FINANCING

OF

UNEMPLOYMENT INSURANCE

THE INCIDENCE AND ECONOMIC EFFECTS
OF THE
FINANCING OF UNEMPLOYMENT INSURANCE

By

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DEDICATED TO MY PARENTS:

The late John Herbert Smithin

and Mrs. Barbara Jill Greaves-Rudge

ABSTRACT

This thesis deals with the incidence and economic effects of payroll taxes earmarked for unemployment insurance. A major objective is to provide an appropriate theoretical framework for a discussion of this issue. In cases where U.I. coverage is reasonably comprehensive, so that the U.I. tax can be regarded as a broad based tax, it is argued that the proper engine of analysis is basically the standard macroeconomic general equilibrium model. The macroeconomic effects of taxation, whether they originate from the demand or supply side, are regarded as an integral part of incidence analysis.

The standard macro framework requires modification in one direction, which is a more detailed development of the aggregate labour supply function. This reflects the view that the most important macroeconomic effects of unemployment insurance are likely to emerge from the supply side, via work incentives.

A number of variants of a small macroeconomic model are developed, each incorporating an explicit modelling of a hypothetical U.I. system. Qualitative incidence results are obtained using the traditional method of comparative statics, while a quantitative dimension is added in static and dynamic simulation exercises with plausible parameter values drawn from the relevant econometric literature. Different versions of the model employ various alternative

hypotheses about the way in which the labour market operates and/or different specifications of the aggregate labour supply function.

The incidence results depend largely on the effect of payroll tax increases on labour supply. In the so-called neoclassical version of the model, for example, payroll tax increases reduce both participation and average weeks worked by participants, but tax and benefit rates are connected via the U.I. budget constraint, and benefit rate changes also effect labour supply. An increase in the benefit rate will tend to reduce average weeks worked by participants but to increase participation itself. Therefore a balanced budget increase in payroll tax rates has a potentially ambiguous effect on labour supply. If the net impact on labour supply is negative we obtain the 'standard' incidence results. A balanced budget increase in payroll tax rates reduces output and employment, increases the general price level, and reduces both capital and labour income. (Similar results also occur in other versions of the model in which the labour market does not clear due to (e.g.) real or money wage rigidity.) On the other hand, if the net impact on labour supply is positive we obtain 'perverse' results, increases in output and employment, reductions in the price level and so on.

The comparative static analysis and simulation exercises enable us to identify the key parameters in the aggregate labour supply function, and their critical values. For plausible parameter values, chosen on the basis of the available empirical evidence, it would appear that perverse results are not likely. However, there is clearly a need for more empirical investigation in this area.

These results conflict with the traditional view that labour bears the full burden of payroll taxation, but we conclude that this view depends heavily on the assumed inelasticity of the aggregate labour supply function. The latter assumption is demonstrated to be inconsistent with the bulk of the empirical evidence on labour supply.

Finally, some attention is also paid to the aggregate demand effects of unemployment insurance, in particular the case where the savings propensity out of U.I. benefits is less than that out of private factor incomes.

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TABLE OF CONTENTS

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LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 The Subject Matter

The financing of the various social insurance programmes is one of the most contentious issues in the administration of the so-called 'Welfare State'. This study is specifically concerned with the financing of unemployment insurance (U.I.), which is likely to be an important element in any social insurance system. While the details of financing schemes differ from country to country, in most cases, including Canada, a major part of the funding is an employer/employee payroll tax. The main focus of the study therefore is a model of a hypothetical U.I. system funded by payroll taxes. We will investigate the incidence and economic effects of changes in the payroll tax rates.

1.2 The Growth of the U.I. Burden

The significance and potentially controversial nature of the subject matter does not need emphasizing. In the U.S. literature, for example, Brittain (1971) and (1972a), Okner (1975), Feldstein (1977b), Friedman and Friedman (1980), and Musgrave and Musgrave (1980), have commented on the rapid rate of growth of all social insurance benefits and payroll tax receipts, including those for U.I., in the period since World War II. The growth is both in absolute terms and as a proportion of all federal government tax receipts and a similar pattern would be found in many other countries.

In Canada, it is perhaps fair to say that the total social insurance burden is less than in the U.S.A., but there has also been increasing public debate in recent years, in the Canadian case about the U.I. programme in particular. In 1971 there was a major change in the U.I. Act which increased coverage and was widely interpreted as making the programme more generous in terms of benefits paid and qualifying period, thereby increasing the unemployment insurance burden.

It is certainly true that total benefits paid have been greatly increased over the past decade, rising from $542.1 million in 1970 to $4,719 million in 1979. In nominal terms, this is an increase of approximately 770%, and even allowing for inflation (using the GNP Deflator), the increase is a sizeable 320%. In 1970 U.I. benefits represented a negligible 0.8% of Net National Income, but in 1979 the percentage was 2.3%, and in 1978 it had been even higher at around 2.5%. The real burden of U.I. payments has been growing at around 20% per year on average throughout the decade, with the biggest increases in 1972 and 1973, immediately after the 1971 amendments. In these two years real annual growth rates were 44% and 85% respectively.[1] Of course, it must be remembered that there are two possible reasons for an increase in U.I. benefits, the first being legislative changes, the second simply worsening economic conditions and increases in unemployment. Which is the main cause in any particular instance is always a matter for debate, although here the timing of the largest increases is suggestive.[2]

What is indisputable is the fact of the increases in benefit payments themselves, and the need to finance them. Apart from big deficits in the U.I. Account in 1972 and 1973 ($470.3 million and $1,387 million, respectively), the rate of growth of revenues earmarked for U.I. has roughly speaking kept pace with the growth of benefits. In 1975 and 1977 there were surpluses. In 1979, the total revenue of the scheme was $4,691 million leaving a deficit of $28 million. The contribution of the employer/employee payroll tax to U.I. financing averaged around 70% of total revenue during the nineteen-seventies. However, there is no doubt that this percentage has been falling over time. In the early years of the decade the payroll tax contributed 75%-85% or more of total revenue, but recently the figure is around 60%-65%. In 1979, payroll tax collections amounted to $2,865 million, or 61% of total revenue. On the other hand, it appears to be official policy to reverse this trend in future, and increase the proportional contribution of the payroll tax once again.[3]

In spite of increases in total payroll tax collections, U.I. tax rates in Canada remain fairly moderate compared with other taxes. For 1979 and 1980 the employee tax rate was 1.35% of insurable earnings,[4] with the employer rate at 1.89%. One may speculate that the federal government still has some unexploited opportunities for tax rate increases, which would not meet with any overt taxpayer resistance.

Various U.I. statistics for Canada are reported in the Appendix to this Chapter, and further discussion of the Canadian U.I. system, along with those in other countries, is contained in Chapter 2.

1.3 The Existing Literature

The issue of U.I. tax incidence has attracted surprisingly little attention in the literature, certainly as compared with, say, work on the incidence of the corporation income tax.[5] Of course, a fair amount of work has been published in recent years on social insurance in general. However, much of this has been concerned with the economic effects of social insurance programmes other than U.I. (in particular retirement pensions), or, where U.I. has been discussed, with issues other than U.I. tax incidence as such. Recent work on social security pensions schemes, for example, has tended to employ models of intertemporal choice ('life-cycle' models) to determine the effect of social security on such variables as savings rates, capital accumulation, and the timing of the retirement decision. This emphasis is to be found in the work of Feldstein (1974) and (1977a), Sheshinski (1978), Kotilikoff (1979a) and (1979b) and Burbidge and Robb (1980), amongst others. However, whereas a life-cycle approach is clearly appropriate in the case of retirement pensions schemes (in which title to benefit is built up by the payment of social security contributions over an individual's working life) it has rather more doubtful applicability in the case of unemployment insurance. In most U.I. schemes, as we will see in Chapter 2 below, title to benefits is earned over a very much shorter period, and the duration of benefits is strictly limited also.

The short-run labour supply effects of the benefit side of U.I. have received some attention in the literature on 'insurance-induced' unemployment. Here the issue is whether or not U.I. benefits affect the unemployment rate itself via work incentives. Canadian contributions to the debate include those by Grubel, Maki, and Sax (1975a) and (1975b), Kaliski (1975) and (1976), Green and Cousineau (1976), Rea (1977), Maki (1977), Lazar (1978), and Bodkin and Cournoyer (1978). In addition, international examples of work in this area may be found in the two collections of papers edited by Grubel and Walker (1978), and Katz and

Hight (1977). Clearly, in a general equilibrium system the effects of U.I. benefits on labour supply will have relevance to the tax incidence question, but so far there does not seem to have been any attempt to derive the implications of U.I. induced unemployment (if it exists) for U.I. tax incidence.

Finally, there is a small empirical literature in the U.S. which is concerned with what might be called the incidence of payroll taxes in general. The chief examples are the work of Brittain (1971) and (1972a), Vroman (1974a) and (1974b), Leuthold (1975), and Hamermesh (1979). None of this work is concerned with the U.I. tax specifically, the main focus of attention being the OASDHI[6] tax in the U.S. Indeed, a feature of this literature is that it concentrates on the tax side in isolation, so that it is essentially irrelevant what particular social insurance programme the tax proceeds are spent on.

Thus there appears to be a gap in the literature in discussing the incidence of a payroll tax which is specifically earmarked for unemployment insurance, and taking into account the likely general equilibrium effects of changes in the benefit side. In particular there has been no attempt to integrate the two last mentioned branches of the literature, that on U.I. induced unemployment and the Brittain-type work on general payroll tax incidence. Such an integration would, in fact, prove extremely difficult because, as we will see below, they rely on quite different assumptions about the nature of the aggregate labour supply function.

1.4 Some Theoretical Difficulties

In Hamermesh (1977a) and Lester (1962), one can find some descriptive material on U.I. tax incidence per se, but one of the few theoretical papers on the topic is that by McLure (1977). This was an attempt to apply the well-known Harberger model of tax incidence in the particular circumstances of the American U.I. tax. In a comment on that paper, Hamermesh (1977b, p. 480) is pessimistic about the current state of knowledge and the prospects for any thoroughgoing empirical investigation of the issue:

> 'The complexity of the incidence problem in U.I. rate makes it foolish to attempt empirical work on the issue at this time. Any examination of the empirical literature shows that even with a tax which is essentially flat rate - like that for OASDHI - empirical work has not been overly successful in narrowing the range of accepted estimates of the extent of the shifting. How much less likely is it, then, that empirical work on the incidence of the more complicated U.I. tax without any theoretical background other than the standard Harberger model, will provide any useful answers? Clearly the appropriate channel for intellectual resources is more theoretical analysis of the program before any empirical work is undertaken.'

McLure's difficulties were obviously compounded by the institutional peculiarities of the American U.I. system. Elsewhere, matters are slightly less complicated as most U.I. payroll taxes, unlike that in the U.S., do not vary across jurisdictions and firms or industries.[7] Unfortunately, however, Hamermesh's comments have wider applicability. Even with simpler tax structures U.I. incidence is still a complicated matter, precisely because it should properly be dealt with in a general equilibrium context, with both taxes and benefits, and the relationship between tax and benefit rates, being taken into account. We therefore take Hamermesh's point that there is considerable scope for a much more thoroughgoing discussion of the theoretical issues involved than has appeared hitherto.

1.5 Objectives of the Study

A major task of this study will be to remedy the abovementioned deficiencies in the theoretical analysis of the problem. The view will be taken that where coverage, for practical purposes, is universal and tax rates and benefit rates are uniform across industries (as in Canada), not merely a general equilibrium but rather a macroeconomic approach is required. By this it is meant that the general equilibrium models used should be more in line with those used in macroeconomic theory and not the more stylised constructs traditionally used in tax incidence theory, such as the Harberger model. In particular, the models should make allowance for:

(a) The effects of tax and benefit rate changes on aggregate factor supplies.

(b) Tax and benefit rate induced changes in output, employment and the unemployment rate.

(c) The relationship between taxes and benefits.

(d) The macroeconomic consequences of any deficit on the U.I. account.

