] A more disaggregated classification is avoided for computational reasons and also because of the difficulties associated with administering a tax system with many different rates. See below for a description of the commodity categories used.

$$\sum_{i}^{n} \beta = 1 , \qquad \beta_i > 0 , \qquad x_i - \alpha_i > 0$$

for all i.[49]

The indirect utility function, v, for the LES is:

$$v = \frac{\left(Y - \sum_{i=1}^{n} q_i \alpha_i \right)}{\prod_{i} q_i^{\beta_i}} \qquad (3.17)$$

Equation (3.16') is often interpreted as stating that the consumer first purchases "subsistence" or "committed" quantities of each good, α_i (i=1,..,n), on which a portion $\Sigma q_i \alpha_i$ of total expenditure is spent. The remainder of the consumer's total expenditure, $Y - \Sigma q_i \alpha_i$, termed "supernumerary expenditure", is then spent among the n goods according to fixed proportions β_i (i=1,...,n).[50]

Note, however, that the subsistence quantity interpretation of the α's is not appropriate if some of them are negative - which is not precluded by the theoretical basis of the LES. It can be shown that demand is inelastic for positive α's and elastic for negative α's.

If all of the α_i's equal zero, the model reduces to the Cobb-Douglas case, so that demands are given by

[49] These restrictions are required for consistency with utility maximisation subject to a budget constraint.

[50] This interpretation allows the indirect utility function (3.17) to be seen as taking "real expenditure" as an indicator of welfare, in that it expresses utility as a function of supernumerary expenditure deflated by a price index, the latter calculated as the weighted geometric mean of the prices with the marginal shares β_i as weights.

$$x_i = \frac{w_i Y}{q_i}, \quad i = 1,\ldots,n \tag{3.18}$$

where w_i is the (average) budget share of good i, and the underlying indirect utility function is of the form

$$v = \frac{Y}{\prod_i q_i^{w_i}} \tag{3.19}$$

3.4. The Data

The data on household expenditure are obtained from a survey on family budgets conducted by the Brazilian Institute of Geography and Statistics in 1974-75 (see IBGE, 1981). This survey, referred to as ENDEF (*Estudo Nacional da Despesa Familiar*), covers a total of about 55,000 families and is the only one carried out at national level so far.

The published ENDEF data groups families by nine classes of total expenditure and reports the mean expenditure on each consumption category for each expenditure class. The number of households and the average number of persons per household in each expenditure class are also reported. All this information is provided separately for urban and rural areas.

Table 3.1 below shows the expenditure levels that define the nine groups of households in the ENDEF tables.[51]

[51] The definition of expenditure in this classification includes consumption and non-consumption expenditure (which includes taxes, transfers, purchase of fixed assets, payment of debts, etc).

Table 3.1

Household Groups
(classified by annual total expenditure)

Group Number	Expenditure Range (in 1974 cruzeiros)	Number of Annual (1974) Minimum Wages
1	less than 4,500	less than 1.0
2	4,500 - 8,999	1.0 - 2.0
3	9,000-15,799	2.0 -3.5
4	15,800 - 22,599	3.5 - 5.0
5	22,600 - 31,599	5.0 - 7.0
6	31,600 - 45,199	7.0 - 10.0
7	45,200 - 67,799	10.0 - 15.0
8	67,800 - 134,799	15.0 - 30.0
9	More than 134,799	More than 30.0

Note These expenditure levels are calculated in terms of fractions or multiples of the highest official monthly minimum wage in force in August 1974, Cr$ 376.80, which corresponds to approximately Cr$ 4,500.00 yearly.

The ENDEF tables identify nine major categories of consumption goods.[52] Although as mentioned earlier, the model also adopts a nine-commodity classification, the commodity groups do not coincide in every case with those from ENDEF. In order to obtain what seems to be a more adequate classification for tax purposes, some of the ENDEF categories and subcategories have been recombined. The names given to the commodity groups used in the model are: food, clothing, housing, durables, personal care, transport, recreation, beverages & tobacco, and miscellaneous. Their relationship with the ENDEF categories is as follows.

The model category 'food' excludes alcoholic beverages, while 'housing' is the

[52] These are: food, clothing, housing, personal care and health expenses, transport, education, recreation and reading, tobacco, and miscellaneous expenditures.

sum of three of the subcategories of housing from ENDEF, namely, rent and other housing charges, household maintenance, and cleaning products. 'Durables' is a combination of the two other subcategories of ENDEF housing - namely, furniture and household articles - and motor vehicles. The category alcoholic beverages is added to the ENDEF category tobacco to obtain the model category 'beverages & tobacco' while 'miscellaneous' includes education.[53] The categories not mentioned in this paragraph correspond exactly to the ENDEF classification.

Tables 3.2A and 3.2B below summarize the information on household expenditures and give the number of households and the average household size for each expenditure class in rural and urban areas respectively.

[53] The other principal items included in miscellaneous are: professional services, hotel accommodation, interest payments, and gifts.

Table 3.2A

Annual Expenditures per Household (in thousands of 1974 cruzeiros), Number of Households and Average Household Size, by Household Group - Urban Areas

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	1.656	3.511	5.504	7.226	8.808	9.964	11.305	12.740	16.448
Clothing	0.162	0.411	0.806	1.383	2.085	2.810	3.707	5.431	9.597
Housing	0.774	1.527	2.753	4.387	6.010	8.272	11.195	18.782	41.924
Durables	0.072	0.254	0.627	1.146	1.674	2.772	5.106	10.378	23.407
Personal Care	0.139	0.330	0.639	1.059	1.493	2.112	2.980	4.526	8.599
Transport	0.038	0.142	0.353	0.650	1.156	2.082	3.748	6.379	10.652
Recreation	0.010	0.042	0.093	0.182	0.306	0.565	0.856	1.624	3.095
Beverages & Tobacco	0.083	0.188	0.371	0.551	0.712	0.877	1.031	1.111	1.287
Miscellaneous	0.051	0.135	0.340	0.686	1.176	1.874	3.142	5.628	13.772
Total	2.985	6.540	11.486	17.261	23.420	31.328	41.070	66.599	128.781
Number of Households (thousands)	641	1,568	2,481	1,914	1,652	1,319	1,068	920	469
Proportion of Households	0.033	0.082	0.130	0.100	0.086	0.069	0.056	0.048	0.025
Average Household Size	2.72	4.04	4.85	5.07	5.34	5.17	4.95	4.54	4.47

Annual Expenditures per Household (in thousands of 1974 cruzeiros), Number of Households and Average Household Size, by Household Group - Rural Areas

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	2.029	4.215	6.924	9.140	10.476	12.399	12.863	14.456	16.211
Clothing	0.160	0.450	0.949	1.482	2.392	2.778	3.433	4.107	7.936
Housing	0.482	0.840	1.466	2.345	3.292	3.897	5.011	7.416	12.888
Durables	0.077	0.216	0.506	1.012	1.879	3.704	7.946	11.665	21.038
Personal Care	0.106	0.304	0.683	1.280	1.682	2.438	2.848	4.493	6.138
Transport	0.027	0.073	0.176	0.469	1.054	2.114	3.923	6.264	13.914
Recreation	0.009	0.028	0.061	0.119	0.204	0.260	0.405	0.571	1.172
Beverages & Tobacco	0.063	0.124	0.222	0.396	0.501	0.699	0.785	1.016	1.183
Miscellaneous	0.050	0.137	0.358	0.753	1.197	2.043	2.454	5.090	12.681
Total	3.003	6.387	11.345	16.996	22.677	30.332	39.666	55.078	93.161
Number of Households (thousands)	1,554	2,435	1,641	642	377	222	129	80	23
Proportion of Households	0.081	0.127	0.086	0.034	0.020	0.012	0.007	0.004	0.001
Average Household Size	3.44	5.15	6.26	6.55	6.42	6.81	6.51	6.38	5.76

In these tables, expenditure is defined as including monetary and non-monetary expenditures. Monetary expenditures refer to cash expenditures while non-monetary expenditures comprise gifts received, salaries in kind received from employers, home-produced goods, and the inputed rent of owner-occupied houses.

In most of the computations, the government's revenue requirement R (equation 3.4) is fixed and equal to the net revenue raised from households in 1975, which was approximately 10.06 percent of total household expenditure.

Also the 1975 effective tax rate for each of the nine model commodities is calculated, since these are to be used not only to calculate the α parameters of LES but also as a reference system for the comparative analysis in Chapter 5.

The basic data used are taken from the "Matrix of Intersector Transactions" of Brazil for 1975 (IBGE, 1987), which contains information on the total expenditure (at consumer prices) and the total net payment of indirect taxes by families, for the consumption of each of two hundred and sixty-one (261) categories of commodities.

The effective tax rate faced by households on a given commodity is calculated as the ratio of total net tax payment to total (gross-of-tax) expenditure on that commodity. This requires a prior aggregatation of consumption categories of the transactions matrix according to the model's nine-commodity classification, before adjusting the data to make them compatible with the definition of expenditure used in the ENDEF survey. The correspondence between the classification of the matrix and the model's commodity groups is in Appendix B at the end of this chapter. The adjustments to the matrix data involved mainly the inclusion of rent and non-monetary expenditure. To impute rent, the ratio of the expenditure on rent to total expenditure on housing was calculated from the ENDEF tables and then applied to the matrix data.

Similarly, non-monetary expenditure was imputed using the proportion of non-monetary to monetary expenditure for each commodity group provided in the ENDEF tables.[54]

Table 3.3 below displays the estimated 1975 effective tax rate and the corresponding consumer price for each of the model's nine commodities, where all producer prices have been normalised to unity.[55] It is worth noting that, since the calculations of those rates are based on actual revenue collections rather than on official rates, the estimates incorporate problems such as evasion and low coverage. For example, the rate of 7 percent for food is mainly due to the impossibility of taxing most food consumed in rural areas, whereas the rate of 1.6 percent on the miscellaneous category reflects not only the low nominal rates on services (which are the main components of that category) but also a low level of coverage and the ease of evasion in this sector.

[54] Since the information on personal consumption presented in the 1975 intersectoral transactions tables is based on the ENDEF survey, there is a reasonable degree of compatibility between the data used in the model and the data in the intersectoral transactions tables.

[55] Notice that the tax rates in Table 3.3 , say r_i, are defined by $r_i = t_i/q_i$, where as before q_i is the consumer price of good i and t_i is the tax paid on the purchase of a unit of good i. Thus, under the assumption that $t_i = q_i - p_i$ (equation 3.5) and with producer prices normalised at unity, q_i is obtained from $q_i = 1/(1-r_i)$.

TABLE 3.3

Estimates of 1975 Effective Tax Rates and Consumer Prices

Commodity Group	Tax Rate (As a proportion of consumer price).	Consumer Price (With producer prices normalised at unity).
Food	0.070	1.075
Clothing	0.133	1.153
Housing	0.044	1.046
Durables	0.178	1.216
Personal care	0.139	1.161
Transport	0.125	1.143
Recreation	0.125	1.143
Beverages & Tobacco	0.586	2.414
Miscellaneous	0.016	1.016

3.5. Specification of Behavioural Parameters

The β parameters of the linear expenditure system, termed marginal budget shares, are calculated indirectly by using existing estimates of expenditure elasticities and average budget shares and a formula for translating these estimates to the β's, while the α parameters are derived using assumed values for the total committed expenditure $\Sigma q_i \alpha_i$, the β estimates, and equation (3.16). The Cobb-Douglas parameters are derived from Tables 3.2A and 3.2B. These procedures are explained below in greater detail.

3.5.1. Marginal budget shares

The estimation of the β parameters utilised the inherent property of the LES demand system that the expenditure elasticity for a given commodity equals the ratio of the marginal to the average budget shares for that commodity.

Since the available expenditure elasticity estimates refer to major commodity categories adopted in the ENDEF tables[56], the estimation involved first calculating the β's for those categories and then adapting the estimates to the nine commodity groups of the model.

The elasticities are from Rossi and Neves (1987), who use ENDEF data for their estimation and utilise a model, proposed by Tyrrell and Mount (1982), that satisfies the "adding up" condition and allows the elasticities to vary with total expenditure. They provide expenditure elasticities for each of the ENDEF's nine classes of households.

The following adjustments are made to the β values obtained from Rossi and Neves elasticities estimates: (a) the marginal budget share for the ENDEF food is decomposed into a share for food exclusive of alcoholic beverages and tobacco and a share for beverages & tobacco; (b) the marginal share for the ENDEF housing is decomposed to give a separate share for housing exclusive of durables and another for durables; and (c) the marginal share for education is added to that for miscellaneous.

To carry out adjustments (a) and (b), separate estimates of β for the model categories of food, beverages & tobacco, housing, and durables are obtained by applying a simple linear regression model to expenditure data from ENDEF on these

[56] See footnote 52.

categories[57]; and then the proportions between these estimates are used to perform the decompositions mentioned in (a) and (b). This procedure assumes that as total expenditure increases, the marginal shares for beverages & tobacco and for durables vary at a similar rate to the variation of the shares for food and housing, respectively.

The adjusted β parameters are shown in Table 3.4. They are assumed to be the same for rural and urban households. The estimates appear intuitively reasonable and consonant with previous studies. The β for food, for example, declines with total expenditure, whereas those for transport, recreation, and miscellaneous are directly related to total expenditure. Further, the tendency of the marginal budget shares for housing and durables to rise with expenditure, and that of the share for clothing to be highest at middle expenditure levels, is in agreement, for instance, with the findings of Lluch, Powell and Williams (1977).

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[57] The weighted-least-squares method has been applied to Engel curves of the form

$$\tilde{E}_i = \gamma_i + \beta_i \tilde{Y}$$

where $\tilde{E}_i$ is per capita expenditure on good i and $\tilde{Y}$ is per capita total expenditure.

A remark should be made that the expenditure elasticities used to calculate the marginal budget shares in Table 3.4 were estimated, by Rossi and Neves, from a nonlinear expenditure system, and thus under the assumption that the proportions in which extra expenditure is allocated among commodities depend on total expenditure. By contrast, in the Linear Expenditure System an increase in total expenditure is always allocated in fixed proportions between the commodities, independently of the level of total expenditure. Thus, in using the Rossi and Neves elasticity estimates to obtain the β parameters of the LES from the relationship between expenditure elasticity and average and marginal budget shares, as implied by the LES, we are arbitrarily inducing marginal budget shares to differ across expenditure classes, as shown in Table 3.4. The differences among those marginal budget shares should, however, be interpreted as reflecting differences in tastes rather than just changes in expenditure patterns in response to increases in total expenditure.