We will develop a series of small macroeconomic models of varying degrees of complexity, and which differ from others available in the literature by an explicit modelling of a hypothetical U.I. system. The hypothetical system is necessarily rather simplified, but care is taken to ensure that it does capture the most important and frequently observed characteristics of 'real world' schemes. The traditional method of comparative statics is then applied to obtain qualitative incidence results.

A further objective is to make some progress, at least, in the direction of obtaining quantitative as well as qualitative results. For the reasons discussed above, a full-blown empirical study of any particular U.I. system is unlikely to yield fruitful results at this point. What is proposed here, however, is the half-way house of computer simulations of the theoretical models, using plausible parameter values. For example, assumed parameter values, drawn from the relevant empirical literature, may be used to provide estimates of the approximate size as well as the sign of the various comparative static multipliers. In addition, in the context of dynamic versions of the models, it will be possible to simulate the time paths of the various endogenous variables after an exogenous shock such as a payroll tax increase. It should not be suggested that these or similar exercises will provide empirical evidence on U.I. tax incidence in the strict sense of that term. However, it is to be hoped that they will prove to be a useful guide to the likely orders of magnitude and patterns of response involved.

1.6 Plan of the Succeeding Chapters

In this section, we will set out the plan of the rest of the study. Firstly, the Appendix to the present Chapter will contain selected Canadian U.I. statistics, and is intended as a supplement to the discussion in section 1.2 above.

Chapter 2 will contain some brief descriptions of various U.I. schemes around the world, including more discussion of the Canadian system, and a review of some of the standard issues and problems that arise in dealing with social security payroll taxes. One objective is to establish the salient characteristics of real world U.I. systems which should be taken into account in modelling.

Chapter 3 will be devoted to a discussion of what exactly is meant by the term, 'incidence and economic effects' of the U.I. tax. The concept of incidence is notoriously ambiguous and needs to be rigorously defined at the outset. There is an obligation to set out the study's terms of reference rather precisely.

In Chapter 4 there will be an exposition of one widely held view of payroll tax incidence, i.e. that the whole burden of payroll taxes is ultimately borne by labour. In particular there will be a critique of the work of Brittain (1971) and (1972a) who seems to be the chief modern exponent of this view. Some competing theories will also be mentioned.

Chapter 5 will review in more detail two of the branches of the empirical literature mentioned above. That is, the 'tax side only' studies of payroll tax incidence, some of which support the labour burden assumption and some of which do not, and the literature on insurance-induced unemployment. As has been pointed out there is one obvious inconsistancy between the two types of study, in the treatment of the aggregate labour supply function.

Chapter 6 will develop the various small macro models which will be the main vehicle of the analysis. An attempt will be made to remedy at least some of the theoretical deficiencies pointed out in the preceding chapters. Comparative static multipliers will be calculated and signed, but at this stage the analysis will be purely qualitative.

In Chapter 7, we will proceed to quantitative analysis and use plausible parameter values in both quantitative estimates of the size of the comparative static multipliers and the dynamic simulations. The choice of particular parameter values, from the relevant empirical literature, will be discussed in detail.

Finally, conclusions and suggestions for further research will be provided in Chapter 8.

FOOTNOTES TO CHAPTER 1

[1] Sources for these figures are the publications of Statistics Canada, National Income and Expenditure Accounts, 13-001, and Social Security: National Programs, 86-201, and the Canadian Tax Foundation, The National Finances.

[2] It would seem to be the perception of the authorities that the legislative changes were mainly responsible. Subsequent amendments to the U.I. Act have all been in the direction of 'tightening-up' the scheme (e.g., the amendments effective 1/1/75 and 1/1/79). See also Chapter 2 below.

[3] See, for example, the leaflets explaining the 1979 amendments.

[4] I.e., the band of income up to the statutory ceiling ($265 per week in 1979, $290 per week in 1980).

[5] In this regard it is interesting to compare the figures on payroll tax receipts, quoted above, with the 1979 yield of the federal corporation income tax of $6,542 million.

[6] Old Age, Survivors, Disability, and Hospital Insurance.

[7] See Chapter 2 below.

APPENDIX TO CHAPTER 1

Table 1.1 U.I. Statistics for Canada 1970-79

(Millions of Current Dollars)

Year	Employer and Employee Payroll Taxes (1)	Total Revenue (2)	Total Benefits Paid (3)	Surplus or Deficit on U.I. Account (4)	Payroll Tax Receipts as % of Total Revenue (5)
1970	491.8	623.0	542.1	+ 80.9	78.9%
1971	495.2	629.6	758.1	- 128.5	78.7%
1972	570.6	678.5	1,148.8	- 470.3	84.1%
1973	763.7	930.8	2,318.2	-1,387.4	82.1%
1974	1,019.5	1,899.0	2,181.4	- 282.4	53.9%
1975	1,622.0	2,543.8	2,521.0	+ 22.8	63.0%
1976	2,087.1	2,964.7	3,533.0	- 568.3	70.4%
1977	2,528.0	4,261.0	3,670.0	+ 591.0	59.3%
1978	2,595.0	3,982.0	4,362.0	- 380.0	65.1%
1979	2,865.0	4,691.0	4,719.0	- 28.0	61.1%

Source: Canadian Tax Foundation, The National Finances.

Table 1.2 Annual Growth Rates of Canadian U.I. Statistics in Real Terms

(Using GNP Deflator)

Year	Employer and Employee Payroll Tax Receipts (1)	Total Revenues (2)	Total Benefits Paid (3)
1970	-	-	-
1971	- 2.4%	- 2.0%	33.6%
1972	9.8%	2.7%	44.3%
1973	22.6%	25.8%	84.8%
1974	16.7%	76.9%	-18.4%
1975	42.5%	20.9%	4.3%
1976	17.5%	6.4%	28.0%
1977	13.2%	34.3%	- 2.9%
1978	- 3.5%	-12.1%	11.7%
1979	1.0%	6.8%	- 1.9%

Sources: (i) The Canadian Tax Foundation, The National Finances.

(ii) Statistics Canada, National Income and Expenditure Accounts.

Table 1.3 Recent Parameters of the Canadian U.I. System

Year	Payroll Tax Rates		Ceiling on Insurable Earnings		Benefit Rates	
	Employee	Employer*	Per Week	Per Annum	As % of Average Weekly Earnings	Maximum Benefits per Week**
	(1)	(2)	(3)	(4)	(5)	(6)
1978	1.50%	2.10%	$240	$12,480	66 2/3%	$160
1979	1.35%	1.89%	$265	$13,780	60 %	$159
1980	1.35%	1.89%	$290	$15,080	60 %	$174

Source: Canadian Tax Foundation, The National Finances.

* The Employer rate is set at 1.4 times the Employee rate.

** I.e., the Benefit rate times Maximum Insurable Earnings.

CHAPTER 2

CHARACTERISTICS OF UNEMPLOYMENT INSURANCE SCHEMES

2.1 The Blaustein and Craig Survey

According to Blaustein and Craig (1977), in their recent survey volume, by 1977 there were some 36 countries around the world which had instituted some sort of scheme to provide income protection for unemployed workers. The authors distinguish between the 'unemployment assistance' approach, in which benefits are paid according to some more or less arbitrary criteria of need, and the 'insurance approach' in which benefits are paid as of right to insured workers who have previously qualified by making the requisite amount of contributions (i.e., have paid payroll taxes). We are, of course, mainly concerned with the latter type of scheme here, and Blaustein and Craig report that this approach is the most common in the countries that they survey, in some cases combined with a supplementary unemployment assistance programme. Countries which have an insurance programme include Canada, Great Britain, the U.S.A., West Germany, France, Japan, Italy, Austria, Belgium, Holland, Spain, Portugal, Greece, Eire, Egypt and South Africa among others.

In what follows we will briefly outline the main characteristics of the Canadian scheme in particular, and compare it to provisions in the U.S.A. and elsewhere. In addition to the information in Blaustein and Craig, descriptions of the Canadian system are available in Issalys and Watkins (1977) and the publications of Statistics Canada and the Canadian Tax Foundation. Actual provisions of the various U.I. Acts may be found in the Government of Canada publication, 'The Statutes of Canada'. The American system is described by Hamermesh (1977) and Lester (1962) as well as by Blaustein and Craig. For other countries we will rely on the Blaustein and Craig material. It should be remarked that details of precise benefit and tax rates, earnings ceilings etc. are apt to date very quickly. Our main concern here however, is not with these details but with the basic structure of the various systems which change a good deal more slowly. Where precise figures are given they relate to 1980 for Canada, 1977 for the U.S.A., and to various times between 1975 and 1977 for other countries.

2.2 The Canadian U.I. System

Canada has had a federal unemployment insurance programme since 1941 when the first U.I. act was passed. As mentioned above, in 1971 there was a major revision of the Act. Coverage was made all but universal, and the system was completely revised in a manner which has since been widely interpreted as being overgenerous. In 1979 further amendments were introduced to tighten up the scheme and to 'reduce some of the disincentives to work.'[1]

Under the current provisions benefits will be paid to insured worker who become involuntarily unemployed, i.e., through dismissal or layoff and, in certain circumstances, to those who leave voluntarily and can show 'just cause'.[2] Since 1971 coverage has extended to nearly all occupational groups, but in 1979 part-time workers (those working less than 20 hours per week) were excluded. In order to qualify, the worker must have had 20 or more weeks of insurable employment in a qualifying period of 52 weeks prior to the week in which separation occurs.

After a two-week waiting period benefits are payable in three phases. In Phase 1 the claimant will receive 1 week of benefit for each week worked, up to a maximum of 25, while in Phase 2, the ratio is one week of benefit for each two weeks worked, up to a maximum of 13. In the final benefit phase, Phase 3, the claimant will receive two weeks of benefit for each 1/2 percentage point by which the national unemployment rate exceeds 4%. The overall maximum duration of benefits is 50 weeks in a 52 week period. Currently, the actual benefit rate is 60% of average weekly earnings during the qualifying period up to the ceiling on insurable earnings. For 1980, the maximum weekly benefit was $174.00. While claiming benefits the recipient is required to undertake an active job search. He or she may be disqualified from benefit for failing to undertake an adequate job search or for refusing a suitable employment offer.

The scheme is financed by the employer/employee payroll tax plus a contribution from the general revenue of the federal government. Officially the costs for Phases 1 and 2 are shared by payroll tax receipts and general revenue, with the cost of Phase 3 being borne by the federal government alone. Given that all revenue ultimately derives from the taxpayer, however, in one way or another, this accounting procedure is rather artificial. What is more important for our purposes is the proportion of total revenue accounted for by the payroll tax, as reported in the Appendix to Chapter 1 above. The employee payroll tax rate is expressed as a percentage of insurable earnings up to a ceiling or maximum. For 1980, the employee payroll tax rate was 1.35%, and the weekly maximum on insurable earnings was $290.00. The employer tax rate is set at 1.4 times the employee rate, 1.89% in 1980.[3] Payroll tax rates are periodically adjusted according to estimates of the amount of revenue needed by a formula set out in the U.I. Act.

2.3 The American U.I. System

In the U.S.A. both federal and state governments are involved in the administration of unemployment insurance. The federal U.I. law sets down certain standard requirements concerning financing, eligibility conditions, administrative procedure, etc., but within this framework each state has its own U.I. arrangements. The result is that tax and benefit rates, eligibility requirements, duration of benefits, and coverage are not standard across jurisdictions and the system is a good deal more complicated than that in Canada. Federal standards do enforce reasonably comprehensive coverage. In 1977, most lines of employment were covered with exceptions in the area of employment by state and local governments, and in agriculture and domestic service. There have been extensions in the latter two areas since then, and individual states can also extend coverage on their own initiative.

The federal government levies an employer payroll tax as a percentage of wages per employee up to a given maximum, 3.2% on the first \$4,200 per annum in 1977. However, individual states with approved U.I. laws are free to replace all but 0.5% of the federal tax with their own tax schedules. As a result standard state tax rates vary, Blaustein and Craig (1977 p. 269) quote a range of 2.8% to 4.2%. States are also free to increase the ceiling on taxable earnings, and some of them have taken advantage of this. In Alaska, the 1975 wage ceiling was \$10,000 p.a.. In addition to the interstate variation in standard tax rates, state laws allow for intrastate variation of tax rates to individual firms via 'experience rating'. Provided that the overall solvency of the state system is maintained, firms with low layoff rates and with a low percentage of former employees receiving benefits, are assessed lower tax rates than firms with adverse experience. Hamermesh (1977a, p. 8), reports a range of minimum firm tax rate from 0.0% to 3.6%, and a range of maximum rates from 2.7% to 8.5%. We should note that the American U.I. tax is basically an employer tax, only three states, Alabama, Alaska, and New Jersey also have an employee tax.

On the benefit side there is also considerable interstate variation. As in Canada, only workers who become involuntarily unemployed will receive benefit, and they must engage in active job search if they are to continue to be eligible. To qualify the worker must demonstrate a minimum level of attachment to the labour force in the 'base period' immediately preceding the separation. In some states the base period is the 52 weeks preceding the claim, in others the first 4 of the last 5 completed calendar quarters. The qualifying requirement is either some minimum number of weeks worked during the base period, usually between 14 and 20, or some minimum amount of earnings during that time.

Most states enforce a waiting period of 1 week, and thereafter, as in Canada, benefits are paid in phases. There is firstly a period of 'regular' benefits, followed by a period of 'extended benefits', when the national or regional unemployment rate is greater than some prescribed level. There are various formulas for the duration of regular benefits, in some states depending upon past employment, in others on past earnings. The maximum duration of regular benefits is 26 weeks in most states, but can be higher, the nation-wide maximum being 39 weeks. The duration of extended benefits is 50% of the number of weeks of regular benefits, but in no state is a combined total of more than 39 weeks of benefit allowed. There are a variety of methods of calculating benefit rates. One common method is the 'high quarter' formula whereby the weekly benefit rate is expressed as a fraction of the claimants earnings during the highest paid quarter of the base period. The fractions used range from 1/15 to 1/31, with 1/26 being the most popular. In other states, the benefit rate is a straight percentage, ranging from 50% to 66 2/3%, of average weekly wages. In all cases, maximum and minimum total weekly benefit levels are specified.[4]

The American programme is financed entirely by payroll tax receipts, there being no provision for a contribution from the general revenue. State U.I. tax receipts are paid into a federal unemployment trust fund, in which there is a separate account for each state, and are withdrawn as needed for benefit payments. The states are responsible for the cost of the regular benefit programme and share the cost of extended benefits with the federal government. In addition federal tax receipts pay for the administrative costs of the system and the accumulation of a federal loan fund, which extends loans to states whose revenue account is in deficit.

2.4 U.I. Systems in Other Countries

U.I. systems in countries other than Canada and the U.S.A. are described in detail in the Blaustein and Craig (1977) survey. In most of the countries surveyed, coverage is compulsory and reasonably comprehensive for full-time workers. It is suggested that coverage is virtually universal in Canada, Israel, and Norway and that 80% or more of full-time workers are covered in the U.S.A., Austria, Belgium, West Germany, Ireland, Holland and the U.K. Elsewhere groups with unusual employment patterns may be excluded, or covered in a separate scheme, e.g., Mariners in France, Greece and Japan, and agricultural workers in Italy. Most countries would also exclude casual or part-time workers and, in some cases, seasonal workers.

Benefit provisions are often quite similar to those described in detail for Canada. There will usually be, for example, a qualifying period based on the number of weeks worked, or the number of contributions paid in the period prior to the spell of unemployment. In Europe, a common requirement is 26 weeks of work in a 1 year period prior to the claim. Other qualifying requirements, such as that a worker be <u>involuntarily</u> unemployed and that he engage in job search during the benefit period, also seem to be standard.

Most countries enforce a waiting period, which varies from the two-week requirement in Canada to 3 days in the U.K. and 1 day in Italy. The rules regarding duration of benefits also vary. A number of countries, including the U.K., Spain, Sweden, France, Italy and Ireland allow a uniform duration of benefits for all claimants. In other cases, as in Canada, the duration of benefits depends upon past employment or number of contributions paid. West Germany and Austria fall into this category, for example. In one unusual case, Japan makes the duration of benefits dependent on a claimant's age. In most countries there is an upper limit to the duration of benefits, usually less than 1 year. Belgium, however, allows benefits to be of unlimited duration.

Benefit rates are usually earnings or wage related, although there are some examples of basic flat rate benefits. The benefit rate is often expressed as a percentage of average weekly earnings during the qualifying period, or as a schedule which varies with income class. For example, in France the benefit rate is 35% of average weekly earnings, compared with 60% in Belgium. In West Germany, the rate varies from 49% to 66% for different income classes. Many countries, unlike Canada, pay higher rates for claimants with dependants.

Financing schemes for U.I. often resemble the Canadian model, an employer/employee payroll tax which covers the greater part of the costs, supplemented by a contribution from general government revenue. These revenues are usually assigned to a separate reserve fund in the public accounts, from which benefits are paid out as required. Commonly there is a commitment to balance the U.I. budget over the business cycle, but the financial soundness of U.I. schemes, in practice, varies from country to country. A number of countries are similar to the U.S. in relying entirely on payroll taxes with no contribution from general revenue. These include France, Greece, Israel, Spain and Italy.[5] Three countries, the U.K., Norway and Eire have unified social security systems in which financing arrangements are rather different. In these cases, payroll taxes and other revenues finance not only U.I. but also other social security benefits such as retirement pensions, sickness benefit, etc.

Payroll tax rates are usually expressed as a percentage of earnings up to some maximum or ceiling, which may or may not be the same ceiling used in the calculation of benefits. In Italy, Japan and Egypt, on the other hand, there is no ceiling. Some countries, e.g., Denmark and Sweden, use a flat rate tax, but this is not common. Employer payroll tax rates will either match employee rates, or be set at some multiple of them. We should note, in passing, that the experience rating provisions used in the U.S.A. seem to be confined to that country. Blaustein and Craig (1977 pp. 105-109), quote a number of payroll tax rates current in 1977. West Germany and Austria, for example, both had an employee payroll tax rate of 1%, with a matching employer contribution. In France, the rates were 0.48% and 1.92% respectively, in Japan 0.5% and 0.8%, in Greece 1.0% and 2.0%, and in Belgium 1.2% and 1.7%. Italy had an employer-only tax of 2.3%.

2.5 Key Parameters of U.I. schemes

From the above discussion we are now in a position to identify what might be termed the 'key parameters' of most actual U.I. programmes, which need to be taken into account in any attempt at the theoretical modelling of such a system. These are as follows:

(a) On the Benefit Side:

- (i) The qualifying period ... usually some minimum number of weeks worked in some period prior to the claim.
- (ii) The waiting period.
- (iii) The duration of benefit ... often related to (e.g.,) the number of weeks worked during the qualifying period.
- (iv) The benefit rate ... often tied to average earnings in the qualifying period.
- (v) The benefit ceiling.

(b) On the Tax Side:

(i) The proportion of costs covered by payroll tax receipts and other revenue, respectively.

(ii) The employee payroll tax rate ... usually some percentage of insurable earnings.

(iii) The employer payroll tax rate ... usually some multiple of (ii).

(iv) The ceiling on insurable earnings.

2.6 Unemployment Insurance as Social Insurance

Finally, there is one more noticeable feature of the administration of U.I. schemes around the world, which requires some comment. This is the extent to which the authorities have promoted U.I. not simply as a tax/transfer mechanism, in which one group of citizens is taxed to finance transfer payments to another, but literally as an insurance scheme in which individuals pay premiums to insure themselves against the undesirable contingency of losing their job. The official literature will refer to 'premiums' or 'contributions' rather than taxes, 'insured persons' rather than taxpayers, etc. This has occasioned a sometimes heated debate as to whether U.I. can genuinely be regarded as an insurance programme or not.

A number of commentators have strongly argued that the implied analogy to private insurance is extremely misleading, not only in the case of unemployment insurance, but also for social insurance programmes in general. The authorities' objective in propagating this view, it is suggested, is simply to lessen taxpayer resistance. See, for example, the comments of Brittain (1972a, p. 6-13), Okner (1975, pp. 567-568) and Friedman and Friedman (1980, pp. 102-107). Okner has referred to the 'insurance myth' and Friedman and Friedman, in rather stronger language, to 'Orwellian doublethink'. The basic complaint of these writers is that the characteristics of so-called 'social insurance' programmes such as U.I. actually bear little or no resemblance to private insurance schemes, and that therefore, the use of the word insurance is merely a 'smokescreen'.

Brittain (1972a) challenges the insurance concept of social insurance on a number of grounds. For example, that there is little attempt at genuine actuarial evaluation of risk either on an individual or collective basis, and that, in practice, individual benefits received bear only a tenuous relationship to taxes or contributions paid. Further, that participation in social insurance is compulsory, and yet the payment of taxes does not legally entitle an individual to any prescribed scale of benefits. Benefit rates, eligibility requirements, duration of benefits, etc., can be and often are, changed ex-post by legislative action. He quotes (1972a, p. 10) some remarks by Barbara Wooton which effectively back up his position and that of like-minded writers and are worth repeating here:

> '...the simple facts of the situation are that benefits on a prescribed scale have been promised, and that funds must be provided to meet them; that is all. In these circumstances, the allocation of precise fractions of contributors payments to cover particular risks becomes an academic, rather than genuinely actuarial exercise.'

On the other hand, many other writers have been prepared to treat the 'insurance' aspects of social insurance more seriously, taking the view that even if social insurance programmes do not resemble private insurance in every respect the concept of social insurance itself is valid, i.e., that social insurance programmes (at least in principle) can pool the risks of loss of work income through unemployment, retirement or ill health in a manner which is actuarially fair on a collective if not an individual basis. In this vein some of the recent literature has considered the design of optimal social insurance policies in the presence of earning-ability risk. See (e.g.) Diamond (1977) and Diamond and Mirrlees (1978) in the case of social security, and Fleming (1978) in the case of U.I.

In this study we will attempt to avoid being drawn into the debate over the extent to which unemployment insurance is or is not a 'genuine' insurance programme. Feldstein (1977b, p. 82) takes a sensible view:

> 'The truth is that social insurance is neither an insurance program nor an income redistribution program. Social insurance payments may be characterized as "event conditioned transfers"....'

Our purpose here is precisely to study the distributional and other economic consequences of the funding of just such an 'event conditioned transfer', the event being 'not working' in the case of an individual who has had minimum work experience in the U.I. qualifying period. But in order to do this it is necessary only to model a system in which the terms of the transfer approximate as closely as possible those existing in real world systems. It is not necessary to inquire whether the transfer system does or does not represent insurance , and still less to ask what would be the characteristics of some hypothetical optimal insurance system.

FOOTNOTES TO CHAPTER 2

[1]See Canadian Tax Foundation (1979/80, p. 123).

[2]There is also some provision for workers who undergo separations through illness or retirement. See Blaustein and Craig (1977, p. 165).

[3]Source for statistics quoted in Section 2.2 is the Canadian Tax Foundation, The National Finances.

[4]Figures from Blaustein and Craig (1977, pp. 239-250) and Hamermesh (1977).

[5]The latter country also follows the U.S. in having an employer tax only.

CHAPTER 3

THE CONCEPT OF INCIDENCE

3.1 Musgrave's Position

R.A. Musgrave (1959, p. 207) defines the incidence of 'changes in budget policy' as 'the resulting change in the distribution of income available for private use,'[1] it being understood that the definition refers to changes in one equilibrium position as compared with another, in the method of comparative statics.[2] It is clear, however, that this general definition raises more questions than it answers. A great deal of further elaboration is required before the definition can become operational.