The reason for assuming taste differences is twofold. First, household budget studies have provided strong evidence of change in expenditure patterns as total outlays increase - a phenomenon also highlighted by the household expenditure data in Tables 3.2A and 3.2B and the corresponding average budget shares in Tables 3.7A and 3.7B. Thus, the sets of β parameters in Table 3.4 are intended to capture the curvature of expenditure relationships while retaining the conveniences of the LES formulation mentioned in section 3.3. Second, by taking account of differences in household preferences, the case for differentiated indirect taxation is strengthened since, as discussed in Chapter 2, if all households have identical preferences represented by the Linear Expenditure System then commodity taxes should be uniform if an optimal linear income tax exists.

In addition, it is worth noting that the β parameters can be estimated separately for urban and rural areas directly by regression analysis of the (linear) Engel curves implied by the LES using the data in Tables 3.2A and 3.2B. However, in order to obtain separate estimates of the β parameters for each expenditure class by the same procedure, some disagregation of household expenditure within each class is necessary. Such an approach was taken, for instance, by Lluch, Powell and Williams (1977), who estimated the β parameters of the LES from household budget data for different socioeconomic groups and also from time series data for countries with different per capita income levels. Interesting enough, as mentioned on page 67, the trends observed in Table 3.4 are fairly consonant with their results, particularly concerning the strong negative relationship between the marginal budget shares for food and total expenditure.

TABLE 3.4

β Parameters of the Linear Expenditure System (marginal budget shares)

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	0.443	0.388	0.310	0.240	0.194	0.151	0.110	0.068	0.032
Clothing	0.071	0.087	0.096	0.099	0.100	0.098	0.094	0.085	0.072
Housing	0.214	0.212	0.229	0.252	0.263	0.277	0.290	0.310	0.306
Durables	0.096	0.095	0.103	0.113	0.118	0.124	0.134	0.139	0.137
Personal Care	0.054	0.066	0.075	0.080	0.082	0.083	0.082	0.078	0.071
Transport	0.016	0.035	0.057	0.073	0.089	0.103	0.117	0.130	0.162
Recreation	0.005	0.009	0.014	0.018	0.022	0.026	0.030	0.034	0.044
Beverages & Tobacco	0.044	0.038	0.031	0.024	0.019	0.015	0.011	0.007	0.003
Miscellaneous	0.057	0.068	0.084	0.100	0.111	0.123	0.136	0.150	0.172

3.5.2. Committed consumption

The α parameters of the LES system are estimated on the basis of prior assumptions about the level of total committed expenditure ($\Sigma q_i \alpha_i$). The main set of results in the following chapters use α values obtained under the assumption that per capita committed expenditure for every household equals 90 percent of the per capita total expenditure of the poorest households.[58] However, since the α parameters are crucial in determining price elasticities, and thus the distorting effects of taxation,

[58] These correspond to those households in the lowest expenditure group in rural areas, which have the smallest total expenditure per head (see Tables 3.2A and 3.2B). Note further, that by fixing total committed expenditure in per capita terms, the total expenditure per household is made proportional to household size - a phenomenon observed, for example, by Lluch, Powell and Williams (1977) and one which is consistent with the subsistence interpretation of the α's. The procedure, however, ignores possible economies of scale.

additional results are reported for an alternative set of α estimates. This second set is calculated by assuming that per capita total committed expenditure is equal to the official minimum wage prevailing in 1974 divided by 4 (four) - since the minimum wage is supposed to attend the basic needs of a family of 4 (four) persons.[59] For the lowest expenditure class, however, total committed expenditure is kept the same as that used in the main set of results, since by the present method it would be greater than total expenditure - which would be inconsistent with the underlying utility theory.

With estimates of marginal budget shares β_i and total committed expenditure ($\Sigma q_i \alpha_i$) for each household group, committed expenditure ($q_i \alpha_i$) for each commodity can be calculated from equation (3.16'). Consumer price estimates in Table 3.3 are used to determine the committed quantities α_i. This last step implies that a unity of a good is defined as that amount which is worth 1 (one) 1974 cruzeiro at producer prices.

[59] A similar approach is adopted by Howe (1977), who estimates subsistence expenditures for Colombia by taking a poverty budget to represent total subsistence expenditure. Some authors have used the official minimum wage in Brazil as a measure of the poverty-line budget (examples of these are Fishlow (1972), Pfefferman and Webb (1979), and Pastore et al (1983), cited in Romão (1993)).

TABLE 3.5A

α Parameters of the Linear Expenditure System (committed quantities) for Urban Households (in thousand units (*) per year)

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	1.192	2.051	2.904	3.757	4.718	5.450	6.519	7.942	11.597
Clothing	0.089	0.103	0.057	0.055	0.136	0.110	0.014	0.074	0.490
Housing	0.567	0.778	0.954	0.987	0.903	0.698	-0.168	-0.707	3.423
Durables	-0.008	-0.055	-0.133	-0.294	-0.495	-0.508	-0.003	1.324	5.084
Personal Care	0.080	0.092	0.053	-0.004	-0.080	-0.137	-0.217	-0.363	-0.254
Transport	0.021	0.020	-0.073	-0.285	-0.479	-0.633	-0.728	-1.565	-8.465
Recreation	0.005	0.009	-0.015	-0.055	-0.104	-0.121	-0.269	-0.482	-2.071
Beverages & Tobacco	0.019	0.024	0.056	0.097	0.142	0.195	0.252	0.288	0.372
Miscellaneous	0.002	-0.093	-0.303	-0.626	-0.950	-1.464	-2.136	-3.784	-7.711

Note : (*) A "unit" of a good is defined as that amount which can be sold for 1 (one) 1974 cruzeiro net of consumer taxes.

TABLE 3.5B

α Parameters of the Linear Expenditure System (committed quantities) for Rural Households (in thousand units per year)

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	1.764	3.076	4.586	5.857	6.558	8.036	8.441	10.343	12.460
Clothing	0.120	0.214	0.286	0.264	0.540	0.277	0.155	-0.120	1.340
Housing	0.400	0.329	-0.004	-0.613	-1.295	-2.882	-4.797	-7.736	-13.622
Durables	0.040	-0.006	-0.127	-0.271	-0.172	0.492	2.829	3.866	7.278
Personal Care	0.077	0.128	0.172	0.285	0.196	0.307	-0.002	0.485	-0.134
Transport	0.019	-0.009	-0.166	-0.352	-0.445	-0.399	-0.101	-0.196	-0.412
Recreation	0.007	0.005	-0.027	-0.087	-0.163	-0.337	-0.544	-1.012	-2.356
Beverages & Tobacco	0.021	0.014	0.010	0.047	0.067	0.135	0.170	0.284	0.376
Miscellaneous	0.032	-0.022	-0.181	-0.420	-0.755	-1.021	-2.195	-2.396	-2.567

Tables 3.5A and 3.5B above show the α estimates used in the main set of computations in the following chapters while Tables 6.3A and 6.3B below show those used for testing the sensitivity of the results. Some of these estimates are negative, making their interpretation as subsistence quantities impossible. This occurs in most cases for transport, recreation, and miscellaneous. On the other hand, for the basic commodities food, clothing, and urban housing, and also for beverages & tobacco, all the estimates remain positive.

TABLE 3.6A

α Parameter of the Linear Expenditure System (committed quantities) for Urban Households (in thousand units per year)

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	1.192	2.546	3.379	4.141	5.046	5.696	6.691	8.037	11.642
Clothing	0.089	0.206	0.195	0.203	0.294	0.260	0.151	0.188	0.585
Housing	0.567	1.056	1.314	1.402	1.360	1.162	0.299	-0.250	3.867
Durables	-0.008	0.053	0.006	-0.133	-0.319	-0.328	0.178	1.500	5.256
Personal Care	0.080	0.170	0.160	0.115	0.049	-0.011	-0.098	-0.259	-0.161
Transport	0.021	0.062	0.009	-0.174	-0.338	-0.475	-0.556	-1.391	-8.250
Recreation	0.005	0.020	0.006	-0.027	-0.069	-0.082	-0.226	-0.435	-2.013
Beverages & Tobacco	0.019	0.046	0.077	0.114	0.156	0.206	0.259	0.292	0.374
Miscellaneous	0.002	-0.001	-0.166	-0.458	-0.751	-1.251	-1.912	-3.556	-7.454

TABLE 3.6B

α Parameters of the Linear Expenditure System (committed quantities) for Rural Households (in thousand units per year)

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	1.764	3.708	5.199	6.353	6.952	8.359	8.667	10.477	12.518
Clothing	0.120	0.346	0.463	0.455	0.730	0.474	0.335	0.039	1.462
Housing	0.400	0.683	0.461	-0.077	-0.746	-2.270	-4.184	-7.095	-13.050
Durables	0.040	0.131	0.052	-0.064	0.040	0.729	3.066	4.114	7.499
Personal Care	0.077	0.228	0.310	0.438	0.351	0.473	0.155	0.631	-0.014
Transport	0.019	0.045	-0.060	-0.209	-0.276	-0.191	0.124	0.049	-0.135
Recreation	0.007	0.020	0.000	-0.051	-0.120	-0.284	-0.486	-0.947	-2.282
Beverages & Tobacco	0.021	0.042	0.037	0.069	0.085	0.150	0.180	0.290	0.379
Miscellan -eous	0.032	0.095	-0.005	-0.203	-0.516	-0.740	-1.901	-2.076	-2.235

3.5.3. Average budget shares

As noted before, part of the analyses of the next chapters is redone assuming that household demand functions are Cobb-Douglas rather than LES, thus eliminating the need for using adjusted or extraneous parameter estimates.

The Cobb-Douglas parameters are calculated directly from Tables 3.2A and 3.2B by taking each household's expenditure on each of the nine goods and dividing by the household's total expenditure on all the nine goods. The results are presented in Tables 3.7A and 3.7B below for urban and rural areas respectively.

TABLE 3.7A

Cobb-Douglas Parameters (average budget shares) for Urban Households

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	0.555	0.537	0.479	0.419	0.376	0.318	0.262	0.191	0.128
Clothing	0.054	0.063	0.70	0.080	0.089	0.090	0.086	0.082	0.075
Housing	0.259	0.233	0.240	0.254	0.257	0.264	0.260	0.282	0.326
Durables	0.024	0.039	0.055	0.066	0.071	0.088	0.119	0.156	0.182
Personal Care	0.047	0.050	0.056	0.061	0.064	0.067	0.069	0.068	0.067
Transport	0.013	0.022	0.031	0.038	0.049	0.066	0.087	0.096	0.083
Recreation	0.003	0.006	0.008	0.011	0.013	0.018	0.020	0.024	0.024
Beverages & Tobacco	0.028	0.029	0.032	0.032	0.030	0.028	0.024	0.017	0.010
Miscellaneous	0.017	0.021	0.030	0.040	0.050	0.060	0.073	0.085	0.107

TABLE 3.7B

Cobb-Douglas Parameters (Average budget Shares) for Rural Households

	Household Groups								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food	0.676	0.660	0.610	0.538	0.462	0.409	0.324	0.262	0.174
Clothing	0.053	0.070	0.084	0.087	0.105	0.092	0.087	0.075	0.085
Housing	0.161	0.132	0.129	0.138	0.145	0.128	0.126	0.135	0.138
Durables	0.026	0.034	0.045	0.060	0.083	0.122	0.200	0.212	0.226
Personal Care	0.035	0.048	0.060	0.075	0.074	0.080	0.072	0.082	0.066
Transport	0.009	0.011	0.016	0.028	0.046	0.070	0.099	0.114	0.149
Recreation	0.003	0.004	0.005	0.007	0.009	0.009	0.010	0.010	0.013
Beverages & Tobacco	0.021	0.019	0.020	0.023	0.022	0.023	0.020	0.018	0.013
Miscellaneous	0.017	0.021	0.032	0.044	0.053	0.067	0.062	0.092	0.136

The trends in these Tables are not very surprising. For example, the proportion of total expenditure devoted to food decreases significantly with expenditure level, whereas the shares of total expenditure allocated to durables, transport, recreation, miscellaneous, and personal care increase as total expenditure increases.

3.6. Final Remarks

Given all the elements necessary to compute the optimal tax structure (i.e., to solve the first-order conditions (3.12)-(3.15)), the solution values were obtained using a non-linear optimization program called MINOS incorporated in the GAMS system.[60]

The existence of multiple solutions was tested by repeating the run with different sets of taxes as starting values. The generation of the same solution vector of optimal taxes suggested the existence of a unique local optimum.

[60] GAMS is a computer language described in Brooke, Kendrick and Meeraus (1988).