In the characteristic Musgravian methodology, incidence, as defined above, is identified as only one of a number of different possible effects of budget policy, or, in our case, tax policy. The others are 'resource transfer', 'Ricardian output effects' and 'Keynesian output effects'. Resource transfer refers to the simple transfer of purchasing power from the private to the public sector, or, in the case of U.I., between two different groups within the private sector. This presumably is the primary or intended purpose of a tax/transfer mechanism such as unemployment insurance. Under the heading of Ricardian[3] output effects, Musgrave would include all tax-induced changes in the full employment level of output via (e.g.,) incentive effects on labour supply or capital formation. Finally, in the context of an economy at less than full employment, Keynesian output effects would refer to tax-induced changes in the level of involuntary unemployment, via changes in aggregate demand. While the general interdependence of all these effects is recognised, Musgrave would argue that for analytical and expositional purposes it is useful to consider each separately, applying ceteris paribus assumptions to the rest of the system. For example, in this view we may usefully have a discussion of incidence, as defined above, in a context in which output and employment are held constant.[4]

We also owe to Musgrave (1959, p. 211-217) the well-known classification of different concepts of incidence according to the specification of the precise exogenous change involved, i.e., the distinctions between absolute (or specific) incidence, differential incidence, and budget incidence. The first of these, absolute incidence, is simply a change in the tax rate under consideration with no offsetting changes in other tax rates or government expenditure. Such a formulation, however, would not be favoured by Musgrave, precisely because it does not allow for separate consideration of the different effects of taxation. A tax increase, for example, with no other offsetting changes, will reduce the budget deficit and set in train a series of macroeconomic consequences which cannot realistically be ignored. Differential incidence, in the Musgravian scheme, may be viewed as an attempt to avoid this problem, and thereby facilitate the discussion of distributional changes in isolation. In this formulation, one tax is substituted for another of equal yield. The question that is really being discussed, therefore, is the distributional consequences of (e.g.,) substituting an income tax for an equal yield corporation tax, rather than the consequences of a unilateral increase in any one tax rate. The concept of differential incidence is not without its ambiguities, however, not least in deciding what is meant by equal yield. (Should this be real yield, money yield, equal yield at a constant level of output, or some other concept?) It is also far from clear that differential incidence can avoid output effects any more than absolute incidence. For example, an income tax and a sales tax, even if they are of equal yield, could conceivably have very different effects on labour supply and/or capital formation and hence on output and employment. The third type of incidence is budget incidence, more precisely balanced budget incidence, in which a tax increase (decrease) is matched by an equal increase (decrease) in government expenditure. According to Musgrave the advantage of this concept is that, like differential incidence, it avoids the macro consequences of changes in the government deficit or surplus. Its disadvantage, on the other hand, is that it becomes impossible to disentangle the separate incidence effects of the tax and expenditure sides.

Musgrave (1959, p. 215) is quite clear as to which of the incidence concepts he finds most useful, and in the light of his methodology of separating out the different effects of taxation, his choice is not surprising:

> 'Among all these formulations, that of differential tax incidence should be most useful, and that of balanced budget incidence is next. Other formulations are possible but of lesser significance.'

3.2 Shoup's Criticism of the Incidence Concept

C.S. Shoup (1969, pp. 7-15), has contributed a careful discussion of the conceptual problems inherent in tax incidence analysis. He draws a distinction between the incidence of what he calls 'narrowly-based taxes', such as a sales tax on a particular commodity, and that of 'broad-based taxes', of which our U.I. tax would be a good example. As far as the former type of tax is concerned, Shoup is of the opinion that 'useful answers' may be obtained using partial equilibrium incidence analysis, as long as certain conditions are satisfied. These are that the effects of the change on factor supply and product demand schedules in untaxed industries and the feedback effects on the supply and demand schedules in the taxed industry are small enough to be ignored; and that the revenue collected is sufficiently small in relation to total revenue that macroeconomic effects are insignificant. When these conditions are met, incidence analysis can be carried out in the traditional partial equilibrium manner of the undergraduate textbooks.[5]

Where the conditions break down however, and a fortiori in the case of broad-based taxes, partial equilibrium analysis is insufficient and only a full-blown general equilibrium analysis will do. The ultimate effect on distribution will just be a part of the total package of simultaneous changes occurring economy-wide. It certainly will not be possible to study a change in income distribution in isolation from (e.g.,) changes in employment as suggested by Musgrave. Shoup's point is that for any change in budget policy, the number of goals to be achieved, and the number of instruments used, must be equal. But if, for example, an attempt is to be made to examine a change in income distribution holding constant employment, output, and the general price level, there are four goals not one; to achieve a desired constant level of an endogenous variable is in itself a goal. In this case, the differential incidence concept breaks down, as changes in no less than four tax rates or other budgetary instruments would be required. As Shoup (1969, pp. 13-14), puts it:

> 'What, now, is the consequent change in the distribution of real income a result of? It does not represent the differential incidence of the first two taxes, since ... more taxes have had to be changed ... To take a more complex case, if there are eight goals to be achieved by the public finance system, eight public finance instruments will normally be required, with a unique set of eight rates or values. If the values for one of these goals is to be changed, while the value of each of the other seven goals are to be unchanged, the values of all eight of the public finance instruments must normally be changed. All eight are changed, just to alter one of the goal values (and to keep the other goal values unchanged). The new distribution of disposable income is necessarily the 'incidence' of changes in eight public finance instruments.'

3.3 A Working Definition of Incidence

In the light of the above difficulties, and given that the U.I. tax in most countries is certainly a 'broad-based tax' in Shoup's terminology, there remains a very real question of the concept of incidence to be employed in this study.

It appears that we must reject the Musgravian notion of a 'micro' concept of incidence as somthing that can be studied in isolation from the 'macro' concept of output effects; but what should be put in its place? The most straightforward course of action seems to be to simply abandon any attempt to define incidence as something as separate or distinct from the other effects of taxation. After any change in budget policy in a general equilibrium system, changes in a number of endogenous variables will ensue, including changes in employment, prices, output, etc., as well as the distribution of income. Furthermore, the changes in distribution are themselves dependent on the other changes, and vice versa. A comprehensive study should surely report all the relevant changes and their interrelationships, rather than the results of artificial ceteris paribus experiments. Quite apart from the problems raised by Shoup, it is not at all obvious that the study of incidence in isolation from other changes (even if this can be achieved) tells us anything very useful about the effects of taxation in the real world. In any actual public finance system a change in budget policy will invariably lead to exactly the kind of complex general equilibrium adjustments we are referring to here. If the incidence of taxation is to be an interesting issue at all, it would seem to be appropriate to discuss it in this context.

In this view of the matter there can never be any all-embracing definition of what is meant by incidence; it will vary according to circumstances, to the exact nature of the problem at hand, to which other changes need to be taken into account, and which do not. The term 'incidence and economic effects' is used specifically to indicate that the analysis cannot be restricted to a study of so-called 'micro' distributional changes only.

In this study, therefore, we will be interested in the effects of payroll tax changes on a number of endogenous variables, including not only distributional concepts such as the after-tax real wage rate and real capital income, but also employment, prices, output and the unemployment rate. The changes in these other variables and their feedback effects on distribution are treated as being an integral part of the analysis rather than as something to be ignored or assumed away.

One further aspect of the problem requires some comment. This is that even when we are using a broader concept of incidence which takes into account all the relevant changes in endogenous variables, it is still not possible to define a unique 'incidence' of any particular tax change. In other words, there is no unique set of changes in endogenous variables associated with a given change in a given tax rate. We should expect that the number, magnitude, and even signs of the endogenous changes will vary according to circumstances. Among the circumstances which need to be taken into account are as follows:

(i) The exogenous event specified ... for example, the Musgravian distinctions between absolute, differential and budget incidence.

(ii) The initial conditions of the economy ... do we start from a position of full employment or less than full employment, equilibrium or disequilibrium?

(iii) The structure of the economy ... the conditions of competition or monopoly, the strength of the labour unions, whether the economy is closed or open.

(iv) The time horizon ... i.e., what is the relevant time horizon for our comparisons? The 'market period', the 'short-run', the 'long-run', the 'very long-run'?

(v) The nature of the dynamic adjustment mechanism ... this is an aspect overlooked in the methodology of comparative statics, but it should be recognised that one's view of the incidence question may well alter when the dynamic adjustment process is taken into account. For example, the real income of a particular group may be the same at the initial and final equilibrium position, but be lower during the adjustment period. This is a significant dimension of incidence, particularly if the adjustment takes place slowly. Another relevant question, of course, is whether convergence is possible at all. The tax change considered might well be destabilising.

The researcher would only be embarrassed by these problems, however, if he insisted on defining incidence as a unique set of responses to a particular change. If, on the other hand, he is prepared to specify (a) the endogenous variables which are of interest, and, (b) the complete set of circumstances in which the change is to apply, his investigation of the effects of tax changes (given those circumstances) will be interesting and relevant. It should not be particularly surprising, after all, that a given tax change will have different effects in different circumstances. It is the researcher's job to identify just which effects in which circumstances.

3.4 Further Remarks

One implication of the above view of the incidence question is that, contrary to Musgrave's opinion, it leaves no basis for a presumptive preference for differential incidence over the other formulations. One of the purposes of the differential incidence concept, it will be recalled, was to isolate incidence, viewed as distributional changes only, as much as possible from the macro or output effects of taxation. If, however, output effects are now regarded as an integral part of the total picture, this justification evaporates. Indeed absolute and budget incidence begin to appear more relevant. It would only be when the substitution of one tax for another is, in itself, the policy question under review, that differential incidence would come back into its own. In this study we will not be entering into the tax substitution question per se, so the differential incidence concept will not be required. We will rather be considering both balanced budget tax changes, where the tax rate is increased (decreased) to allow a higher (lower) level of benefit, and unilateral tax changes, which allow budget deficits or surpluses to develop. The former type of change will require the concept of budget incidence, the latter, absolute or specific incidence.

There is one more aspect of the incidence question which has not so far been discussed, and this is the matter of the appropriate concept of income distribution. The debate over whether the functional or personal distribution of income is the more useful concept unfortunately tends to be ideologically charged, and it is not our intention to enter that debate here. The type of models (small macro models) used in this study naturally lend themselves to the factor pricing approach, so it is simply convenient to take that line here. It should be noted, however, that the discussion will be in terms of factor prices, such as the after-tax real wage rate, or the total income accruing to factors, such as the total real wage bill, and not in terms of the rather nebulous concept of factor shares. It might also be remarked that even if one's ultimate objective were to determine changes in the size or personal distribution of income, a discussion of factor pricing is an indispensable first step. If we know the proportions of total income accounted for by each factor source, within each income class, it is possible to move immediately from a discussion of factor pricing to the size distribution.

3.5 Specific Issues in Payroll Tax Incidence

Given that the U.I. tax is a payroll tax, it is necessary to comment on some of the issues which arise in discussions of incidence, and are peculiar to this particular type of tax.

The most obvious of these is the significance, if any, of the employer/employee split. It is a well established proposition, of course, that under competitive conditions it is irrelevant on which side of the market a tax is imposed. This is as true in factor markets as it is in product markets.[6] However, competitive conditions cannot be taken for granted. Suppose, for example, that labour unions have market power. One can then conceive of a very different reaction to a tax imposed on the employee side of the market as opposed to the employer side. In general, non-competitive conditions may well cause the employer/employee split to have significance.[7] This issue has received rather cavalier treatment in the literature. Often, the incidence of the employer portion is regarded as the only interesting question, with the incidence of the employee tax taken for granted. J.A. Brittain (1971) and (1972a) is vulnerable to this criticism, as is much of the empirical literature based on his work.[8]

Another issue which is often raised in connection with payroll tax incidence, although it is not confined to this case, is the distinction between 'backward shifting' and 'forward shifting' of the tax burden.[9] In the case of the payroll tax, forward shifting would imply that tax increases are passed on to the consumer in the form of higher prices, while backward shifting implies cuts in money wages.[10] Brittain (1971, p. 115) argues that where we are concerned with the distribution of real factor incomes the question of forward versus backward shifting loses much of its significance. In other words, that it does not matter whether a given fall in the after-tax wage rate, for example, comes about because of a decrease in the money wage or a rise in the general price level. Obviously, if real factor incomes are the only concern, this point is perfectly valid. However, it is not our intention in this study to ignore the backward v. forward shifting issue. Whatever may be the case in theoretical exercises, for policymakers the question of whether payroll taxes are shifted forward or not is a matter of concern. In the practical situation there will always be some groups (e.g., those on fixed incomes such as pensioners) who stand to lose when the general price level rises. If forward shifting takes place these groups share some of the burden with the various factor-owning groups. One of the advantages of our broad definition of 'incidence and economic effects', referred to above, is that changes in the general price level may be studied as an important part of the analysis, and used as an indicator of the degree of forward shifting.