APPENDIX A

Manipulation of the first-order conditions along the same line as Atkinson and Stiglitz (1976) yields:

$$-\frac{\sum_j t_j \sum_l H^l S_{ji}^{\ l}}{X_i} = 1 - \sum_l b^l \left(\frac{x_i^{\ l}}{X_i}\right) + \frac{\mu_i d_i}{\lambda X_i} \tag{3.12'}$$

$$-\frac{\sum_j t_j' \sum_m H^m S_{ji}^{\ m}}{X_i'} = 1 - \sum_m b^m \left(\frac{x_i^{\ m}}{X_i'}\right) + \frac{\phi_i c_i}{\lambda X_i'} - \frac{\mu_i d_i}{\lambda X_i'} \tag{3.13'}$$

$$\bar{b} = 1 - \left(\frac{\nu + \omega}{\lambda N}\right) \tag{3.14'}$$

$$\bar{b}' = 1 + \frac{\nu}{\lambda N'} \tag{3.15'}$$

where X_i, X_i', N, and N' denote $\Sigma_l H^l x_i^l$, $\Sigma_m H^m x_i^m$, $\Sigma_l H^l$, and $\Sigma_m H^m$, respectively; $S_{ji}^{\ l}$ and $S_{ji}^{\ m}$ are the compensated derivatives of household l's and m's demands for good j with respect to the price of good i;

$$b^l = \frac{B^l}{\lambda} + \sum_j t_j H^l \left(\frac{\delta x_j^{\ l}}{\delta I}\right)$$

is the net marginal social value of income accruing to household l;

$$b^m = \frac{B^m}{\lambda} + \sum_j t_j' H^m \left(\frac{\delta x_j^{\ m}}{\delta I'}\right)$$

is the net marginal social value of income accruing to household m;

$$B^l = \left(\frac{\delta W}{\delta v^l}\right)\left(\frac{\delta v^l}{\delta I}\right)$$

is the gross marginal social value of income accruing to household l;

$$B^m = \left(\frac{\delta W}{\delta v^m}\right)\left(\frac{\delta v^m}{\delta I'}\right)$$

is the gross marginal social value of income accruing to household m; and

$$\bar{b} = \frac{\sum_l b^l}{N}$$

$$\bar{b}' = \frac{\sum_m b^m}{N'}$$

APPENDIX B

Correspondence Between our Commodity Categories and the 1975 Intersector Transactions Matrix Categories

Our Categories	Code Numbers from the Matrix			
Food	0101091	0102001	0203001	0204001
	0205002	0206001	0291003	0291004
	0291005	0291006	0291008	0291091
	0301002	0302001	0302002	0303091
	2601001	2602001	2603001	2604001
	2605001	2605002	2607101	2607104
	2607191	2608001	2608002	2608003
	2608004	2609001	2610001	2610002
	2610091	2611001	2611093	2612001
	2613001	2613002	2614001	2614002
	2614003	2691001	2691091	2702001
Clothing	1999001	2402002	2402003	2404002
	2501001	2502091		
Housing	0101002	0101003	2001001	2003106
	2003193	2003203	2007002	2091001
	2091092	2299002	2302003	4001001
	4101001	5301001	5502001	0502092
Durables	1002091	1005102	1105091	1107001
	1191001	1191002	1191091	1207001
	1207002	1301002	1303001	1305002
	1305003	1307002	1308001	1308002
	1401001	1491001	1502003	1601001
	1602001	1802002	2302091	2491001
	2491002	2501003		
Personal Care	2199002	2299001	5504001	
Transport	1403002	1801001	2002001	2003101
	2003104	5204002	5502002	5503003
Recreation	1702091	1703091	2901002	2902001
	3099001			
Beverages & Tobacco	2701101	2701201	2701301	2801001
	2802001			
Miscellaneous	2615001	2901001	5503001	5503005
	5503006			

Note: The expenditure on the matrix category "accommodation and food services" (code no. 5501001) was allocated 78 percent to food and 22 percent to miscellaneous, according to the relative importance of meals out and of hotel accommodation in the ENDEF tables. The unallocated items in the matrix were allocated *pro rata* over our nine goods.

Chapter 4

The Optimal Tax Design

4.1. Introduction

The present chapter examines the optimal tax results yielded by the model described in Chapter 3 under alternative assumptions regarding both the extent of the government's concern with inequality as well as the constraints on its ability to impose taxes. It also explores the sensitivity of some of the results to alternative parameters and specifications of the model. The chapter is divided as follows.

Section 4.2 considers the optimal structure of commodity taxes, when these are the only redistributive instruments available, under different assumptions reflecting the restrictions faced by the government on the use of these tools. It starts with an ideal situation where there are no commodity tax restrictions. Gradually, the relevant restrictions are introduced so as to give what seems to be a more realistic representation of the problem confronted by the government in Brazil. In each case tax estimates are presented for various values of the inequality aversion parameter ϵ.

Section 4.3 focuses on the consequences for the optimal tax structure of permitting households to receive lump-sum payments from the government. Two hypothetical situations are considered: (1) where the government can make a uniform payment to all households, and (2) where the government can make two different uniform payments, one to rural households and another to urban households.

Section 4.4 examines the robustness of some of the results to (i) changes in the

specification of the households' utility functions (concerning parameter values and functional form), (ii) using individual utility instead of household utility in the social welfare function, and (iii) increases in the government's revenue requirement.

Finally, section 4.5 summarises the conclusions emerging from the preceding sections.

It should be emphasised that every tax structure reported in this chapter represents a solution to the first-order conditions given by equations (3.12) to (3.15) for a particular set of assumptions concerning tax restrictions and parameter values.

In addition, unless otherwise stated, the preferences of households are represented by the linear expenditure system with the parameter values displayed in Tables 3.4, 3.5A and 3.5B, and the government's revenue requirement (R in equation (3.4)) is set at 10.06 percent of the total sum of all expenditures of households.[61] The data on the exogenous expenditures of households and the number of households in each expenditure group are taken from Tables 3.2A and Table 3.2B.

All the tax rates in this chapter and in the following ones are expressed as a percentage of the price inclusive of tax.

4.2. Optimal Commodity Taxes under Different Assumptions about Tax Restrictions

This section estimates optimal commodity taxes for Brazil under alternative assumptions about tax restrictions and for different degrees of inequality aversion. The restrictions imposed on the possible pattern of tax rates are intended to reflect

[61] As mentioned in the previous chapter, this percentage is equal to that calculated from actual indirect tax collections for 1975.

administrative and/or political constraints actually faced by the government. This section, therefore, rules out the possibility of lump-sum taxes or subsidies. Note that in this case, the first-order conditions reduce to equations (3.12) and (3.13).

Four cases are considered. For the sake of comparison, a situation is considered where the unavailability of lump-sum taxation is the only restriction, the government being able to tax all commodities at will and to choose two different sets of taxes, one for rural areas and one for urban areas.

The second case considers a more realistic setting where a restriction is introduced which requires the government to choose the same set of taxes for both rural and urban areas. This is so on the account of the difficulties associated with avoiding tax arbitrage between the two sectors. Moreover, the restriction may be dictated by concerns about the political acceptability of the tax system.

The third case imposes the additional restriction of not taxing food. This is meant to reflect the fact that the structural features of the agricultural sector in Brazil virtually prevent the government from taxing internal transactions within that sector.[62] That urban food is untaxed, on the other hand, is assumed as a consequence of the restriction generated by the arbitrage problem.

The last case considered in this section relaxes the arbitrage restriction to make allowance for the fact that, as pointed out by Heady and Mitra (1986, p.299), certain goods such as electricity need not be subjected to that restriction. Housing (which includes electricity) is taken to represent such goods in the model, with its price being allowed to vary across rural and urban areas.

For each of the four situations described above the calculations are repeated for

[62] See the section on indirect taxes in Chapter 1.

different values of the inequality aversion parameter ϵ, ranging from 0.1 (where the government's concern about inequality is weak) to 5.0 (where the government is greatly concerned with promoting equity).

4.2.1. Case 1: There are no commodity tax restrictions

Tables 4.1A and 4.1B overleaf report the optimal tax rates for the case where there are no constraints on the government's ability to either tax commodities or to practice rural-urban price discrimination. The most striking feature of these Tables is the difference between rural and urban tax estimates. Taxation in the urban sector is much heavier than in the rural sector for all values of the inequality aversion parameter. This follows from the fact that expenditures are higher and less concentrated in the urban sector.[63]

Intersectoral rate differences are particularly acute at low levels of inequality aversion, specifically $\epsilon = 0.1$, where all urban goods are highly taxed and all rural goods are highly subsidised. This is because rate differention between sectors involves no distortion,[64] and thus becomes the principal means to carry out redistribution when one is primarily concerned with the efficiency cost of taxation. On the other hand, the rates within each sector are fairly uniform at $\epsilon = 0.1$. This is not surprising, since that level of ϵ represents near neutrality with respect to distribution and it is known that if inequality was not a concern at all (a situation represented by $\epsilon = 0$), tax rates within

[63] Compare Table 3.2A with Table 3.2B in the previous chapter.

[64] The model ignores intersectoral effects of taxation through, for instance, induced migration. Although Heady (1987b, 1988) develops models that focus on optimal taxation in the presence of migration, the introduction of this additional element in the present model would present severe empirical complications.

Table 4.1A

Optimal Tax Rates for Urban Areas with Varying Degrees of Inequality Aversion: Case 1 (percent)

Commodity Group	Degree of Inequality Aversion ϵ				
	0.1	0.5	1.0	2.0	5.0
Food	24.4	1.9	-19.6	-33.0	-51.5
Clothing	33.8	38.7	41.2	40.2	38.7
Housing	34.1	38.2	37.1	24.4	16.4
Durables	37.2	54.6	76.1	96.0	96.4
Personal Care	34.0	39.1	40.7	36.4	33.6
Transport	35.0	43.5	48.4	48.3	47.6
Recreation	35.1	43.5	48.3	47.6	47.3
Beverages & Tobacco	29.3	20.3	11.9	12.8	5.1
Miscellaneous	35.0	42.7	45.8	39.0	35.5

Table 4.1B

Optimal Tax Rates for Rural Areas with Varying Degrees of Inequality Aversion: Case 1 (percent)

Commodity Group	Degree of Inequality Aversion ϵ				
	0.1	0.5	1.0	2.0	5.0
Food	-87.3	-107.9	-120.1	-121.9	-84.9
Clothing	-75.2	-58.8	-40.4	-13.2	18.1
Housing	-75.6	-63.3	-53.6	-43.2	-23.0
Durables	-70.6	-42.0	-18.0	5.9	31.2
Personal Care	-73.9	-53.6	-32.6	-4.1	25.7
Transport	-67.0	-28.6	0.2	23.5	37.2
Recreation	-70.1	-41.9	-20.1	1.3	19.1
Beverages & Tobacco	-82.3	-89.0	-90.6	-80.8	-34.9
Miscellaneous	-71.3	-45.9	-25.7	-5.6	14.2

each sector should be uniform - for this is equivalent to a tax on the households' exogenous income and is thus non-distortionary.[65]

At higher levels of inequality aversion, however, achieving equity objectives requires a considerably higher degree of rate differentiation across commodities. In urban areas, the (positive) tax on food is replaced by a subsidy which increases in magnitude with increasing ϵ. The taxes on beverages & tobacco and housing are also significantly lower at higher values of ϵ. These three categories of consumption represent high proportions in the budget of low-income households.[66] Meanwhile, the tax rate on durables, the principal luxury item for urban households, increases drastically as the degree of inequality aversion becomes stronger.[67] The other urban taxes vary relatively little as ϵ increases, remaining considerably high.

In order to allow reductions in the taxation of the urban necessities the tax burden in the rural sector is increased for increased aversion to inequality. The rural subsidies for food and beverages & tobacco increase with ϵ at first but this increase is reversed at higher levels of inequality aversion. The subsidy for rural housing decreases with ϵ but remains negative over the entire range of the parameter, whereas the other rural subsidies are replaced by positive taxes at high values of ϵ.

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[65] This corresponds to the classical optimal taxation solution for an one-consumer economy where one factor is in completely inelastic supply. See e.g., Dixit (1970) and Sandmo (1976).

[66] The budget share data in Chapter 3 (Tables 3.7A and 3.7B) show that food and housing together take up more than 80 percent of the expenditure of the poorest household group both in urban and in rural areas. Beverages & tobacco represents a relatively small share in the budget of all household groups. This share, however, is significantly lower for the highest expenditure classes.

[67] The term "luxury" is used throughout this work to refer to those consumption items which are more important in the budget of high-income households, while "necessity" is used to refer to those goods which represent higher shares in the budget of low-income households.

4.2.2. Case 2: There is a restriction that requires the rate for each commodity to be the same across rural-urban locations

Table 4.2 presents the optimal tax results for the case where, due to the possibility of arbitrage, the government cannot set taxes differently in rural areas from urban areas.

Table 4.2

Optimal Tax Rates with Varying Degrees of Inequality Aversion: Case 2 (percent)

Commodity Group	Degree of Inequality Aversion ϵ				
	0.1	0.5	1.0	2.0	5.0
Food	-0.5	-31.5	-56.7	-74.7	-77.7
Clothing	13.3	20.4	26.5	34.5	36.7
Housing	14.8	24.7	29.5	31.1	31.7
Durables	17.8	39.4	56.9	65.2	63.1
Personal care	13.9	22.7	29.8	38.1	41.0
Transport	16.5	32.6	43.6	51.3	52.5
Recreation	16.4	31.5	41.3	48.4	49.8
Beverages & Tobacco	8.1	-0.7	-5.1	4.9	13.9
Miscellaneous	15.6	28.1	35.0	38.6	38.6

These results can be summarised as follows:

(i) At a low value of ϵ (specifically $\epsilon = 0.1$), the tax rate on food is virtually zero, the rates on other goods except beverages & tobacco are approximately uniform and the rate on beverages & tobacco is about half that on the other taxed items.

(ii) At higher values of ϵ, food is subsidised, beverages & tobacco remains relatively lightly taxed[68], and all the other goods - particularly durables, transport, and recreation - are heavily taxed;

[68] It is actually lightly subsidised at moderate levels of ϵ.

(iii) the subsidy for food as well as the taxes on the other goods except beverages & tobacco increase with increases in ϵ,[69] whereas the rate on beverages & tobacco decreases at first with ϵ and then increases.

These results suggest that the whole weight of the equity-improving aspect of the indirect tax system should be borne by food subsidies. This reflects the outmost importance of food in the consumption outlays of poorer households.[70]

Note that although the magnitudes of the tax rates are quite sensitive to changes in the inequality aversion parameter, the tax structures at different levels of the parameter present a remarkable degree of consistency. To some extent, this is because with fixed incomes plus the limited substitution possibilities between goods imposed by the linear expenditure system, the optimal tax formula insures that luxuries will be taxed more heavily than necessities for positive values of ϵ.[71] At the same time, the disparities in the distribution and in the patterns of expenditure among households have certainly contributed to accentuate the progressivity and robusteness of the estimated tax structures.

Another feature of Table 4.2 that calls for attention is the relatively minute variation in the tax estimates as ϵ changes from 2.0 to 5.0. This indicates that the scope for redistribution through commodity taxes is near exhaustion when the rates are those calculated for $\epsilon = 2.0$.

Finally, a comparison of Table 4.2 with Tables 4.1A and 4.1B shows that the

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[69] The increase is reversed for durables at a very high level of ϵ.

[70] As shown in the budget share tables in Chapter 3, food takes up 68 percent of the expenditure of the poorest household group, while it represents only 13 percent of the expenditure of the richest group.

[71] A demonstration of this can be found in Deaton (1977).

inability to achieve redistribution through intersectoral rate differentiation has led to a greater variance in rates across commodities at low levels of inequality aversion. It is also worth noting that the wider range of possibilities for redistribution offered in Case 1 implies a significantly higher sensitivity of the optimal taxes to changes in the degree of inequality aversion.

4.2.3. Case 3: As Case 2 but with food untaxed

Table 4.3 is devoted to the case where, in addition to the impossibility to discriminate between rates on locational grounds, the government cannot tax or subsidise food.

The effect of this additional restriction can be seen by comparing Tables 4.2 and 4.3 (overleaf). At a low level of inequality aversion, $\epsilon = 0.1$, the optimal tax estimates are virtually the same in the two Tables since the rate on food even in the absence of the restriction is very close to zero.

Table 4.3

Optimal Tax Rates with Varying Degrees of Inequality Aversion: Case 3 (percent)

Commodity Group	Degree of Inequality Aversion ϵ				
	0.1	0.5	1.0	2.0	5.0
Food	0.0	0.0	0.0	0.0	0.0
Clothing	13.0	5.9	0.4	1.8	2.6
Housing	14.6	11.3	5.3	-1.0	-1.3
Durables	17.5	29.2	43.9	49.4	47.4
Personal care	13.7	9.5	7.1	11.2	12.9
Transport	16.3	24.2	34.0	41.5	41.9
Recreation	16.2	22.9	30.7	37.0	37.5
Beverages & Tobacco	7.9	-19.7	-44.6	-38.6	-28.6
Miscellaneous	15.5	20.5	24.7	26.1	25.4

On the other hand, at higher levels of inequality aversion, the inability to subsidise food permits a large reduction in the tax rates on all the other goods. It also implies a higher degree of rate differentiation across taxable items. In Table 4.3, for $\epsilon = 0.5$, for example, the subsidy on beverages & tobacco is much higher than it is in Table 4.2 and the ratio between the highest and the lowest (positive) tax rates is 5:1 compared with 2:1 in Table 4.2. This represents an attempt to transfer to beverages & tobacco, housing, clothing, and personal care some of the redistributive role associated with food subsidies in Case 2, by switching taxation from these goods to those with higher degree of luxury.

Note, however, that only in the case of housing does the rate decrease monotonically with increasing inequality aversion. The rates on clothing and personal care decline initially as ϵ increases, reaching their lowest values at a moderate level of inequality aversion ($\epsilon = 1.0$), and then they increase with ϵ. Correspondingly, the

subsidy on beverages & tobacco is highest for $\epsilon = 1.0$ and decreases for higher values of the parameter.

This is because beverages & tobacco, personal care, and in particular clothing, are more important in the consumption bundle of middle-income households. Consequently, as aversion to inequality reaches a level where one is primarily concerned with the welfare of the very poor, there is a shift in taxation towards those goods and away from housing, which figures heavily in the budget of low-income households.

Meanwhile, the tax rates on the categories that are chiefly consumed by high-income families (i.e., durables, transport, recreation, and miscellaneous) become very high with increased inequality aversion. Nevertheless, they are lower than the corresponding rates in Table 4.2, indicating that the impossibility to subsidise food has reduced the redistributive power of the tax system.

As in Case 2, the tax structures in Table 4.3 show a high degree of consistency. From moderate to high levels of inequality aversion, more specifically from $\epsilon = 1.0$ to $\epsilon = 5.0$, the ranking of commodities according to tax rates remains unchanged except for the tax on housing, which falls below that of clothing for high values of ϵ.

Again note that as ϵ increases from 2.0 to 5.0 the rates themselves change relatively very little, even less than in Table 4.2, since the tax system's scope for redistribution has been reduced relative to Case 2.

4.2.4. Case 4: As Case 3 but with the possibility of housing being taxed differently across rural-urban locations

In Case 4 the arbitrage restriction is relaxed to permit the government to tax rural housing differently from urban housing. The results yielded by this case are displayed in Table 4.4.

A comparison of this Table with Table 4.3 shows that, as one would expect from the results in Case 1, allowing dual pricing for housing produces a substantial increase at all levels of ϵ in the taxation of urban housing which is used mainly to finance a subsidy for rural housing. This is due not only to the relative poverty of rural residents, but also to the fact that in the rural sector housing tends to be more important in the budget of poor than rich households, whereas the reverse is true in the urban sector. This means that the ability to set a different tax rate for housing in each sector is likely to increase significantly the distributional capabilities of the tax system in relation to Case 3.

The increase in the urban rate on housing relative to Case 3 also allows, at every level of ϵ, an increase in the subsidy on beverages & tobacco and a slightly reduction in the taxation of clothing and personal care. The rates on goods other than those mentioned remain roughly unchanged.

Table 4.4

Optimal Tax Rates with Varying Degrees of Inequality Aversion: Case 4 (percent)

Commodity Group	Degree of Inequality Aversion ϵ				
	0.1	0.5	1.0	2.0	5.0
Food	0.0	0.0	0.0	0.0	0.0
Clothing	12.7	4.5	-2.3	-1.5	2.9
Urban housing	16.9	22.7	28.1	29.8	24.5
Rural housing	-1.3	-63.1	-135.5	-199.9	-190.5
Durables	17.3	27.8	40.7	50.4	52.0
Personal care	13.4	8.3	4.3	5.6	8.5
Transport	16.2	23.7	32.4	39.8	40.9
Recreation	16.1	22.1	28.1	34.4	36.5
Beverages & Tobacco	7.1	-23.9	-57.5	-74.7	-64.9
Miscellaneous	15.4	19.9	23.6	25.4	25.7

As the degree of inequality aversion increases over the range 0.1 to 2.0, the tax on urban housing as well as the subsidy on rural housing increase, but these increases are reversed at higher levels of ϵ. This is because, though more important in the budget of the urban rich, housing also figures heavily in the budget of the urban poor. The rates on all the other goods behave as in Case 3 with respect to changes in ϵ.

4.3. Optimal Commodity Taxes in the Presence of Optimal Lump-Sum Subsidies

This section examines the effect on the structure of optimal commodity taxes of allowing the government to pay lump-sum subsidies to households. Two hypotheses concerning the government's ability to make such payments are considered: (1) where the subsidy is the same for all households in the economy, and (2) where the subsidy

may vary between rural-urban areas. Although such policies may be currently impractical in Brazil, their simulations permit a useful comparison.

Each of these situations is combined with two different assumptions about commodity tax restrictions considered in section 4.2: (1) that there are no commodity tax restrictions (Case 1); and (2) that there is the restriction that the tax rates must be the same in both rural and urban areas (Case 2).

This adds four more cases to the analysis in respect of taxation possibilities: Case 5 to Case 8 below. The results in Cases 5 and 6 are to be compared with those in Case 1, whereas the results in Cases 7 and 8 are to be compared with those in Case 2.

The results presented in this section are limited to only three levels of inequality aversion ϵ: 0.1, 1.0, and 2.0, representing weak, moderate, and strong concern for inequality respectively. As observed in Section 4.2, these values yield estimates that are quite representative of the type of tax structures the model can generate.

4.3.1. Case 5: As Case 1 but with the possibility of paying a uniform poll subsidy to all households

The results yielded by Case 5 are reported in Table 4.5. A comparison of this Case with Case 1 (Tables 4.1A and 4.1B), shows the effect of a uniform poll subsidy to be paid to all households when there is no restriction on the possible pattern of commodity taxation.

Table 4.5

Optimal Tax Rates and Poll Subsidy with Varying Degrees of Inequality Aversion: Case 5 (tax rates in % and poll subsidy in thousands of 1974 cruzeiros per year)

Commodity Group	Degree Of Inequality Aversion ϵ					
	0.1		1.0		2.0	
	Urban	Rural	Urban	Rural	Urban	Rural
Food	29.0	16.6	17.7	12.2	23.7	8.4
Clothing	41.8	19.6	55.2	30.5	57.1	37.3
Housing	40.3	18.6	48.6	23.6	48.9	26.7
Durables	46.5	21.4	81.2	39.1	95.7	48.5
Personal care	41.5	20.0	53.7	32.8	54.9	40.5
Transport	43.2	22.3	58.8	42.6	59.8	51.0
Recreation	43.3	20.2	59.1	32.6	59.7	39.8
Beverages & Tobacco	39.5	17.7	48.0	20.4	49.7	27.3
Miscellaneous	42.6	20.2	56.5	32.5	55.8	39.9
Poll subsidy	7.236		10.234		12.424	

Substantial differences exist between the results in the two Cases. In Table 4.5 all urban and rural rates are positive and much higher than the corresponding rates in Tables 4.1A and 4.1B, while their variance across goods as well as between sectors is much smaller.[72] This follows from the fact that lump-sum subsidies are more efficient instruments to achieve redistribution (they are actually non-distortionary) than are differential commodity taxes, and hence it is desirable to rise commodity taxation in order to finance lump-sum subsidies to households.

Note, however, that although the availability of lump-sum subsidies has markedly reduced the degree of tax rate differentiation across goods, significant

[72] The ordering of goods by tax rates, however, remains generally unchanged in relation to Tables 4.1A and 4.1B.

differences among the rates still exist at higher levels of inequality aversion, particularly between food and the other goods. Moreover, for all values of ϵ the rural taxes are significantly smaller than the urban ones. This means that greater redistribution can be achieved by supplementing the poll subsidies with progressive commodity taxes.

As expected, with increasing concern for inequality, the poll subsidy and the tax rates on all goods except food increase.

4.3.2. Case 6: As Case 5 but now the poll subsidy may vary across rural-urban locations

Table 4.6 shows the results for the case where there is the possibility of setting two uniform poll subsidies: one for urban households and one for rural households.

The tax rates in both sectors as well as the total amount of revenue the government transfers to households in the form of lump-sum subsidies[73] are virtually the same as those yielded by Case 5.

[73] That is, the sum of all payments made to households in both sectors.

Table 4.6

Optimal Tax Rates and Poll Subsidies with Varying Degrees of Inequality Aversion: Case 6 (tax rates in % and poll subsidies in thousands of 1974 cruzeiros per year)

Commodity Group	Degree of Inequality Aversion ϵ					
	0.1		1.0		2.0	
	Urban	Rural	Urban	Rural	Urban	Rural
Food	29.0	16.3	17.5	11.2	23.7	9.0
Clothing	41.7	20.4	54.9	32.1	57.3	36.5
Housing	40.4	19.2	48.8	24.7	48.8	26.1
Durables	46.3	22.2	80.3	41.2	95.7	47.2
Personal care	41.5	20.9	53.5	34.5	55.1	39.6
Transport	42.9	23.0	58.4	43.9	60.2	50.4
Recreation	43.1	21.1	58.7	34.4	60.0	38.9
Beverages & Tobacco	39.1	19.0	46.5	24.1	50.7	25.0
Miscellaneous	42.4	21.2	56.1	34.6	56.3	38.8
Poll subsidy	5.115	9.967	9.398	11.209	12.755	12.029

The ability to pay two different uniform poll subsidies seems to make little difference also for the optimal level of the subsidy paid in each sector. Only in the case where there is a weak concern for inequality and significant rate variation across goods is not prescribed, some scope is left for further redistribution through the intersectoral differentiation of the poll subsidy. At higher levels of inequality aversion, the differentiation of the tax rates across goods and sectors appears to have effectively reduced the inequalities between urban and rural households, so that the poll subsidies paid to each sector are roughly of the same magnitude.

4.3.3. Case 7: As Case 2 but with the possibility of paying a uniform poll subsidy to all households

Comparison of Table 4.7 below with Table 4.2 shows that, as in the previous two cases, the payment of an optimal uniform subsidy to all households requires a substantial increase in all the tax rates and simultaneously drastically reduces the difference among them. Food, though, is still subsidised for higher levels of inequality aversion.

As expected, all rates but that on food rise with inequality aversion in order to pay for corresponding increases in the lump-sum transfers as well as in the food subsidy.

Table 4.7

Optimal Tax Rates and Poll Subsidy with Varying Degrees of Inequality Aversion: Case 7 (tax rates in % and poll subsidy in thousands of 1974 cruzeiros per year)

Commodity Group	Degree of Inequality Aversion ϵ		
	0.1	1.0	2.0
Food	10.4	-8.3	-14.7
Clothing	29.7	45.1	48.5
Housing	30.6	46.0	48.3
Durables	35.0	65.2	70.9
Personal care	30.6	47.8	51.4
Transport	33.1	55.2	59.5
Recreation	32.8	53.4	57.2
Beverages & Tobacco	26.8	36.9	40.0
Miscellaneous	31.3	48.3	50.8
Poll subsidy	3.956	6.821	7.143

A comparison of the lump-sum transfers in Table 4.7 with those in Table 4.5 shows that the impossibility of discriminating between rural and urban areas in setting

commodity tax rates has significantly reduced the optimal level of the lump-sum transfers at all levels of inequality aversion. The reason for this is that in Case 5 the transfers are financed mainly by revenue from the richer urban sector.

4.3.4. Case 8: As Case 7 but now the poll subsidy may vary across rural-urban locations

As one would expect, the differences between the rural and the urban lump-sum subsidies in Case 8 (Table 4.8 below) are much more accentuated than in Case 6 where commodity taxes are also allowed to vary between sectors.[74] This means that in Case 8 the ability to pay a subsidy that differs between the sectors has compensated to some extent for the commodity tax restriction.

As in Cases 5 and 6, comparing Table 4.8 with Table 4.7 shows that allowing two different uniform poll subsidies in place of one does not produce a significant change either in the total amount of revenue transferred to households or in the optimal tax rates.

[74] In both cases, however, these differences decrease with the degree of inequality aversion.

Table 4.8

Optimal Tax Rates and Poll Subsidies with Varying Degrees of Inequality Aversion
Case 8 (tax rates in % and poll subsidy in thousands of 1974 cruzeiros per year)

Commodity Group	Degree of Inequality Aversion ϵ		
	0.1	1.0	2.0
Food	11.1	-6.3	-12.6
Clothing	28.9	44.6	48.2
Housing	29.4	44.4	46.6
Durables	34.0	64.7	71.0
Personal care	29.7	47.0	50.8
Transport	32.1	53.9	58.4
Recreation	31.8	52.2	56.2
Beverages & Tobacco	25.9	35.9	38.9
Miscellaneous	30.5	47.5	50.3
Urban Poll Subsidy	0.965	4.599	5.486
Rural Poll Subsidy	8.476	9.987	9.546

If anything, the possibility of paying a higher poll subsidy to the worse-off rural households has permitted a small movement of the tax structure towards uniformity - characterised by a slight increase in the taxation of food accompanied by a slight decline in the taxes on the other goods.