Finally, we should mention the recurring theme in payroll tax incidence of the alleged regressive nature of the tax, particularly in those cases where there is a ceiling on taxable earnings. This is stressed by both Brittain (1971, p. 110) and Musgrave and Musgrave (1980, p. 507). For the tax to be shown to be regressive, in the generally accepted sense that it bears proportionately more heavily on lower income groups, it seems that two separate assumptions are required. These are, (a) that labour bears the full burden of the tax, and (b) that persons who earn low wages are also in low income classes when all sources of income are taken into account. While (a) and (b) may well turn out to be perfectly valid, it should be scarcely necessary to add that the regressivity or otherwise of the tax cannot be established until the incidence question has been settled one way or another. Even the professional literature, however, seems to be guilty of pre-judging the issue.

FOOTNOTES TO CHAPTER 3

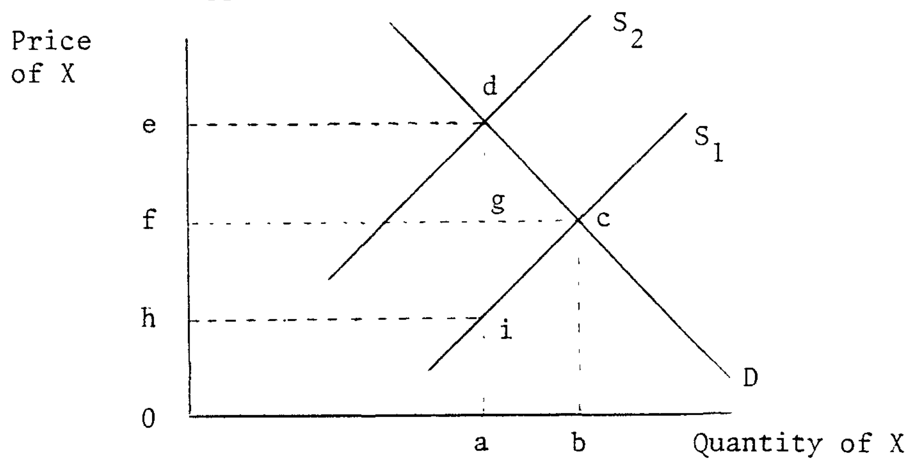
[1]Earlier definitions of incidence were much more vague. See, for example, Seligman (1902, p. 1), 'the settlement of the burden on the ultimate tax payer'.

[2]See Musgrave (1959, pp. 209-210) however, for a recognition of the problems arising from a consideration of the dynamic adjustment process.

[3]It is not entirely clear why Musgrave uses this term; there is no connection with our so-called 'Ricardian case' in Chapter 6 below.

[4]In their undergraduate textbook, Musgrave and Musgrave (1980, pp. 256-258) identify incidence with the 'micro effects (of taxation) on the distribution of income and the efficiency of resource use ...' as distinct from the '... macro effects on the level of capacity output, employment, prices and growth'.

[5]Consider, for example, in the diagram below, a per-unit sales tax imposed on the supply side of commodity X:



The supply schedule of X shifts up and to the left by the full amount of the tax. The price of X rises from Of to Oe, and the quantity traded of X falls from Ob to Oa. The incidence of the tax consists of the lost rectangle of consumer surplus fgde and the lost rectangle of producer surplus fghi, whose combined value in monetary terms is equal to total tax collection edhi. In addition there is the familiar 'excess burden' triangle dci, arising as a result of the cutback in production.

If the various feedback effects on the demand and supply schedules are small enough to be ignored, the matter ends here, and we have a reasonably comprehensive analysis of the incidence of this particular tax.

[6]For a simple discussion and demonstration of this point see Musgrave and Musgrave (1980, pp. 507-508).

[7]Musgrave and Musgrave (1980, p. 292 and 509) also discuss this issue.

[8]See Chapter 5 below.

[9]Musgrave and Musgrave (1980, p. 259) define the shifting of taxes as "... the economic adjustment process, or the transmission of the burden from its impact point (the place of statutory incidence) to its final resting point (the place of economic incidence)".

[10]In the case of the employee portion this is something of a misnomer, but recall that, as pointed out above, the literature often treats only the employer tax.

CHAPTER 4

THE LABOUR BURDEN CONCLUSION

4.1 A Conventional View?

It would be stretching a point to claim that there has ever been a consistently formulated conventional view on U.I. tax incidence as such. There simply has not been sufficient discussion of the issue. On the other hand, there is a view of the incidence of payroll taxes in general which has been sufficiently widely held to justify use of the term conventional. This is that labour bears the full burden of payroll taxation, in the sense that the after-tax real wage rate declines by the full amount of the tax increase, with no effect on employment, output and the price level, or capital income. It is possible to trace the development of a tradition in support of this position from the work of Brown (1924) to that of Brittain (1971) and (1972a). In addition, as pointed out by Break (1974), and McLure (1975), application of the well-known Harberger (1962) model of tax incidence to this problem would lead to the same conclusion.

It should be stressed that all of this work examines the effect of payroll taxes in isolation from the purposes for which the tax proceeds are used. In other words, the payroll tax is not treated as an integral part of any social security or U.I. scheme.[1] This is why it is possible to refer to the incidence of payroll taxes 'in general'. Nonetheless, many commentators have been inclined to use the labour burden assumption in discussions of real world payroll taxes which are part of actual social security or U.I. systems. For example, the labour burden assumption is an option widely used in the construction of tax-burden tables. See Okner (1980), Atkinson (1980), Musgrave and Musgrave (1980, Ch. 12), Gillespie (1976), and Pechman and Okner (1974). It also figures prominantly in the textbooks, e.g., Musgrave and Musgrave (1980, Ch. 23), and has received emphatic support in the popular writings of Friedman and Friedman (1980, p. 105).

If labour does bear the burden, this will, of course, lend support to the view that the payroll tax is regressive, as mentioned in Chapter 3 above. The financing of the American OASDHI system has often been criticised on these grounds. Brittain (1971) and (1972), clearly holds this view, as does Okner (1975). If the labour burden conclusion holds for U.I. taxes, then presumably (given the caveat mentioned in Chapter 3) they would be regarded as regressive also.

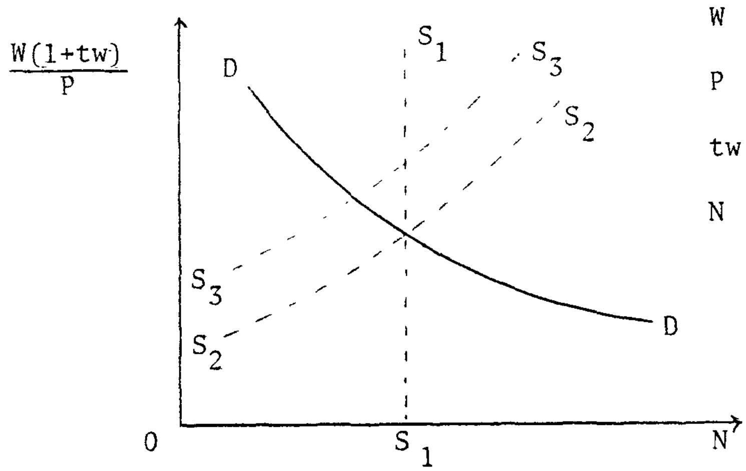
In what follows in this chapter, we will discuss J.A. Brittain's theoretical case for the labour burden assumption in more detail, and some possible criticisms of his analysis. In addition, some mention will be made of the sparse literature on the incidence of U.I. taxes as such (as opposed to payroll taxes in general).

4.2 Brittain's Analysis of Payroll Tax Incidence

For J.A. Brittain (1971) and (1972a), the main focus of interest, as mentioned in Chapter 3 above, is the employer portion of the tax. Presumably, the implication is either that there is no controversy over the employee portion, or that inferences may be validly drawn about the incidence of the employee portion once the incidence of the employer portion is known.

The analysis rests essentially on the neoclassical marginal productivity theory of distribution, combined with a strong assumption about the elasticity of the aggregate supply of labour function. A profit-maximizing employer will hire workers up to the point where the gross real wage rate is equal to the marginal product of labour. If an employer payroll tax is imposed on the use of labour services then the gross wage must include that tax. From the employer's point of view, the tax simply adds to the expense of employing labour, and must be treated on the same footing as wage payments in the optimising calculus. At the macro level, the aggregate demand for labour will therefore be a downward sloping function of the gross-of-tax real wage rate.[2] If this aggregate demand for labour curve is than combined with a perfectly inelastic aggregate supply of labour curve, it is clear that labour will bear the full burden of any tax increase. Neither employment, output, nor the marginal productivity of labour will change, implying that there will also be no change in the gross real wage rate that employers are willing to allow. Consequently, the employee's net of tax wage will be reduced by the full amount of the tax. The argument may be illustrated with the aid of the following diagram:

Figure 4.1 Aggregate Labour Demand and Supply as Functions of the Gross of Tax Real Wage Rate.



W = Nominal Wage

P = Price Level

tw = Payroll Tax Rate

N = Employment

The above is a representation of the aggregate labour market, with, as suggested, the demand for labour curve DD as a downward sloping function of the gross real wage. If the aggregate supply of labour curve is completely inelastic, like S_1S_1, it is apparent that labour bears the burden of any tax increase. The equilibrium gross real wage rate will be constant, so labour's net remuneration must be reduced by the full amount of the tax. On the other hand, consider the case where the labour supply curve is a positively sloped function of the net-of-tax real wage rate, as in S_2S_2. As it is the gross wage on the vertical axis, the payroll tax rate is now a shift variable in the labour supply curve. An increase in the payroll tax rate will shift the supply curve up to a position like S_3S_3. Employment will fall, the equilibrium gross of tax real wage rate will be higher, and the fall in the net-of-tax real wage rate will be modified. Capital income will also bear some of the tax burden.[3]

In this context Brittain can make two arguments in support of the labour burden conclusion. The first, quite obviously, is simply that the aggregate supply of labour curve is indeed inelastic. The alternative argument represents the one instance in which the analysis does touch upon the fact that the payroll tax is part of a social insurance scheme. This is that labour accepts the official line that payroll taxes are insurance premiums, and will treat the taxes as part of its wages. In this case, even if the labour supply curve is elastic, like S_2S_2, it will not shift when a tax is imposed. Labour will accept a reduction in its net wage under the impression that its total remuneration is unchanged. Brittain (1972a, p. 38) explains his alternative arguments in the following way:

> '... the essence of this conclusion (that labour bears the burden) would not be disturbed by a small degree of supply elasticity. Even if the supply of labour were substantially elastic, the same result ... would occur ... if labour regarded both of the withheld contributions as part of its supply price ... the main point is that if labour supply were highly inelastic and/or a substantial portion of social security contributions were viewed by labour as part of its income, employment effects would be minor.'

4.3 Criticisms of the Brittain Analysis

There are a number of possible criticisms of the above analysis. The most obvious concerning the assumption that the aggregate supply of labour curve is vertical. As pointed out above, to the extent that there is some slope to the labour supply curve, the view that the entire burden falls on labour cannot be defended. Brittain's assertions regarding the slope of the labour supply curve are made without any actual reference to the relevant empirical literature. In fact, as we will see in Chapters 7 and 5 below, the notion of a vertical aggregate labour supply curve is inconsistent both with that literature, and with the various studies on insurance - induced unemployment, which rely on a positive response by workers to a change in the relative price of labour and leisure. The analysis also ignores the implications of possible imperfections or rigidities on the supply side of the labour market. There may be money wage rigidity due to explicit or implicit contractual arrangements, or 'real wage resistance' due to strong labour unions. Musgrave and Musgrave (1980, p. 509), for example, mention the possibility that backward shifting of the employer tax may be successfully resisted by a labour union.