4.4. Sensitivity of Results to Other Parameters and Model Specifications

The goal of the present section is to explore the sensitivity of some of the results (1) to the specification of household preferences, (2) to a change in the social welfare function that replaces household utilities by individual utilities as its arguments, and (3) to changes in the government's revenue requirement. Accordingly, the section is divided

as follows.

The first sub-section presents optimal tax estimates based on Cobb-Douglas utility functions and compares them with the results for the linear expenditure system. The Cobb-Douglas functions are parametrized using the budget shares given in Tables 3.7A and 3.7B.

Sub-section 4.4.2 examines the sensitivity of optimal taxes to different values of the α parameters of the linear expenditure system by replacing the set of parameter values used so far by those given in Tables 3.6A and 3.6B.

In sub-section 4.4.3 optimal taxes are computed using a modified social welfare function written in terms of individual instead of household utilities. In doing so, supernumerary expenditure is divided by household size. This admittedly represents a crude way of overcoming the problem of comparing the welfare of households with different numbers of people since it ignores variations in welfare due to differences in household composition and to economies of scale in consumption.[75]

Finally, sub-section 4.4.4 gives optimal taxes for different revenue requirements.

For each specification of the model considered in the present section, the calculations are repeated for the two alternative assumptions about taxation possibilities represented by Cases 1 and 2 in Section 4.2 and for three levels of inequality aversion.

[75] Although the appropriate procedure would be to use "equivalence scales" (Deaton and Muellbauer, 1980, chapters 8 and 9), the lack of data prevents any such attempt.

4.4.1. The effect of using Cobb-Douglas utility functions

Tables 4.9 and 4.10 display the optimal tax estimates for the Cobb-Douglas specification of the households' preferences. Those Tables are comparable to Tables 4.1A and 4.1B and to Table 4.2, respectively.

Overall, the results for the Cobb-Douglas case do not appear to be very different from those yielded by the linear expenditure system. There is, however, a closer agreement between the estimates for the two preference specifications at low levels of inequality aversion than at higher levels. This is not surprising since, as observed in sub-section 4.2.1, the assumption of fixed incomes implies that if redistribution is not a major concern the optimal tax structure will resemble uniformity regardless of the choice of the demand system.

Table 4.9

Optimal Tax Rates with Varying Degrees of Inequality Aversion:
Case 1 with Cobb-Douglas Utility Functions (percent)

Commodity Group	Degree of Inequality Aversion ϵ					
	0.1		1.0		2.0	
	Urban	Rural	Urban	Rural	Urban	Rural
Food	28.7	-83.3	4.8	-100.1	-16.6	-101.8
Clothing	31.5	-77.9	33.2	-55.8	37.9	-31.6
Housing	32.0	-79.7	34.5	-77.9	34.3	-76.6
Durables	34.0	-68.7	52.5	-4.3	65.8	27.1
Personal care	31.8	-76.4	34.8	-45.8	38.6	-17.9
Transport	33.4	-66.1	50.5	10.7	65.5	44.6
Recreation	33.5	-73.9	50.4	-31.4	64.8	-0.9
Beverages & Tobacco	29.4	-79.5	14.6	-72.2	7.9	-63.5
Miscellaneous	33.8	-71.1	51.9	-16.4	65.6	15.5

Table 4.10

Optimal Tax Rates with Varying Degrees of Inequality Aversion:
Case 2 with Cobb-Douglas Utility Functions (percent)

Commodity Group	Degree of Inequality Aversion ϵ		
	0.1	1.0	2.0
Food	5.8	-27.0	-49.3
Clothing	10.3	15.8	24.7
Housing	11.6	22.7	28.3
Durables	14.3	44.4	62.3
Personal care	10.8	19.5	29.7
Transport	14.0	45.7	66.8
Recreation	14.0	43.6	63.0
Beverages & Tobacco	8.0	-0.6	0.7
Miscellaneous	14.0	42.7	60.6

Nevertheless, it is noticeable that at $\epsilon = 0.1$ the tax structure is closer to uniformity under the Cobb-Douglas case than under the linear expenditure system. The reason for this is that the Cobb-Douglas formulation does not involve committed quantities, which has two implications. First, the differences in utility levels among households is less accentuated under the Cobb-Douglas specification than under the linear expenditure system, for, in the former utility is a function of total expenditure while in the latter it is a function of supernumerary expenditure. Second, the absence of committed quantities means that consumers have more flexibility in allocating consumption among goods, and consequently the distortionary cost of rate differentiation is higher under the Cobb-Douglas formulation.

While at higher levels of inequality aversion there are more significant differences between the rates yielded by the two demand systems, the basic lessons that emerge from the results in each case are fairly similar. In Tables 4.1A, 4.1B and 4.9

the items to be taxed/subsidised, for instance, are more or less in agreement.[76] Greater consistency exists between Tables 4.2 and 4.10, where taxes are the same in rural and urban areas. In both Tables, at moderate and high levels of inequality aversion, food is subsidised more or less heavily; beverages & tobacco is virtually untaxed; and durables, transport, and recreation are taxed at roughly the same rate, as are clothing, housing, and personal care. The latter three categories of goods, however, face a rate roughly that on the former three categories.

4.4.2. The effect of using a different set of α parameters

Tables 4.11 and 4.12 report the optimal tax results corresponding to the α parameters of the linear expenditure system given in Tables 3.6A and 3.6B.[77] They represent the same situations concerning tax restrictions as those depicted in Tables 4.1A and 4.1B and in Table 4.2, respectively.

A comparison of the corresponding Tables shows that, particularly in the case where the rates must be equal between sectors, the changes brought about by the replacement of the α parameters are quite small, and relative magnitudes are roughly preserved.

[76] The exceptions are the following: at $\epsilon = 1.0$, urban food is subsidised in Table 4.1A and lightly taxed in Table 4.9, while, at $\epsilon = 2.0$, miscellaneous consumption in rural areas is lightly subsidised in Table 4.1B and taxed in Table 4.9. Further, although the rural rates on recreation have also different signs in Table 4.1B and 4.9 for $\epsilon = 2.0$, they are very close to zero in both cases.

[77] The β parameters remain the same as before.

Table 4.11

Optimal Tax Rates with Varying Degrees of Inequality Aversion:
Case 1 with a Different Set of α Parameters (percent)

Commodity Group	Degree of Inequality Aversion ϵ					
	0.1		1.0		2.0	
	Urban	Rural	Urban	Rural	Urban	Rural
Food	21.5	-85.0	-29.7	-117.3	-64.2	-119.1
Clothing	33.7	-71.1	40.0	-33.1	29.4	-7.1
Housing	33.9	-71.5	35.7	-46.3	15.2	-35.3
Durables	37.7	-65.8	75.0	-6.6	95.6	19.4
Personal care	33.9	-69.6	39.5	-24.5	25.9	3.5
Transport	35.1	-62.0	48.3	9.9	37.1	32.6
Recreation	35.2	-65.5	48.0	-13.1	35.3	6.9
Beverages & Tobacco	28.9	-78.5	11.0	-82.7	-2.2	-74.7
Miscellaneous	35.0	-66.7	45.1	-17.4	29.7	2.8

Nevertheless, the following differences in the results can be pointed out. First, in Table 4.11, where rates are allowed to vary between sectors, the urban taxes, specially on food, are lower (and, as a result, rural taxes are higher) than in Table 4.1A. Second, in Table 4.12, where there must be only one set of taxes for both sectors, the subsidy for food is larger and taxes on goods other than food are higher than in Table 4.2.

Table 4.12

Optimal Tax Rates with Varying Degrees of Inequality Aversion:
Case 2 with a Different Set of α Parameters (percent)

Commodity Group	Degree of Inequality Aversion ϵ		
	0.1	1.0	2.0
Food	-3.5	-66.5	-86.6
Clothing	14.1	25.5	30.8
Housing	16.0	30.8	33.3
Durables	19.5	58.8	66.6
Personal care	14.9	29.3	35.4
Transport	17.9	45.4	52.1
Recreation	17.7	42.4	48.3
Beverages & Tobacco	9.0	-2.0	2.0
Miscellaneous	16.8	35.3	38.4

These changes, which stress the progressivity of the tax system, reflect the fact that the committed quantities (i.e., the α parameters) on which Tables 4.11 and 4.12 are based are considerably larger than those used to derive Tables 4.1A, 4.1B and 4.2.[78] Consequently, supernumerary expenditures (and hence household utility levels) particularly those of poorer households, given the prices, are lower with the former set of parameters than with the latter.

4.4.3. The effect of using a social welfare function based on individual utilities

The consequence of counting individual utilities instead of household utilities in the social welfare function can be seen by comparing Tables 4.13 and 4.14 below with

[78] Not surprising, the effect of the present experiment on the tax structure is the opposite of that produced by the experiment with Cobb-Douglas preferences in the previous section.

Tables 4.1A and 4.1B and with Table 4.2, respectively.

Table 4.13

Optimal Tax Rates with Varying Degrees of Inequality Aversion:
Case 1 with the Social Welfare Function Written in Terms of Individual Utilities (percent)

Commodity Group	Degree of Inequality Aversion ϵ					
	0.1		1.0		2.0	
	Urban	Rural	Urban	Rural	Urban	Rural
Food	28.2	-102.9	-1.5	-138.9	-23.7	-131.1
Clothing	37.8	-92.1	35.4	-67.4	39.4	-33.7
Housing	38.0	-91.9	30.6	-73.4	27.4	-51.9
Durables	41.4	-87.6	95.5	-43.5	96.0	-8.6
Personal care	38.0	-90.8	34.4	-59.8	36.5	-24.4
Transport	38.9	-83.9	40.6	-22.6	47.8	11.5
Recreation	39.0	-86.7	39.9	-41.8	46.8	-12.1
Beverages & Tobacco	33.4	-98.7	19.1	-114.5	13.7	-96.3
Miscellaneous	39.0	-88.0	37.0	-48.2	39.6	-18.5

Table 4.14

Optimal Tax Rates with Varying Degrees of Inequality Aversion:
Case 2 with the Social Welfare Function Written in Terms of Individual Utilities (percent)

Commodity Group	Degree of Inequality Aversion ϵ		
	0.1	1.0	2.0
Food	-0.9	-55.4	-75.1
Clothing	13.2	24.2	31.5
Housing	15.1	30.9	33.7
Durables	17.9	55.1	64.6
Personal care	13.9	27.8	35.8
Transport	16.6	42.6	50.7
Recreation	16.6	40.5	47.5
Beverages & Tobacco	7.9	-6.6	0.6
Miscellaneous	15.8	34.2	38.1

In the case where the rates are allowed to differ between sectors the modification of the social welfare function brings about a shift of the tax burden towards the urban sector and away from the rural sector. This is not surprising in view of the fact that, for a given expenditure class, the average household size is larger in rural areas than in urban areas[79], so that dividing supernumerary expenditure by household members increases not only inequality between rural and urban residents but also the representation of the former in the social welfare function.

In addition it is worth noting that, particularly at $\epsilon = 1.0$, writing the social welfare function in terms of individuals' utilities also causes, in the urban sector, a move in taxation towards food and beverages & tobacco, and away from the other urban goods, and, in the rural sector, an attenuation of the differences between the food subsidy and the other rural subsidies. This is because the pattern of inequality between people in distinct expenditure classes also changes within the same sector. In particular, people in the lowest expenditure class, which has the smallest average household size in both sectors, become relatively better off and are assigned less weight in the modified social welfare function.

On the other hand, a comparison of Table 4.14 with Table 4.2 shows that when tax rates must be equal across rural and urban areas, writing social welfare as a function of either individual utilities or household utilities makes virtually no difference from the point of view of the optimal tax estimates. Apparently, the changes that would result from differences in the average size of households in different expenditure classes are offset by the changes that would result from differences in the average size of households in different sectors.

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[79] See Tables 3.2A and 3.2B.

4.4.4. The effect of increasing revenue requirement

Table 4.15 reports optimal taxes for two different levels of the government revenue requirement, corresponding to 15 percent and 20 percent of the households' total expenditure. These taxes should be compared with those in Table 4.2 (Case 2), which, as mentioned in the introduction to this chapter, raise an amount of revenue equivalent to 10.06 percent of the households' expenditure.[80]

Table 4.15

Optimal Tax Rates with Varying Degrees of Inequality Aversion and for Different Revenue Requirements
Case 2 (percent)

Commodity Group	Degree of Inequality Aversion ϵ					
	0.1		1.0		2.0	
	I	II	I	II	I	II
Food	4.6	9.6	-48.8	-40.9	-64.0	-53.2
Clothing	18.4	23.7	31.6	36.8	38.8	43.0
Housing	19.9	25.1	33.7	37.9	35.0	39.0
Durables	22.9	28.2	61.9	67.0	68.2	70.9
Personal care	19.0	24.3	34.6	39.5	42.1	46.2
Transport	21.4	26.5	46.8	50.1	53.3	55.3
Recreation	21.3	26.3	44.5	47.8	50.6	52.8
Beverages & Tobacco	13.7	19.5	5.5	17.2	18.9	33.5
Miscellaneous	20.6	25.7	38.6	42.1	41.4	44.1

Note : Case I refers to 15 percent of expenditure while Case II refers to 20 percent of expenditure.

The results for the three levels of revenue are qualitatively similar for all values of the inequality aversion parameter, though, as one would expect, larger revenue

[80] Underlying this procedure is the implicit assumption that government expenditures do not affect the households' welfare.

requirements bring about a reduction in the subsidy for food and increase the rates of tax for the other goods.

4.5. Summary and Conclusions

This chapter attempted to characterize the optimal structure of indirect taxes for Brazil under alternative assumptions about taxation possibilities and the government's attitudes towards inequality. It also examined the robustness of the results with respect to changes in the parameterisation and specification of the model. The following broad conclusions emerge from this experiment.

In the case where the government is constrained to tax goods equally in both rural and urban locations and is only slightly concerned with redistribution, food ought not to be taxed while there ought to be an approximately uniform tax on all other goods except beverages & tobacco, which should enjoy a significantly lower rate than those on the other taxed items.