Another criticism is the lack of attention paid to the problem of the disposal of the tax proceeds. The underlying assumption seems to be similar to that made by Harberger (1962), that the budget is balanced, and that the pattern of expenditure out of tax proceeds is exactly the same as would have occurred had the money remained in the hands of the original taxpayers.[4] Break (1974) and McLure (1975) explain that this assumption is often made in various applications of the Harberger model, to neutralise the effects of tax receipts. The procedure seems particularly unappealing in the case of payroll tax incidence, however, precisely because of the fact that payroll taxes are usually imposed as part of a social insurance system of some kind, with the proceeds going to finance social insurance benefits. It is a rather unlikely proposition, on the face of it, that spending from social insurance benefits will have the same economic effects as spending from private factor incomes.

It is necessary, firstly, to be clear about exactly which of the social insurance programmes we are dealing with if the payroll taxes are funding retirement pensions, for example, recent work using 'life-cycle' models (referred to in Chapter 1 above) would indicate numerous economic effects of the benefit side, for example on saving, capital accumulation, and the retirement decision, all of which will ultimately affect the incidence question. In our case, in which the payroll taxes fund a U.I. scheme, the disposal of payroll tax receipts as U.I. benefits is equally significant, but in a rather different way. Because of the different institutional structure of U.I., life-cycle considerations will be less important. In most U.I. schemes there is no question of building up title to U.I. benefits over the life-cycle as would be the case for pensions. (As we have seen, eligibility for U.I. benefits is determined solely by the contribution record in a fairly short period of one year or less, immediately prior to the benefit claim. Past contributions are quite irrelevant.) U.I. benefits presumably <u>will</u> have a major impact however, on the short-run labour/leisure choice. Changes in benefit rates, duration of benefits, and the qualifying period, will change the relative price of labour and leisure, and, except in the completely inelastic case assumed by Brittain, will have their impact on labour supply. If there is a balanced budget increase in U.I. tax rates this must mean either that benefit rates increase, or that some other aspect of the scheme is made more generous. Consequently it is then necessary to take into account all the supply side effects of these changes, and their 'feed-back' into the general equilibrium solution. It cannot be assumed that the tax proceeds have the same effects as if they remained in the hands of the original taxpayers.

There is one further point that should be mentioned in this connection and this is the argument that, under certain conditions, U.I. benefits may have aggregate demand effects via their impact on saving, but in this case because of the effect on the short-run <u>aggregate</u> savings propensity rather than on individual life-cycle savings profiles.

If the tax proceeds (i.e. U.I. benefits) are spent in the same way as they would have been originally, the implication must be that spending propensities are the same across all income receiving groups, including the unemployed. It could be plausibly argued, however, that the savings propensity out of unemployment benefits is less than that out of earned income, as benefit recipients are likely to spent most of their income. If this is the case, the U.I. system transfers income from groups with relatively high savings propensities to a group with a low one. This will have an expansionary impact on aggregate demand in the short-run, but adverse effects on capital accumulation (as in the pensions case) in the long-run. Some of the early Keynesian economists, notably Seymour Harris (1941), made a great deal of this point, particularly as regards the short-run consequences, but it is missing from Brittain's analysis.

A final criticism has already been mentioned in Chapter 3 above. This is the inability of the analysis, in its empirical application at the macro level, to distinguish between the traditional categories of backward and forward shifting. The reader is referred to the discussion in Chapter 3, section 3.5.

In the theoretical analysis in this study, particularly in Chapter 6 below, we will attempt to build models which rectify as many as possible of the problems discussed here.

4.4 Previous Views of U.I. Tax Incidence

The reason for concentrating on Brittain's analysis of payroll tax incidence 'in general', and the labour burden assumption, is simply that there has been a paucity of studies of the U.I. tax as such. In this final section of the chapter, however, we will briefly discuss some of the studies that do exist and how they relate to the labour burden conclusion.

In two monographs on the American U.I. system, Lester (1962), and Hamermesh (1977), present some descriptive material on U.I. tax incidence. We should recall, however, that the American U.I. tax has some institutional peculiarities which are not found elsewhere. It is an employer tax only, the effective rate of which varies across states and, because of 'experience rating', even across industries and/or individual firms. Neither author adopts a general equilibrium approach or attempts to assess the tax's impact on real factor incomes. They are concerned, rather, with whether the employer tax is shifted 'forward' in higher consumer prices, 'backward' in lower money wages, or is deducted from the individual firms profits. In this context, Lester (1962, p. 66) is of the following opinion:

> '... perhaps no more than a third of the unemployment compensation tax burden ... is shifted to consumers in prices ... Undoubtedly, most of the remainder is absorbed by the employers, who are forced to do so primarily because of the differential character of the tax.'

The argument rests on the notion that the tax is firm specific because of experience rating. Under these circumstances, it must be paid out of profits and not passed forward to consumers (who have the option of buying elsewhere), or backward to workers (who have the option of supplying their services elsewhere). Hamermesh (1977, pp. 12-15) takes precisely the opposite view. He makes the point that firms, as such, can only bear the burden of taxation if there are substantial elements of monopoly in the economy. This is because only monopolists earn 'excess' or 'abnormal' profits and the 'normal' profits of competitive firms are not reducible. Therefore:

> 'Since in the United States the extent of monopoly profits as a fraction of all profits is not likely to be very large, it is unlikely that employers will bear the tax burden in the long run.'

The alternative options, according to Hamermesh, are forward shifting to consumers or backward shifting to workers.[5] Either of these may occur, because tax rates, in practice, are industry specific rather than firm specific, so that U.I. induced cost changes tend to be similar for all producers of a similar product. The point is that either good or adverse employment experience, when it occurs, is likely to affect all firms in a particular industry, not just one firm, so that tax rates are likely to stay in line. Hamermesh's suggestion (p. 13), as a rule of thumb, is to 'assume that the burden eventually falls half on consumers and half on workers'. It must be pointed out, however, that this partial equilibrium analysis bears little relationship to the aggregative general equilibrium framework we have advocated. The changes referred to are changes in money wages and prices in a particular industry. Whether they support the labour burden assumption, or otherwise, at the aggregate level, is difficult to say.

McLure (1977) has used the standard Harberger general equilibrium model to investigate U.I. tax incidence, also in the American institutional framework. In keeping with the nature of the U.S. system of differential tax rates, McLure uses a two sector model in which a payroll tax is assumed to apply in one sector only. The analysis however is somewhat inconclusive (p. 478):

> 'Unless either factor intensities or the ease of factor substitution differ markedly between industries, labour is likely neither to gain very much nor lose very much as a result of the cross-subsidisation implicit in U.I.'

It must be recalled, of course, as McLure (1974, pp. 140-141) has himself demonstrated, that the analysis of a general payroll tax in the Harberger framework would allow no such ambiguity. In that case labour would certainly bear the full burden of the tax.

In short, a convincing analysis of U.I. tax incidence, differing from Brittain's methodology, is as yet unavailable. In the absence of any other coherent view, the labour burden conclusion is still often used in tax burden tables etc., for U.I. taxes, as well as for other social insurance contributions.

FOOTNOTES TO CHAPTER 4

[1]Brittain (1972a) uses the title The Payroll Tax for Social Security but the fact that payroll taxes finance social security benefits does not really affect his discussion of the incidence question.

[2]Brittain (1971, p. 114) points out that his case does not really depend on the assumption of profit maximisation, or even the less restrictive assumption of cost minimisation on the part of employers. All that is really necessary is to accept an aggregate demand for labour function, however derived, as depending upon the gross real wage rate.

[3]It should not be suggested that a partial equilibrium construction such as Figure 4.1 can show the incidence of taxation in any definitive way The discussion ignores the feedback effects on the slope and position of labour demand and supply curves which would be present in a general equilibrium model. See McLure (1975, pp. 128-132). Our purpose here is purely illustrative.

[4]See Brittain (1972a, p. 51).

[5]As with Lester, the possibility of a reduction in the real factor income of capital owners does not seem to be considered.

CHAPTER 5

A SURVEY OF SOME OF THE RELEVANT EMPIRICAL LITERATURE

5.1 Introductory Remarks

In this chapter we will briefly survey two branches of the empirical literature which have a bearing on our topic. Section 5.2 will review some of the studies which have set out to test Brittain's labour burden hypothesis of payroll tax incidence, while section 5.3 will be addressed to the literature on insurance-induced unemployment. The latter is of relevance here because it is essentially concerned with the effect of the benefit side on labour supply, the importance of which has already been alluded to.

5.2 Payroll Tax Incidence

The main reference here is J.A. Brittain's own empirical work, (1971) and (1972a), which he takes as providing conclusive proof that the entire burden of the tax falls on labour. Brittain himself (1971, pp. 112-113) and (1972a, pp. 22-32), provides a review of some of the empirical work antedating his own. It appears that while a fair amount of descriptive and anecdotal evidence had been published, genuine empirical studies were rather few. One of the latter was by E. Deran (1967), using Puerto Rican data for the period 1947 to 1955. Deran purported to show that employers, rather than labour, had borne the main tax burden after the American OASDHI tax was introduced in that country in 1951. However, it was later demonstrated by Hoffman (1968), that Deran's conclusions depended on an inappropriate use of the chi-square test, and Brittain (1972a, pp. 30-31) is able to dismiss Deran's findings on those grounds.

Another study worth mentioning is that by Weitenberg (1969). This was essentially a simulation exercise in the context of a previously estimated and tested large scale econometric model, which was then in use by the Dutch Central Planning Bureau for short-term forecasting. This model, as Weitenberg (1969, p. 199) put it, had 'strong Keynesian features', in that the demand side played a 'dominant role'. In this context, Weitenberg found that responses to payroll tax increases were more likely to take the form of prices increases and increases in unemployment (reductions in employment) than of reductions in real after-tax wages. On the other hand, when Weitenberg turned to the rather different medium-term growth model of the Bureau, which had a 'classical' supply side (1969, p. 205), the results were more in line with the labour burden hypothesis. The conclusion would be, presumably, that labour can escape the tax burden in the short-run, but not in the long-run.

Brittain's own empirical work revolves around the estimation of an aggregate demand for labour function derived from an assumed CES aggregate production function (1971, p. 117). Brittain does not explicitly derive the estimated function from these underpinnings, but this task has been performed by Feldstein (1972) in the course of his comment on Brittain's work. Using Feldstein's notation, the C.E.S. production function is of the form:

(5.1) $V = (\alpha K^{-\rho} + \beta L^{-\rho})^{-1/\rho}$

Where, V = Value added in thousands of U.S. dollars.[1]

K = Capital inputs.

L = Labour inputs.

The marginal product of labour, therefore, is given by:

(5.2) $\frac{\partial V}{\partial L} = \beta(V/L)^{1/\sigma}$

Where, $\sigma = (1+\rho)^{-1}$ = the elasticity of substitution. If firms equate the gross wage rate (W^g) to the marginal product of labour, this would mean:

(5.3) $W^g = \beta(V/L)^{1/\sigma}$

According to the argument put forward in Chapter 4 above, W^g, the gross wage that is equated to the marginal product of labour, should include both portions of the payroll tax. Denoting the employer tax by tw, this would imply:

(5.4) $W^g = W(1+tw)$

Where W is the money wage. Brittain, however prefers to write the following equation:

(5.5) $W^g = W(1+stw)$

The parameter s is dubbed the 'shifting coefficient' as it represents (1972a, p. 61) 'the fraction of the employer tax actually borne by labour'. If s=1, then equation (5.4) is appropriate and, according to Brittain, this would indicate that labour bears the full burden. On the other hand if s=0, then capital bears the burden. Substituting (5.5) into (5.4), we obtain:

(5.6) $W(1+stw) = \beta(V/L)^{1/\sigma}$

Taking logs and rearranging:

(5.7) $\ln W = \ln\beta + 1/\sigma \ln(V/L) - \ln(1+stw)$

The final step is to approximate the term $\ln(1+stw)$ by $s \ln(1+tw)$ and add an error term, u. This gives:

(5.8) $\ln W = \ln\beta + 1/\sigma \ln(V/L) - s \ln(1+tw) + u$

This is exactly the same as Brittain's estimating equation (1971, p. 118) and (1972a, p. 66), viz:

(5.9) $\ln W = a + b \ln(V/L) - s \ln (1+t) + u$

Where Brittain uses the notation 't' instead of our 'tw'. From (5.9) the value of the 'shifting coefficient' s may now be estimated as a coefficient in a regression equation. Brittain ran a number of variants of (5.9) using, (a) U.N. data for manufacturing industries across countries in 1958, and, (b) U.S. time series data for manufacturing industries 1947-1965. In the majority of his estimations, the value of the coefficient s was close to 1.0, and statistically significant. In other words, in Brittains terms, (1971, p. 121):

> '... the results strongly support the hypothesis that in the aggregate the entire employer tax is shifted to labour.'