On the other hand, if there is a stronger concern for inequality, food should be subsidized and the tax rate on beverages & tobacco should be still lower, the revenue being recovered by increasing the taxes on all other goods, particularly on durables, transport, and recreation.

As expected, with an increase in inequality aversion, the rate of subsidy for food should increase while the rate of tax should increase for all the other goods. These rates, however, are fairly insensitive to increases in the degree of inequality aversion as the parameter becomes greater than 2.0. This probably indicates that when the rates are those for the optimum at $\epsilon = 2.0$, there is little scope to promote further

redistribution through rate differentiation.

When food cannot be subsidized because of a constraint on the government's power to tax, then the estimates suggest that beverages & tobacco should be subsidized[81], clothing and housing should be taxed at a very low rate or even exempted while the taxation of the other goods should generate the required revenue but falling less heavily on personal care.

It is worth noting here that, at higher levels of inequality aversion, the ranking of goods by the estimated optimal tax rates conforms broadly to that obtained by Sampaio de Souza (1993) using estimates of the marginal social costs of taxation. For instance, among her eighteen product categories, food and tobacco presented the highest marginal social costs associated with increased taxation, while products which in the present model have being allocated to the categories durables, transport, and recreation exhibited the lowest marginal social costs, thus turning out to be the main candidates for additional taxation.[82]

Faced with the possibility of taxing goods differently in rural and urban areas, the government should impose a substantially lower burden on the rural sector. If, due to the possibility of arbitrage to which most goods are subject, only housing can be priced differently in each sector, then it should be taxed in urban areas and heavily subsidized in rural locations. These results reflect the fact that rural households in Brazil are, in average, great deal poorer than urban households.

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[81] It may be appropriate to observe that the result that alcoholic beverages and tobacco should be subsidised is based solely on equity considerations, ignoring the negative effects associated with the consumption of these goods (on which grounds the heavy taxes commonly levied on them are justified).

[82] Sampaio de Souza (1993) classifies products by sector of production (she uses the 1980 input-output table as her main data source) which prevents a more detailed comparison of her results with those of this study.

If the government can pay an optimal uniform lump-sum subsidy to all households, the role of differential taxes on goods in achieving redistribution is significantly reduced, and so should the degree of non-uniformity of the indirect tax system. Nevertheless at higher levels of inequality aversion indirect taxation should still be characterized by food subsidies and increased rates on luxuries (specially on durables).

The inability to differentiate commodity tax rates between sectors makes it desirable to pay a higher poll subsidy to rural households relative to urban households. This however should not cause any significant change in the tax rates in relation to the case where only one uniform poll subsidy is available.

Both the Stone-Geary and Cobb-Douglas functional forms for household preferences yielded very similar tax structures. The results also appeared to be fairly robust with respect to changes in the α parameters of the Stone-Geary formulation. The main effect of these modifications in preferences was to attenuate or accentuate the pattern of taxation prescribed above, depending on whether they reduced ou increased the inequities between the households' utility levels.

The replacement of household utilities by individual utilities in the social welfare function (in an attempt to overcome the problem of comparing households of different sizes) turned out to make little difference in terms of the tax estimates when the rates are the same in urban and rural areas. It however reinforces the case for imposing a lower burden on rural residents when price discrimination between sectors is feasible, since rural families are larger.

Finally, the last simulations provide evidence that the optimal pattern of indirect

taxes is fairly insensitive to the government's revenue requirement.[83]

Two concluding remarks should be made about these results. Firstly, they emphasise the dominant role played by the so-called distributional characteristics[84] of the goods in determining the optimal tax structure. While this is a necessary consequence of the assumption that labour is inelastic in supply, the critical influence of the distributional characteristics has also been observed by other researchers under more general assumptions about substitution possibilities. For example, Harris and MacKinnon (1979) find using UK data that the efficiency-cost-minimising commodity taxes are regressive, with food being taxed very heavily. But they also find that as soon as some distributional concerns are introduced, the ordering of goods by tax rates is completely reversed so that food becomes the least taxed item. Also, Heady and Mitra (1982) show using Brazil data that the optimal tax structure is quite similar (with food enjoying the largest subsidy) under assumptions of both elastic and inelastic supply of the production factors.[85] Other examples are Ahmad and Stern (1991, chapter 7) and Sampaio de Souza (1993), which provide evidence of the predominant effect of the distributional pattern of consumption in determining the appropriate directions for

[83] The relative robustness of the optimal pattern of redistributive commodity taxes with respect to the amount of revenue required has been also observed in other simulation studies, for example, Deaton (1977) and Ebrahimi and Heady (1988).

[84] The distributional characteristic of a good depends on the pattern of consumption of the different expenditure classes and on the weights assigned to them in the social welfare function. A mathematical representation of the distributional characteristic of a good as a component of the optimal tax formulae can be found, for instance, in Atkinson and Stiglitz (1980, chapter 12).

[85] Heady and Mitra's use of a highly aggregated model of the economy (designed only for illustrating their theoretical analysis) precludes a direct comparison of their results with those obtained here.

indirect tax reform, respectively, in Pakistan and Brazil.[86]

Secondly, it may not be possible to carry out the changes suggested by the results until and unless the tax system is taken to the optimum since this would represent a large departure from the current tax structure and may thus involve high political and/or administrative costs. Therefore it would be useful to consider the potential welfare gains from tax changes that do not reach the full optimum, as well as the welfare losses from not being able to reach the optimum or to overcome the tax restrictions considered in this chapter. These are issues addressed in the next chapter.

[86] Sampaio de Souza performed sensitive analysis with respect to different demand specifications and observed that the directions of reform were relatively insensitive to the demand system used.

Chapter 5

Welfare Effects of Partial and Optimal Tax Changes

5.1. Introduction

This chapter examines both alternative proposals for partial tax reform and some of the optimal tax designs estimated in Chapter 4 by describing the resulting distribution of gains and losses across household groups and by assessing their overall impact on social welfare.

Section 5.2 presents the measures used to calculate aggregate and household welfare effects of the proposed tax changes. Section 5.3 reports the results for a variety of partial reform options designed to represent either feasible moves in the direction of the optimum or certain proposals often advanced in tax policy debates. Section 5.4 is concerned with the consequences of implementing some the optimal tax structures derived in the previous chapter and with seeing how these compare with the results obtained in Section 5.3. Section 5.5 investigates the sensitivity of these welfare measures to the specification of household preferences.

5.2. Measuring Welfare Changes

The measure used to assess the impact of a tax reform on a household is equivalent variation (EV), defined as the amount of income that has to be given to a

household in the initial position to produce a change in utility equivalent to the change caused by the reform. It is defined in terms of the expenditure function ***e(q,v)*** as:

$$\begin{aligned} EV &= e(q_0, v_1) - e(q_0, v_0) \\ &= e(q_0, v_1) - Y_0 \end{aligned} \tag{5.1}$$

where subscripts 0 and 1 refer to the pre- and post-reform positions, respectively.[87]

The expenditure function, which gives the minimum expenditure required to achieve a certain level of utility for a particular set of prices, can be obtained by inverting the indirect utility function. Thus, for the linear expenditure system, equation (3.17) yields:

$$e = v \prod_i q_i^{\beta_i} + \sum_i q_i \alpha_i \tag{5.2}$$

For Cobb-Douglas utilities, equation (3.19) gives:

$$e = v \prod_i q_i^{w_i} \tag{5.3}$$

Hence, the equivalent variations for the two preference systems are:

$$EV = \left(Y_1 - \sum_i q_{1i} \alpha_i\right) \prod_i \left(\frac{q_{0i}}{q_{1i}}\right)^{\beta_i} - Y_0 + \sum_i q_{0i} \alpha_i \tag{5.4}$$

and

[87] As defined in equation (5.1), the equivalent variation may incorporate changes in prices as well as in income. It coincides with King's (1983) "equivalent gain" measure.

$$EV = Y_1 \prod_i \left(\frac{q_{0i}}{q_{1i}} \right)^{w_i} - Y_0 \qquad (5.5)$$

respectively. In the Tables generated in this chapter, equivalent variation is expressed as a percentage of the household's total expenditure in the pre-reform position.

A measure of overall variation in social welfare is necessary to evaluate and rank alternative reform proposals. Towards this end, a methodology proposed in Rosen (1976) is used, which translates a change in the social welfare function index into an equivalent change in household expenditures by using the concept of "uniformly distributed income" (UDI).[88] This is analogous to the concept of equivalent variation and is defined as the amount of income which, if uniformly distributed over all households in the initial position, would produce a level of social welfare equal to that obtained in the post-reform position. Formally,

$$W\left[v^1(q_0, Y_0^1 + UDI), \ldots, v^H(q_0, Y_0^H + UDI) \right] = W\left[v_1^1(q_1, Y_1^1), \ldots, v_1^H(q_1, Y_1^H) \right] \qquad (5.6)$$

The specific form of W used in this chapter is the same used for the calculation of optimal taxes (i.e., equation (3.3)). Thus the UDI value of a tax change reflects a particular attitude towards distribution. Concerning household preferences, computations in the following two sections use the linear expenditure system, with the parameter values given in Tables 3.4, 3.5A and 3.5B. Also, the last section presents results for the Cobb-Douglas model, whose parameters are reported in Table 3.7.

[88] See also Feldstein (1974) for an earlier use of the notion of uniformly distributed income.

5.3. Welfare Effects of Alternative Partial Tax Reforms

The six proposals for partial tax reform analised here may be broadly described as follows:

(1) two rates of VAT, in addition to a zero rate on food in rural areas, combined with excise duties on alcoholic beverages and tobacco;

(2) three rates of VAT, in addition to a zero rate on food in rural areas, combined with excise duties on alcoholic beverages and tobacco;

(3) three rates of VAT, in addition to a zero rate on food in both rural and urban areas, combined with excise duties on alcoholic beverages and tobacco;

(4) three rates of VAT, together with a subsidy for food and excise duties on alcoholic beverages and tobacco;

(5) a proportional rate of VAT, a zero rate on food, coupled with excise duties on alcoholic beverages and tobacco; and

(6) a proportional VAT on all goods.

The choice of proposals (1) to (4) represents an attempt to match distributional objectives with considerations of administrative convenience and political acceptability. The equity aspects of those proposals are intended to embody suggestions of the optimal tax results in Chapter 4. Proposals (5) and (6), on the other hand, represent the kind of recommendation that often arises in tax policy discussions when administrative issues play a central role in the argumentation. Paradoxically, note that proposal (6) is not realistic because of the difficulties of taxing the agricultural sector.

Those proposals are each compared with the effective 1975 indirect tax structure shown in Table 3.3, and also with a modified version of it which does not tax food in

rural areas while the rate on urban food is scaled up in order to preserve revenue neutrality. This is because, for reasons pointed out in Chapter 1, it is expected that the rate on food faced by rural households is much lower than 7 percent (probably close to zero) and thus the bulk of the revenue associated with the taxation of food is collected from urban households. A comparison of the welfare effects for the two reference structures can thus provide an idea of possible overstatements of the impacts of the reforms.

The first two columns of numbers of Table 5.1 below show the 1975 tax structure in the two versions, which are called Base Case A and Base Case B respectively, whereas the remaining collumns show the tax structures corresponding to the reform proposals (1)-(6).

In proposals (1)-(4), the allocation of goods to be taxed at a reduced rate or at an increased rate and also the determination of the relative magnitudes of the rates are made in the light of the estimated optimal taxes, while accounting for administrative and political constraints mainly by choosing smaller changes.

Table 5.1

1975 Effective Taxes and Reform Proposals (percentage)

	1975 Taxes Base Case		Reform Proposal					
	A	B	(1)	(2)	(3)	(4)	(5)	(6)
Urban Food	7.2	10.2	4.8	4.3	0.0	-10.0	0.0	10.1
Rural Food	7.2	0.0	0.0	0.0	0.0	-10.0	0.0	10.1
Clothing	13.7	13.7	4.8	4.3	4.8	6.5	13.3	10.1
Housing	4.5	4.5	4.8	4.3	4.8	6.5	13.3	10.1
Durables	18.4	18.4	19.1	25.8	29.0	38.9	13.3	10.1
Personal care	14.3	14.3	19.1	12.9	14.5	19.4	13.3	10.1
Transport	12.9	12.9	19.1	25.8	29.0	38.9	13.3	10.1
Recreation	12.9	12.9	19.1	12.9	14.5	19.4	13.3	10.1
Beverages & Tobacco	60.5	60.5	60.5	60.5	60.5	60.5	60.5	10.1
Miscellaneous	1.7	1.7	19.1	12.9	14.5	19.4	13.3	10.1

Notice, however, that in all but proposal (6) it is assumed that the category beverages & tobacco continues to be taxed as before. This is because while the optimal tax estimates indicate that alcoholic beverages and tobacco should be taxed at a reduced rate on equity grounds, in practice these items are heavily taxed for reasons such as paternalism and the negative externalities associated with their consumption. Furthermore, excise duties on beverages and tobacco constitute a major source of revenue for the Brazilian federal government.

All tax systems in Table 5.1 raise the same amount of government revenue. Specifically, they are constrained to satisfy the government budget condition given by equation (3.4), where, as in the computation of the optimal taxes, the revenue requirement R is set equal to 10.06 percent of the total household expenditure. This is accomplished by multiplying the tax rates that characterise each particular structure by

the same scalar until, by a process of iteration, they raise the required revenue.[89]

5.3.1. Variation in household welfare

Tables 5.2A and 5.2B below report the impact on the households' welfare of each reform proposal in Table 5.1 when Base Case A is the original position. The figures show the equivalent variation as a percentage of the household's expenditure.

As expected, except for proposal (6), all reforms have a progressive impact on the distribution of welfare (or real income), in that, both in urban and in rural areas, the derived benefit is greatest for the lowest expenditure class and declines continuously until the highest class. In fact, for the last expenditure classes (the last four in most cases) the reforms have a negative effect and generate a welfare loss.

[89] For the proposal with two VAT rates iterations were started with rates of 5 and 20 percent, and for those proposals with three VAT rates the initial values were 5, 15, and 30 percent. Note that the estimated 1975 tax rates were also slightly adjusted to generate the fixed revenue R when demand responses are allowed for.

Table 5.2A

Equivalent Variations as a Percentage of Expenditure for the Reform Proposals in Table 5.1
- with Base Case A as the Initial Position : Urban Households

Urban Household Group	Reform Proposal					
	(1)	(2)	(3)	(4)	(5)	(6)
1	1.14	1.75	3.67	7.10	1.50	-0.85
2	1.03	1.48	3.22	6.16	1.73	-0.17
3	0.69	1.01	2.36	4.31	1.26	0.40
4	0.34	0.62	1.58	2.59	0.65	0.57
5	0.00	0.23	0.89	1.18	0.22	0.59
6	-0.52	-0.48	-0.25	-1.10	-0.28	0.70
7	-1.14	-1.46	-1.71	-3.89	-0.64	0.82
8	-1.70	-2.33	-3.11	-6.63	-1.29	0.67
9	-2.28	-2.84	-3.97	-8.21	-2.29	0.10

Table 5.2B

Equivalent Variations as a Percentage of Expenditure for the Reform Proposals in Table 5.1
- with Base Case A as the initial position : Rural Households

Rural Household Group	Reform Proposal					
	(1)	(2)	(3)	(4)	(5)	(6)
1	4.80	5.02	4.59	9.20	3.34	-1.30
2	4.69	4.96	4.47	8.81	3.59	-0.71
3	4.15	4.47	3.88	7.43	3.23	-0.27
4	3.20	3.50	2.75	5.04	2.56	0.29
5	2.48	2.48	1.52	2.39	1.98	0.67
6	1.43	1.01	-0.24	-0.91	1.80	1.23
7	0.67	-0.83	-2.52	-5.49	1.72	2.07
8	-0.68	-2.08	-3.93	-7.95	0.87	1.94
9	-2.28	-3.85	-5.94	-11.44	-0.30	1.61

Not surprising, proposal (4), which involves a subsidy for food, is by far the most progressive. The results suggest that implementing this reform would improve the welfare of the poorest urban households by the equivalent of increasing their expenditures by 7.1 percent, while the welfare of the richest urban households would be reduced by the equivalent of a decrease of 8.21 percent in their expenditures. The corresponding figures for rural groups are 9.2 and 11.44 percent.

Proposal (5), which sets a zero rate on food but applies a proportional rate of VAT on the other commodities, appears to be the less progressive. Yet it still yields a gain for the three poorest rural groups equivalent to an increase in expenditure of more than 3 percent.

Proposal (6), on the other hand, which imposes a uniform rate of tax on all commodities, is clearly regressive, generating a welfare loss for the lowest expenditure classes, though, it should be recognised, the various groups neither gain nor lose very much from the reform.

A comparison of the equivalent variations for urban and rural areas shows that even in the cases where the two sectors face the same post-reform prices (i.e., proposals (4), (5) and (6)) rural households are the most affected by the reforms. Apparently this is due to the fact that food, the item most favoured by proposals (4) and (5) and one of the most penalised by proposal (6), represents a larger share of the budget of rural households than of urban households while durables and transport, which are highly penalised by proposals (4) and (5) and particularly favoured by proposal (6), represent a significantly larger share of the budget of higher-income households in the rural sector than in the urban sector.

Tables 5.3A and 5.3B below show the distributional impact of the reforms when

it is assumed that in the initial position rural households pay no tax on food, while urban households face a rate of 10.2 percent (Base Case B). It is clear that in this case all reforms in Table 5.1 involve a significant shifting of the tax burden from the urban to the rural sector. As a result, apart from proposal (4), the reforms benefit only urban households and reduce or in some cases maintain the welfare of rural residents.

It is worth noting, however, that the losses suffered by the poorest rural groups from proposals (1), (2), or (3) are quite small. This suggests that if rural households in fact do pay some tax on food (even if this tax is much lower than that paid by urban households) then proposals (1)-(3) would make the poorest rural households better off.

A comparison of Tables 5.2A and 5.2B and 5.3A and 5.3B provides an idea of the extent to which the gains for rural households may be overstated and those for urban groups understated when it is assumed that urban and rural households face the same pre-reform price of food.

Table 5.3A

Equivalent Variations as a Percentage of Expenditure for the Reform Proposals in Table 5.1 - with Base Case B as the Initial Position : Urban Households

Urban Household Group	Reform Proposal					
	(1)	(2)	(3)	(4)	(5)	(6)
1	2.92	3.60	5.55	9.02	3.34	0.96
2	2.81	3.26	5.03	8.00	3.51	1.59
3	2.27	2.60	3.95	5.93	2.85	1.97
4	1.71	2.00	2.96	3.98	2.03	1.95
5	1.23	1.46	2.13	2.41	1.45	1.83
6	0.52	0.56	0.79	-0.07	0.75	1.75
7	-0.29	-0.60	-0.86	-3.04	0.22	1.69
8	-1.08	-1.71	-2.49	-6.02	-0.66	1.30
9	-1.86	-2.43	-3.55	-7.80	-1.87	0.52

Table 5.3B

Equivalent Variations as a Percentage of Expenditure for the Reform Proposals in Table 5.1 - with Base Case B as the Initial Position : Rural Households

Rural Household Group	Reform Proposal					
	(1)	(2)	(3)	(4)	(5)	(6)
1	-0.24	-0.03	-0.45	4.01	-1.66	-6.15
2	-0.24	0.02	-0.46	3.76	-1.31	-5.49
3	-0.39	-0.09	-0.65	2.81	-1.29	-4.72
4	-0.79	-0.49	-1.22	1.02	-1.41	-3.64
5	-0.93	-0.93	-1.87	-1.02	-1.42	-2.71
6	-1.57	-1.99	-3.22	-3.89	-1.21	-1.77
7	-1.71	-3.19	-4.87	-7.82	-0.67	-0.31
8	-2.60	-3.99	-5.83	-9.83	-1.05	0.01
9	-3.55	-5.11	-7.19	-12.68	-1.57	0.33

5.3.2. Variation in social welfare

Tables 5.4 and 5.5 below display the social valuation in terms of uniformly distributed income (UDI) of each reform option in Table 5.1 for different values of the inequality aversion parameter, with respect to Base Cases A and B, respectively. They also rank reform proposals according to their UDI value.

Table 5.4

Uniformly Distributed Income (UDI) and Ranking for Reform Proposals in Table 5.1 - with Base Case A as the Initial Position (cruzeiros per year)

Reform Proposal	Degree of Inequality Aversion (ϵ)					
	0.1		1.0		2.0	
	UDI	Rank	UDI	Rank	UDI	Rank
(1)	18.62	3	150.36	4	141.56	4
(2)	-1.06	4	163.14	3	150.24	2
(3)	-22.31	5	171.35	2	144.38	3
(4)	-124.00	6	332.25	1	293.43	1
(5)	45.31	2	122.81	5	102.26	5
(6)	78.62	1	-25.11	6	-38.22	6

Table 5.4 shows that, for moderate and high levels of inequality aversion, all but proposal (6) result in a preferable after-tax distribution of real income, generating rather large social gains.

Those gains are roughly of the same magnitude for proposals (1), (2) and (3) and are roughly equivalent to giving to each family in the population 150 cruzeiros per year at 1974 prices.[90]

[90] This corresponds to approximately 40 percent of the monthly minimum wage prevailing in 1974, which was CR$ 376.80.

Table 5.5

Uniformly Distributed Income (UDI) and Ranking for Reform Proposals in Table 5.1 - with Base Case B as the Initial Position (cruzeiros per year)

Reform Proposal	Degree of Inequality Aversion (ϵ)					
	0.1		1.0		2.0	
	UDI	Rank	UDI	Rank	UDI	Rank
(1)	1.55	3	32.24	4	5.45	4
(2)	-18.12	4	45.11	3	14.13	2
(3)	-39.35	5	53.36	2	8.27	3
(4)	-141.08	6	214.69	1	156.82	1
(5)	28.20	2	4.52	5	-33.89	5
(6)	61.47	1	-145.30	6	-175.15	6

Not surprising, proposal (4) which involves a food subsidy, yields the most substantial welfare improvement when the government shows a significant concern for redistribution. This improvement is about twice as large as those from the first three proposals and about three times as large as with proposal (5).

Table 5.4 also makes it clear that there is a fairly strong trade-off between equity and efficiency in that, for instance, at $\epsilon = 0.1$ the most progressive reform proposal (i.e., proposal (4)) results in significant welfare loss whereas the uniformity option (i.e., proposal (6)) is welfare-improving at this level of inequality aversion but results in a loss at higher levels. This observation is reinforced by the fact that the ordering of reform options according to the amount of UDI they represent is completely reversed as ϵ changes from 0.1 to higher levels.

It should be noted, however, that reform proposals (1) and (5) are both superior to Base Case A at all levels of ϵ presented in Table 5.4. Note also that the social valuation of the reforms varies relatively little as ϵ increases from 1.0 to 2.0. The only

change in the ranking of the reform proposals as ϵ changes from 1.0 to 2.0 is that proposal (2) becomes preferable to proposal (3). This is in accordance with the optimal taxation results, which indicate that it is desirable to favour rural households, at the expense of urban residents, on equity grounds.

In turn, Table 5.5 shows that, with Base Case B, except for proposal (4) all other proposals in Table 5.1 are not capable of generating significant improvements in social welfare when one is strongly concerned with redistribution. Proposals (1), (2) and (3) yield somewhat significant gains only for moderate inequality aversion. This is not very surprising given that Tables 5.3A and 5.3B showed that the benefits from the reforms (with Base Case B) accrue mainly to the richer urban sector. At the same time, a comparison of Table 5.4 with Table 5.5 indicates that the gains reported in Table 5.4 are primarily due to the exemption of food in rural areas.

5.4. Welfare Effects of the Optimal Tax Design

This section investigates the distributional and social welfare consequences of imposing the optimum tax design. Cases 2, 3, 4, 7, and 8 concerning taxation possibilities are selected from Chapter 4 for examination here. The purpose is to obtain an idea of the implications of the different restrictions on the government's ability to tax for the achievement of its distributional objectives. The results in this section are to be compared with those in Section 5.3, where it is assumed that the constraints faced by the government are such that only partial reform is feasible.

5.4.1. Variation in household welfare

As seen in Chapter 4, different attitudes towards inequality lead to different tax designs. Since the primary interest here is in investigating the potential distributional impact of indirect taxation, this sub-section deals with the changes in household welfare that result from the implementation of the optimal tax structure corresponding to the case where the government's degree of inequality aversion is 2.0 (which represents quite a strong commitment to equity). For convenience, Table 5.6 below shows the optimal taxes for $\epsilon = 2.0$, for the different tax restriction cases mentioned above (these taxes are presented in different Tables in Chapter 4). The impact of these taxes on households, with Base Case B taken to be the pre-reform position, is presented in Tables 5.7A and 5.7B below.

Table 5.6

Optimal Tax Designs Associated with Tax Restriction Cases 2, 3, 4, 7 & 8 for $\epsilon = 2.0$

Commodity Groups	Optimal Tax Designs				
	I (Case 2)	II (Case 3)	III (Case 4)	IV (Case 7)	V (Case 8)
Food	-74.7	0.0	0.0	-14.7	-12.6
Clothing	34.5	1.8	-1.5	48.5	48.2
Urban Housing	31.2	-1.0	29.8	48.3	46.7
Rural Housing	31.2	-1.0	-199.9	48.3	46.7
Durables	65.2	49.4	50.4	70.9	71.0
Personal care	38.1	11.2	5.6	51.4	50.8
Transport	51.3	41.5	39.8	59.5	58.4
Recreation	48.4	37.0	34.4	57.2	56.2
Beverages & Tobacco	4.9	-38.6	-74.7	40.0	38.9
Miscellaneous	38.6	26.1	25.4	50.8	50.3
Urban Poll Subsidy	-	-	-	7,143	5,486
Rural Poll Subsidy	-	-	-	7,143	9,546

Table 5.7A

Equivalent Variations as a Percentage of Expenditure for the Tax Designs in Table 5.6
- with Base Case B as the Initial Position : Urban Households

Urban Household Groups	Optimal Tax Designs				
	I	II	III	IV	V
1	16.48	8.90	-1.02	175.81	132.21
2	15.86	7.96	-0.27	68.40	49.73
3	10.15	6.43	-1.54	26.53	16.96
4	3.94	4.77	-3.38	6.52	0.83
5	-0.59	3.17	-4.86	-4.11	-7.92
6	-7.21	0.33	-7.67	-14.03	-16.53
7	-14.48	-3.55	-11.11	-23.28	-24.84
8	-22.67	-7.49	-15.55	-33.01	-33.73
9	-28.61	-9.70	-19.23	-40.58	-40.63

Table 5.7B

Equivalent Variations as a Percentage of Expenditure for the Tax Designs in Table 5.6
- with Base Case B as the Initial Position : Rural Households

Rural Household Groups	Optimal Tax Designs				
	I	II	III	IV	V
1	16.25	0.98	17.07	166.62	227.68
2	16.94	1.12	17.32	68.51	95.84
3	13.05	0.79	19.26	28.51	42.85
4	6.48	-0.31	21.02	8.78	17.84
5	-1.07	-2.45	20.19	-3.93	2.67
6	-8.48	-6.15	14.99	-14.40	-9.64
7	-19.92	-11.77	7.94	-26.72	-23.23
8	-24.99	-13.82	7.17	-33.30	-30.80
9	-32.14	-17.27	3.25	-41.70	-40.14

Design I has about the same distributional consequences for urban and rural groups. In both sectors, the beneficiaries are the lowest four expenditure groups and the two poorest groups enjoy a welfare gain equivalent to an increase in expenditure of approximately 16 percent. On the other hand, the richest group in each sector suffers a loss equivalent to a decline in expenditure of about 30 percent.

Comparing the welfare effects from design I with those from design II, it is clear that the inability to subsidise food markedly reduces the redistributive impact of the optimal taxes. Only urban households in the lower expenditure classes benefit significantly from design II, with the highest gain (of 8.9 percent) accruing to the poorest group.

Design III, which sets a substantial subsidy for rural housing and taxes urban housing, makes all urban households worse off than in the original position. The poorest urban groups, however, are only slightly affected. As expected, all rural groups are highly benefited by design III, particularly middle- and lower-expenditure classes, whose gains reach the equivalent to an increase in expenditure of about 20 percent.