Subsequent work along similar lines provides only mixed support for the hypothesis. Vroman (1974b), for example, uses Brittain's own model and attempts to provide confirmation of the value of the shifting coefficient. His main point (1974b, pp. 188-190) is that, for various reasons, the data used by Brittain, in particular the 1958 U.N. data, is rather unreliable. Consequently, when subjected to a series of further tests (pp. 190-194), the results are not robust. On the other hand, when the model is re-tested using data that Vroman regards as being better suited to the purpose (OECD cross-country data for various years), the results once more support the conclusion that s=1. The upshot then, is backhanded support for Brittain's position. In contrast, Leuthold (1975) also replicates Brittain's model in a study using U.S. quarterly data for the period 1948I to 1965II, but her findings on the value of s are radically different, (p. 10):

> 'In no case did the estimate of the shift parameter approach or exceed 1, suggesting that the hypothesis of full shifting onto labour be rejected.'

Indeed, Leuthold's estimates are generally close to zero, the highest being only s = 0.138. Leuthold does not offer a theoretical explanation of why s might be close to zero, (which would imply that employers are willing to absorb all of any tax increase), but notes that her specification of the model is slightly different from Brittain's in one or two respects, and that the data base is different.[2] Whether or not these differences can explain the discrepancies in the results, her attitude (p. 11) is that 'the empirical results speak for themselves'.

It would be unwise, however, to dwell for very long on the controversy of the empirical value of s because there is a fundamental problem with the interpretation of this 'shifting coefficient' which tends to cast doubt on the whole approach. This problem was first raised by Feldstein (1972) in his comment on Brittain's original work. Feldstein argues that all Brittain has done is to estimate the parameters of the aggregate demand curve for labour. As was established in Chapter 4 above, under neoclassical assumptions the demand curve for labour is a locus along which the gross payment for the use of labour services is equated to the value of the marginal product of labour. From the employers point of view this gross payment automatically includes both portions of the payroll tax, which are necessary expenses that must be incurred to secure the services of one unit of labour. Consequently the coefficient s in equation (5.6) is necessarily equal to one, whatever the extent of the actual tax shifting. As Feldstein (1972, p. 737) puts it:

> 'The value of s ... is implicitly one even (when) no assumptions about the extent of shifting have been made ... the finding that s equals one provides no information about the extent of actual shifting'

The argument may be illustrated with reference to Figure 5.1 below:

Figure 5.1 Aggregate Labour Demand and Supply as Functions of the Net-of-Tax Real Wage

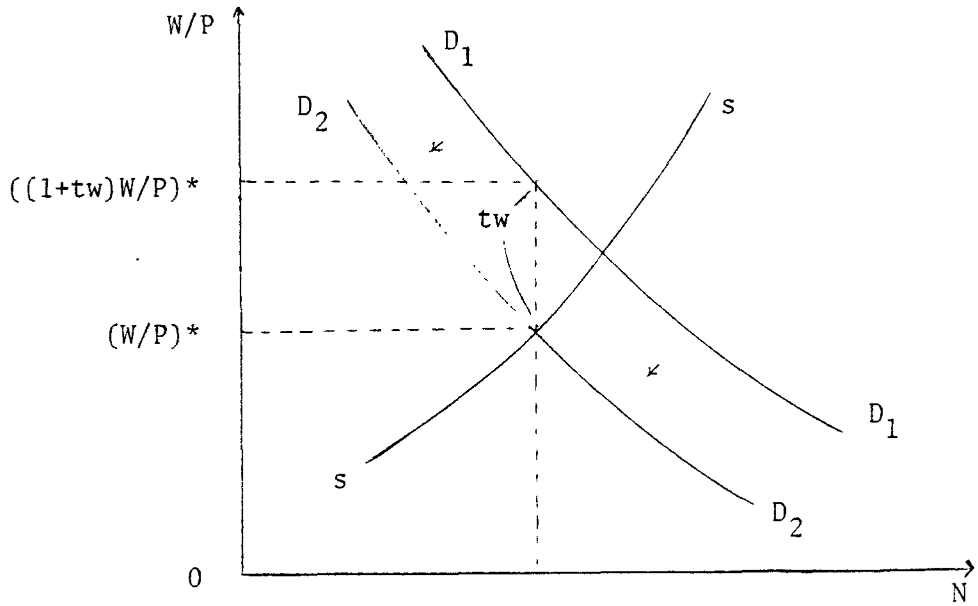


Figure 5.1 illustrates a model of an aggregate labour market similar to Figure 4.1 above. Unlike Figure 4.1 however, it is the net-of-tax real wage on the vertical axis rather than the gross wage. Assume that there is no payroll tax initially, and that the initial labour demand and supply curves are D_1D_1 and SS_1 respectively. Next allow an employer only[3] payroll tax to be imposed, at rate tw. With the net wage on the vertical axis, and given that it is the gross wage which is relevant for labour demand, the payroll tax is a shift variable for the labour demand curve. The curve will shift down and to the left, to D_2D_2. Obviously the vertical distance of the shift will be equal to the tax rate tw, and it is a truism that the new equilibrium gross real wage ((1+tw)W/P)* will differ from the equilibrium net wage (W/P)* by

exactly the amount of the tax. But, if we refer back to equation (5.6) it is apparent that this truism implies that the 'shifting coefficient' s will always be equal to one. To emphasize the point, note that the case drawn in Figure 5.1 cannot be one in which labour bear the full burden, as there is some positive slope to the labour supply curve. Unless employers behave irrationally in some sense, so that the demand curve does not shift by the full amount of the tax, the result s=1 is to be expected in all cases. In itself, s=1 provides no information about tax incidence.

One implication of the above considerations of course, is that doubt is cast upon the validity of any empirical work, such as Leuthold's which purports to find that s≠1. They strongly suggest that such findings are the result of data or estimation problems.

In a reply to Feldstein, Brittain (1972a, p. 740) makes the point that if s is equal to one <u>and</u> the supply curve of labour is inelastic, as he assumes, then it would be true that labour bears the full burden. While this point is undoubtedly correct as the theoretical analysis of Chapter 4 has shown, the key assumption is the inelasticity of labour supply, not that s=1. Brittain's empirical work provides no separate evidence on the crucial labour supply issue.

Another paper on payroll tax incidence by Vroman (1974a) takes a rather different approach. Vroman makes the familiar complaint that Brittains work, in common with the Harberger model of tax incidence, ignores the distinction between backward and forward shifting. His paper attempts to redress the balance by determining how much of the employer payroll tax is shifted backwards onto money wages. Using quarterly data for U.S. manufacturing industry for the period 1956 I to 1969 IV, Vroman employs a regression model of the following general form:

(5.10) $\dot{W} = f(U, \dot{P}, \bar{R}, D, \dot{ST}, \dot{SO})$

where, $\dot{W}$ = Percentage change in manufacturing wages

U = The unemployment rate

$\dot{P}$ = Percentage change in consumer prices

$\bar{R}$ = A measure of the profit rate

D = Dummy for the U.S. wage 'guideposts' (in force for part of the period)

$\dot{ST}$ = A measure of changes in employer contributions for social insurance

$\dot{SO}$ = A measure of changes in other labour incomes.

If there is complete backward shifting, the coefficient on the $\dot{ST}$ variable should be close to -1, but in Vroman's initial experiments the coefficient always turned out to be (slightly) positive. Using, one, two, and three quarter lags negative coefficients do appear, but the range of estimates is only between -0.21 and -0.44, (1974a, p. 201). Vroman's conclusion is that there is some evidence of backward shifting but that, clearly, it is not complete. One may remark, of course, that the effect of payroll tax changes on money wage behaviour is only partially relevant to the broader question of payroll tax incidence. Whatever happens to money wages, the main object of interest is the effect on after-tax real wages and real capital income. Vroman himself admits (1974a, p. 203) that his work:

> '...gives no empirical insight about the incidence of that part of the employer tax which is not shifted backward. Either forward shifting or payment by employers is possible.'

More recently, Hamermesh (1979) has published a study of payroll tax incidence which seems to address much the same question as Vroman, but using a rather different methodology. One innovation was the use of microeconomic rather than aggregative data, in this case based on interviews carried out under the auspices of the 'Panel Study on Income Dynamics' in the U.S. between 1968 and 1974. From an original sample of 5000 families, Hamermesh chose a sub-sample of 587 adult males. The most general specification of his model is as follows (1979, p. 1210):

(5.11) $W^* = H(X^D, X^S, \tau)$

Where (5.11) may be viewed as the reduced form of a labour supply and demand model and:

W^* = Equilibrium money wages.

X^D = A vector of variables in the labour demand equation.

X^S = A vector of variables in the labour supply equation.

τ = Average payroll tax rate.

Other specifications involve lagged demand and supply variables and lagged payroll tax rates. It is important, for Hamermesh's purpose, to note that τ will vary across individuals, according to the proportion of their income which is above or below the ceiling on taxable earnings. The use of microeconomic data allows a good deal of variation in the average tax rate. Hamermesh uses O.L.S. and maximum-liklihood techniques to infer the effect of payroll taxes on money wages. The O.L.S. coefficient on τ, for example, or the sum of coefficients in cases using lagged tax terms, will provide 'an upper bound estimate of the extent of the shifting' (1979, p. 1213) Hamermesh's conclusions (1979, p. 1217) were as follows:

> 'At most only one third of any flat-rate payroll tax increase is shifted by employers onto labour ... (in the form of lower money wage rates).'

Actually, this result is rather similar to Vroman's (reported above) derived from aggregative data. Like Vroman's results they are also difficult to interpret in terms of whether they provide support or otherwise for the labour burden hypothesis. As mentioned in connection with Vromans work, knowledge of the effect of payroll taxes on money wage behaviour does not by itself provide much information about the effect on real variables.

As the above discussion indicates it would seem that, to date, not very much has been learned from the existing empirical literature on payroll tax incidence. One pervasive problem, of course, is that most of the studies that have been discussed here are essentially partial equilibrium in nature. In reality, as has been pointed out before, payroll tax incidence is a general equilibrium problem, particularly so in the case of the U.I. tax.

5.3 Insurance-Induced Unemployment

Another branch of the empirical literature which is relevant for our purposes is that concerning the phenomenon of so-called 'insurance-induced' unemployment. For the sake of brevity our remarks here will be confined to the Canadian literature, although it should be noted that the issue has also attracted considerable attention in the United States and elsewhere. For an introduction to the American literature, the reader is referred to the recent collection of papers in the 'Industrial and Labour Relations Review' edited by Katz and Hight (1977). Similarly, for worldwide evidence on the phenomenon, reference may be made to the conference volume edited by Grubel and Walker (1978).

The hypothesis is that more generous benefit rates in U.I. schemes lead to an increase in the measured rate of unemployment. This occurs as a result of benefit induced changes in the relative price of labour and leisure, which reduce work incentives, and increase the average number of persons unemployed at any one time and/or the average duration of spells of unemployment. The existence of U.I. induced unemployment, if it can be proven, is relevant to this study for two reasons. Firstly, a point that has been mentioned before, that in any general equilibrium study of U.I. tax incidence it must be recognised that there is a definite relationship between payroll tax rates and benefit rates via the budget constraint. Any and all effects of changes in benefit rates are therefore immediately relevant. Secondly, if it can be demonstrated that benefit induced changes in the relative price of leisure have definite labour supply effects, there is no reason to suppose that analogous changes caused by variations in the payroll tax rate have no such effects. The existence of insurance-induced unemployment is prima facie evidence against the labour burden assumption.