The last two columns of Tables 5.7A and 5.7B show that the presence of poll subsidies considerably increases the system's ability to transfer real income from richer to poorer households. The impact of design IV is very much the same in both sectors. The first four expenditure classes experience a substantial welfare improvement, with the poorest group gaining the equivalent of an increase in expenditure as great as 175.81 percent in the urban sector and 166.62 percent in the rural sector. On the other hand, the five highest classes suffer losses that range from the equivalent of a reduction in expenditure of about 4 percent (for the fifth expenditure class) to more than 40 percent (for the richest group).

Design V has a similar effect to that of design IV, but since it involves the payment of a higher poll subsidy for rural households, the gains for the rural poor are expectedly higher than those for the urban poor. Note that the gain for the poorest rural group is equivalent to more than doubling its expenditure.

5.4.2. Variation in social welfare

Table 5.8 reports the potential social welfare gain in terms of UDI from implementing the optimal tax system for different assumptions about tax restrictions (corresponding to Cases 2, 3, 4, 7 and 8 of Chapter 4) and for different degrees of inequality aversion. with Base Case B as the initial position.

Table 5.8

Uniformly Distributed Income (UDI) Associated with Optimal Taxation for Different Tax Restrictions Cases (cruzeiros per year)

Tax Restriction	Degree of Inequality Aversion (ϵ)		
	0.1	1.0	2.0
Case 2	94.44	574.04	574.46
Case 3	94.37	133.99	64.46
Case 4	102.73	391.78	404.58
Case 7	366.15	2,842.51	3,975.25
Case 8	420.85	3,031.25	4,215.07

Note Each entry in this Table shows the UDI value of a particular optimal tax structure reflecting a given assumption about taxation possibilities and for a given level of inequality aversion. See Tables 4.2, 4.3, 4.4, 4.7, and 4.8 for the tax structure corresponding to each entry.

Given that at $\epsilon = 0.1$ the optimal tax structure in Cases 2, 3 and 4 are very similar, it is not surprising that the social gain associated with each of these structures

is approximately the same at this level of ϵ. However, as the degree of inequality aversion increases, the impossibility of subsidising food (Case 3) greatly reduces the potential welfare gain from optimal taxation. On the other hand, the ability to set a different price for housing in rural areas (Case 4) can compensate quite effectively for the non-taxability of food.

In turn, the presence of uniform lump-sum transfers (Cases 7 and 8) results in remarkable social improvements, which increase with aversion to inequality. At $\epsilon = 2.0$, for example, the social gain from implementing the optimal system of taxes and transfers is approximately equivalent to giving each family the equivalent of the annual minimum wage at 1974 prices. It should be emphasised that this is a pure welfare gain, with the government's expenditure (net of the lump-sum transfers) being unaffected. The possibility of paying two different poll subsidies, one for urban and another for rural households, makes relatively little difference in terms of the impact on social welfare.

A comparison of Table 5.8 with Table 5.5 shows that there is substantial scope for improvements over the reform proposals in Table 5.1 with respect to their effects on social welfare. It must, however, be noted that when only commodity taxes are available and food cannot be subsidised (Case 3) the social gain is modest for higher levels of inequality aversion, even with optimal taxes.

5.5. Sensitivity of the Results to Preference Specification

This section presents the welfare consequences of reform proposals in Table 5.1 when it is assumed that household preferences are of the Cobb-Douglas form. Tables 5.9A, 5.9B display the welfare change for each household group in urban and rural areas, respectively, and Table 5.10 shows the overall effect on social welfare. The pre-reform position is taken to be Base Case B.

Table 5.9A

Equivalent Variations as a Percentage of Expenditure for the Reform Proposals in Table 5.1 - with Base Case B as the Initial Position and Cobb-Douglas Preferences : Urban Households

Urban Household Group	Reform Proposal					
	(1)	(2)	(3)	(4)	(5)	(6)
1	3.80	3.84	5.85	9.68	3.58	1.59
2	3.42	3.47	5.26	8.38	3.68	2.03
3	2.69	2.74	4.08	5.99	2.93	2.43
4	2.04	2.09	3.00	3.76	2.03	2.41
5	1.48	1.53	2.12	2.02	1.41	2.29
6	0.54	0.60	0.71	-0.68	0.64	2.19
7	-0.65	-0.58	-0.99	-3.83	0.06	2.10
8	-1.80	-1.72	-2.69	-7.00	-0.89	1.60
9	-2.59	-2.50	-3.86	-9.08	-2.14	0.73

Table 5.9B

Equivalent Variations as a Percentage of Expenditure for the Reform Proposals in Table 5.1 - with Base Case B as the Initial Position and Cobb-Douglas Preferences : Rural Households

Rural Household Group	Reform Proposal					
	(1)	(2)	(3)	(4)	(5)	(6)
1	0.04	0.06	-0.36	4.78	-1.62	-5.69
2	0.06	0.08	-0.42	4.25	-1.34	-5.33
3	-0.08	-0.06	-0.68	3.03	-1.37	-4.66
4	-0.52	-0.48	-1.31	0.97	-1.53	-3.52
5	-0.96	-0.92	-1.98	-1.29	-1.59	-2.60
6	-2.02	-1.96	-3.33	-4.27	-1.41	-1.59
7	-3.22	-3.14	-4.97	-8.30	-0.91	-0.12
8	-4.02	-3.94	-5.95	-10.43	-1.32	0.26
9	-5.13	-5.04	-7.32	-13.44	-1.87	0.54

A comparison of Tables 5.9A and 5.9B and Tables 5.3A and 5.3B shows that variations in household welfare are generally larger with the Cobb-Douglas model than with the LES. This results from the fact that the Cobb-Douglas formulation is more elastic than the LES one. Note that for the uniform rate proposal (6) the welfare effects are more favourable under the Cobb-Douglas model than under the LES since, due to its higher elasticity, the efficiency advantage of uniformity is greater in the former case. The differences between the two Tables are quite small, however, and in almost all cases there is an agreement about who gains and who loses.

The differences between Tables 5.10 and 5.5, in their turn, may be understood by considering the differences between Tables 5.9A and 5.9B and Tables 5.3A and 5.3B. For $\epsilon = 0.1$, all reforms but the uniformity option (proposal (6)) cause more damage or are less beneficial under Cobb-Douglas preferences than in the LES case, whereas at higher levels of ϵ the social welfare effects are more favourable with the Cobb-Douglas model. Reform proposal (6), on the other hand, results in greater gain at $\epsilon = 0.1$ and in lower loss at higher levels of inequality aversion with the Cobb-Douglas model than with the LES one. Again, this reflects the fact that the efficiency cost of rate differentiation is larger under the former.

The rankings of reform proposals for the two demand systems are identical for $\epsilon = 0.1$ and $\epsilon = 1.0$.[91] On the other hand, for $\epsilon = 2.0$, Table 5.5 indicates that one should be more or less indifferent to reform proposals (1), (2) and (3) and Base Case B (the pre-reform position) and that Base Case B is preferable to proposal (5), while Table 5.10 suggests that at that level of inequality aversion all but proposal (6) would

[91] Note that although the UDI value of proposal (1) at $\epsilon = 0.1$ has a positive sign in Table 5.5 and a negative sign in Table 5.10, the impact of this proposal at this level of ϵ is negligible both with the Cobb-Douglas and with the LES formulations.

improve social welfare. Further sensitivity analyses should be performed in order to determine the desirability or otherwise of these proposals when there is strong inequality aversion. It is fairly clear, however, that they should not be expected to have a substantial effect on social welfare.

Table 5.10

Uniformly Distributed Income (UDI) and Ranking for the Reform Proposals in Table 5.1 - with Base Case B as the Initial Position and Cobb-Douglas Preferences (cruzeiros per year)

Reform Proposal	Degree of Inequality Aversion (ϵ)					
	0.1		1.0		2.0	
	UDI	Rank	UDI	Rank	UDI	Rank
(1)	-5.17	3	63.38	4	51.20	4
(2)	-26.22	4	77.30	3	66.29	3
(3)	-59.75	5	97.93	2	87.27	2
(4)	-245.00	6	230.84	1	266.57	1
(5)	5.67	2	49.39	5	26.92	5
(6)	128.22	1	-41.84	6	-100.58	6

The important conclusions emerging from the analyses carried out in this chapter and in the preceding ones are drawn together below.

CONCLUSION

The present study has attempted to shed some light on the following two questions:

(1) how indirect taxes in Brazil should be structured in order to allow the achievement of certain redistributional objectives while raising enough revenue to finance government expenditures; and

(2) to what extent indirect taxes can promote redistribution.

The relevance of these questions in the context of Brazil has been emphasised in Chapters 1 and 2, which suggest that, in accordance with the theory of optimal taxation, the particular circumstances of the country's economy and tax system provide a strong case for using the indirect tax system for redistributive purposes. This is basically due to the combination of two factors: the observed inequalities in living standards among the population and the weakness of both the income tax and the income support system. These chapters also highlighted the consequences for tax design of the dual nature of the Brazilian economy. In particular, attention was called to the difficulties of taxing food consumed within the rural sector.

In Chapter 3 a model for computing the optimal structure of commodity taxes for Brazil was specified which seeks to capture the rural-urban dualism and some important constraints faced by the government in choosing tax design. The model was solved under different assumptions about the restrictions on the use of tax tools and on the possible pattern of taxation, the attitude of the government towards redistribution and the structure of household preferences.

The results, reported in Chapter 4, show that the optimal indirect tax system involves a subsidy for food, a low tax on alcoholic beverages and tobacco, and high taxes on all other commodities, particularly on durables, transport and recreation. If food cannot be subsidised, then the optimal tax estimates suggest a subsidy for beverages and tobacco and exemptions for clothing and housing. These patterns are accentuated as the concern with inequality becomes stronger. In addition, the results in Chapter 4 indicate that even if the government could make uniform lump-sum transfers to all households, there would still be room for further redistribution through food subsidies and higher rates on luxuries (notably, durables). Further, the optimal tax results point to a substantially lower tax burden on rural households than on urban residents.

Estimates of the likely impacts on the welfare of different household groups and on the overall level of social welfare from fully implementing the optimal taxes as well as from partial tax changes in the direction of the optimum are presented in Chapter 5. These impacts are compared with those from other reforms that move the tax system towards uniformity. The estimates indicate that the power of commodity taxation (and subsidisation) for redistributing real income and improving social welfare is, contrary to some common opinion, rather large. The magnitude of the distributional effects appear, however, to depend crucially on the ability to subsidise food and also, but to a less extent, on the ability to discriminate between rural and urban taxation. In addition, it is shown that considerably greater progress on income distribution could be achieved if the government could use revenue from commodity taxation to finance lump-sum transfers to households. Further, the gains from redistributive taxation are shown to become significantly more impressive when compared with the situation

yielded by the imposition of uniform commodity taxes.

The calculations in Chapters 4 and 5 also reveal that if the tax changes must be revenue neutral, both the subsidisation of food and direct income support to households require substantial increases in the level of the taxes on goods other than food. This means that if the government indeed wants redistribution, it should be prepared to promote larger changes in indirect taxes than, for instance, those represented by the partial reform options considered here (those not involving food subsidies), which are similar to the actual proposals that have been discussed in the Brazilian context. On the other hand, the results show that, provided that some food subsidies or transfer schemes are in operation, only a few different rates of tax would be necessary for adequately accommodating distributional considerations.

In summary, the analysis may be seen as suggesting that a tax system based on two or three rates of VAT plus some food subsidies and/or direct support for certain household groups supplemented with excises on luxury goods could effectively advance the objective of greater equity. Such a system does not appear to involve great administrative complexity. It is actually consistent with a reform that has often been proposed by tax analysts in Brazil, which simplifies the existing tax structure by merging the tax on the circulation of goods and transportation and communication services (ICMS), the tax on industrial products (IPI) and the tax on services (ISS) into a single VAT. A three-rate structure has been suggested for this VAT, which would be levied by the states, while the federal government would levy excise taxes on a few goods such as tobacco, alcohol, gasoline and cars.

Concerning subsidies for the poor, while truly lump-sum transfers of the kind considered in the model may be currently infeasible, some support in the form of food

rations, for example, could very probably be operated satisfactorily. There are, of course, administrative and corruption problems associated with ration schemes. Nevertheless, the analysis indicates that the welfare gains from implementing such a scheme are sufficiently large to offset those other considerations.

It is important to realise that in many cases equity considerations are not the only reason for adopting the policies suggested above. For instance, both equity and the difficulties of taxing food in rural areas and of avoiding tax arbitrage between rural and urban areas point to the non-taxation of food. Also, taxes on the ownership and operation of motor vehicles (including excises on gasoline) can be justified on grounds of equity as well as of externalities. Further, tax policies aimed at benefiting the poor in rural areas might be designed as part of a strategy of minimising the problem of rural to urban migration. Finally, the improvement of the living standard of workers and their families is an important requirement for increasing productivity and promoting economic development. In this sense, granting exemptions or subsidies for some of the goods consumed by the poor may be seen as a major policy objective.

The conclusions of this study have been shown to be robust with respect to the specification of household preferences. It should be noted, however, that choices between work and leisure have not been allowed for, and hence effects of the tax changes proposed on work effort have been ignored. This means that the trade-off between equity and efficiency have probably been underestimated. Other limitations of the model as a whole should be pointed. Firstly, the number of households in each sector was held constant, and thus the effects of migration on welfare and revenue have not been accounted for. Secondly, by holding producer prices constant, the model has not considered the possibility of using those prices to obtain better consumer prices

when there is a tax restriction on some goods. For instance, it might be desirable to subsidise agricultural inputs as a means of improving the consumer price of food. Finally, the data used refer to 1975, and although in many respects they still may be seen as a reasonable representation of the current state of affairs (concerning income distribution and the tax structure, for example), it should be remarked that the proportion of the population living in urban areas has increased significantly, from about 60 percent in 1975 to about 75 percent in 1990.

Nevertheless, it is hopefully expected that the calculations made and the conclusions reached in this study may provide a better understanding of the relationship between indirect tax policy and redistribution in Brazil, and in this sense be useful as a rough guideline to policy formulation and as an incentive for revising current reform proposals which seems actually to have minor redistributive effects and fail to ameliorate a highly unequal distribution of income.

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