A standard reference in the Canadian literature is a paper by Grubel, Maki and Sax (1975a). The authors argue that there are three likely effects of an increase in the U.I. benefit rate relative to the average money wage rate, each of which is likely to increase the measured rate of unemployment. These are (i) an increase in quits by those currently in employment, (ii) an increase in the duration of unemployment spells by those who are currently involuntarily unemployed (i.e., a decrease in job search effort), and (iii) an increase in participation by persons whose intention is to work only for the qualifying period and then become unemployed and claim benefits. An increase in the benefit/wage ratio, it is argued, provides incentives for each of these three types of behaviour. On the other hand, in the Canadian system these effects may be reduced or counterbalanced to some extent, by various offsetting factors. One of these is the cost of job search, the time and effort involved in finding a new job when benefits do run out, which reduces the value of the 'leisure' consumed by the unemployed. Similarly, increases in the waiting period or in the stringency with which the authorities apply the eligibility rules, would also reduce the incentives to consume leisure in this way. There is also the more subtle argument that a generous U.I. benefit regime facilitates a more efficient job search by workers, and hence in the longer run will actually reduce unemployment by providing a better match between workers and jobs. The authors contention therefore, is that the actual effect of changes in the benefit/wage ratio on the unemployment rate is an empirical matter. Their paper sets out to determine, for Canada, whether such changes affect the unemployment rate or not.[4] The empirical model is based on the following equation (1975a, p. 181):

(5.12) $U = f(SU,CU,TU,IU)$

Which states that total unemployment may be decomposed into four categories, structural (SU), cyclical (CU), seasonal (TU) and insurance induced (IU), unemployment. In the empirical model TU may be eliminated by using annual data, and SU may be similarly dispensed with by assuming that it is 'a constant that changes slowly over time', (1975a, p. 181). The model therefore needs only to take into account the determinants of cyclical and insurance induced unemployment. The specific model used by Grubel et al. was a four equation simultaneous model, estimated by two-stage least squares, using Canadian annual data 1953-72. The second stage regression of the first equation is relevant for our purposes, and was reported by the authors (p. 183) as follows:

$$\text{(5.13)} \quad \ln U = \underset{(2.71)}{-15.15} + \underset{(2.96)}{2.35}\,\frac{UCB}{AWW} - \underset{(4.32)}{0.03}\,PCGNP - \underset{(7.07)}{0.05}\,PCGNP_{-1}$$

$$+\underset{(3.85)}{0.12}\,FLFPR + \underset{(2.76)}{0.17}\,MLFRR - \underset{(4.26)}{0.02}INEL$$

't' scores in parenthesis, $R^2 = 0.90$, $DW = 2.14$.

Where, U = Unemployment rate.

UCB/AWW = Ratio of U.I. benefits to average weekly wages.

PCGNP = Percentage change in current dollar GNP, included to capture cyclical effects on unemployment.

FLFPR = Female labour force participation rate.

MLFPR = Male labour force participation rate.

INEL = Percentage of benefit claims ruled ineligible each year, a proxy for the degree to which the authorities are enforcing eligibility requirements.

The important finding is the coefficient on the UCB/AWW variable, showing the effect of increases in the benefit/wage ratio on the (log of) the unemployment rate. This is positive and statistically significant. An O.L.S. version of (5.13) is also reported, and as can be seen, the difference in the reported coefficients is not too large, indicating, according to Grubel et al. that the problem of simultaneous equations bias is not too great in this case. The alternative result is:

$$\text{(5.14)}\quad \ln U = \underset{(1.88)}{-8.09} + \underset{(3.89)}{2.54}\frac{UCB}{AWW} - \underset{(5.01)}{0.04}\, PCGNP - \underset{(7.40)}{0.05}\, PCGNP_{-1}$$

$$+\underset{(3.37)}{0.08}\, FLFPR + \underset{(1.96)}{0.09}\, MLFPR - \underset{(4.65)}{0.02}\, INEL$$

't' scores in parenthesis, $R^2 = 0.92$, DW = 2.29

The authors conclusion is that increases in the benefit/wage ratio do lead to increases in the unemployment rate. In other words, that the phenomenon of insurance-induced unemployment is a real one. They go on to use their figures in an attempt to estimate the impact of the 1971 changes in the U.I. act (which increased the UCB/AWW ratio among other things[5]) on the measured unemployment rate in Canada. Based on an elasticity of response of 0.69 (measured at the point of means) the conclusion (1975a, pp. 187-188) is that the effect of the U.I. changes in 1971 was to raise the measured employment rate in 1972 by 0.8 percentage points. Further, that up to 22% of total unemployment in Canada in 1972 was 'insurance-induced'.

The work of Grubel, Maki and Sax has not been without its critics, of course. In an exchange with Kaliski (1975) the authors (1975b) conceded the fact that their data made no allowance for the fact that U.I. benefits were made subject to income tax after 1971. The estimate that the 1972 unemployment rate was increased by 0.8 percentage points was revised down to 0.5 percentage points. Other commentators, notably Rea (1977) and Bodkin and Cournoyer (1978), have criticised the specification of the model, arguing that a labour market demand and supply framework would be more appropriate.[6]

On the other hand, there are a number of studies which support the general conclusions. Lazar (1978, p. 559), for example, in comparing the Grubel, Maki, Sax study with a number of others, including that by

Green and Cousineau (1976), makes the comment:

> '... the findings are surprisingly similar, namely that the (1971) revisions increased the national unemployment rate in 1972 by between 0.6 and 0.8 percentage points.'

In this regard, and in spite of his methodological criticisms of Grubel et al. one might mention the work of Rea (1977). His simulation study was also addressed to the likely effects of the 1971 U.I. changes, and among the conclusions was as follows (1977, p. 277):

> 'If all these claiming benefits in 1972 responded to the provisions as predicted, the unemployment rate would have been 1.6 percentage points lower without the U.I. program.'

In other words, this would be the effect of totally removing the U.I. programme. This may be compared with another estimate of Grubel et al. (1975a, p. 188) who suggest that the unemployment rate would have been 1.4 percentage points lower if the benefit/wage ratio had been reduced, not to zero, but to the much lower level in effect in 1955/56.

More evidence of insurance-induced unemployment is to be found in the work of Maki (1977) and Lazar (1978), though of a rather different kind. Both papers note that the other studies mentioned above were only concerned with the effect of benefit rate changes on the overall unemployment rate, they did not determine whether the increased unemployment comes about because of increased turnover (i.e., more quits) or because a longer average duration of unemployment. Both Maki and Lazar appear to take the view, a priori, that longer average duration is more likely, and therefore set out to test this hupothesis. Maki, using monthly data disaggregated by Province for the period December 1962 to October 1974, found a strong positive relationship between the average duration of claims and the benefit/wage ratio. Elasticities of average duration of claims with respect to the benefit/wage ratio ranged from 0.35 in Ontario to 1.35 in Newfoundland, (1977, p. 233). Lazar (1978, p. 561) calculated 'weekly unemployment continuation probabilities' and 'the number of new weekly spells of unemployment' for different age-sex groups for the period February 1966 to December 1975. As might be expected, average unemployment rates were substantially higher for the later period 1972-75 than for 1967-71. The difference was attributable mainly to longer duration for male groups and a combination of longer duration and increased turnover for female groups. Regressions of the continuation probabilities and turnover rates on a number of variables, including a dummy for the 1971 U.I. Act revisions, then established that the changes were indeed partly responsible for the difference between the two periods. The relationship between benefit rate changes and the average duration of claims is implicit in these results (1978, p. 568).

From the above selective summary of the Canadian empirical literature it would appear that insurance induced unemployment is a real phenomenon, even though it may be possible to criticize individual studies on various grounds and to question precise numerical estimates. In addition, it will be recalled, there is a certain amount of evidence in the U.S.A. and elsewhere. In their own survey of the Canadian literature on the effects of the 1971 changes, Bodkin and Cournoyer (1978, pp. 83-85), are similarly unwilling to commit themselves to any exact figures, but they do conclude:

'...apparent rates of unemployment have shifted upward, due to implementation of a new system of unemployment insurance, which was introduced by the 1971 legislation.'

FOOTNOTES TO CHAPTER 5

[1]The data base is cross-section data across countries taken from U.N. publications for 1958. See Brittain (1971, pp. 123-124).

[2]Leuthold uses quarterly time series data for the entire U.S. 'private non-farm business sector' (1975, p. 11) as opposed to Brittain's U.N. cross-country data for manufacturing industry.

[3]We assume an 'employer only' tax to facilitate comparison with Brittain's analysis. There is no loss of generality.

[4]There is another qualification, not mentioned by the authors, which relates to point (iii) in the text. It is not axiomatic that the increase in participation will tend to increase the unemployment rate. Anticipating the notation to be used in Chapter 6 below, the unemployment rate over a given period may be written as:

$$URTE = \left(\frac{XH^* - N}{XH^*}\right) 100$$

Where, URTE = The unemployment rate

X = The number of participants

H* = Total number of 'man hours' or 'man weeks' available to each participant

N = Total number of 'man hours' or 'man weeks' actually worked

The increase in benefits may increase X, as suggested, but the effect on N is ambiguous (see Chapter 6 for a full explanation of this point), the overall effect on URTE cannot be determined a priori.

[5]According to Grubel et al. (1975a, p. 182) the ratio UCB/AWW increased from around 0.29 to 0.41 between 1971 and 1972.

[6]One criticism which does not seem to have appeared in the literature concerns the specification of the UCB/AWW variable in ratio form. As will be seen in Chapter 6 below, theoretical considerations would indicate that wage and benefit rates should enter the labour supply function in linear form.

CHAPTER 6

COMPARATIVE STATICS

6.1 Description of the Model

In this chapter we will present some comparative static results of changes in payroll tax rates in a number of variants of a small macroeconomic model. The purpose is to establish both the conditions under which the labour burden conclusion holds, and those under which it will not. The novel features of our approach will entail an explicit modelling of a hypothetical U.I. scheme at the macro level, and a detailed development of the aggregate labour supply function, involving the effects of both tax and benefit rates. In other respects the model of this chapter is essentially a conventional static 'textbook' construction. The cases dealt with are all short-run in the sense that they apply for a time horizon in which the capital stock is fixed. In Chapter 7 below we will go on to deal with long-run versions of the model in which the capital stock is allowed to adjust endogenously to its long-run equilibrium value.

Other features of the model are now described in what follows. The government has only two functions, to control the money supply, and to administer the U.I. system. There are no taxes apart from the U.I. payroll tax and no government expenditure. Nor is there any attempt at deficit financing of the U.I. system, the U.I. budget is balanced and the money supply is held constant. Each of the flow variables of the system will have a definite time dimension which we will call a 'year'. The unit of labour supply is a standard working 'week', which is a subdivision or fraction of a year. Unemployment over a year is defined as the total number of working weeks potentially available to labour force participants minus weeks actually worked. Each participant will be paid unemployment benefit at a flat weekly rate for each week that he does no work. Thus benefit is paid to unemployed participants whether the unemployment is voluntary or involuntary, but is not paid to non-participants. This implies that the government is unable or unwilling to distinguish between voluntary and involuntary unemployment. A similar assumption is of course a key feature of the literature on insurance-induced unemployment discussed in Chapter 5 above. The scheme is financed by a proportional payroll tax on the nominal weekly wage rate, matched by an equal contribution from the employer. The government may choose either the benefit rate or the payroll tax rate as a policy variable, but, because of the balanced budget requirement, the choice of one of these variables as exogenous implies that the other must be endogenous. In the analytical solutions, note that we will take the initial values of both tax and benefit rates to be zero, so that, strictly speaking, the exogenous event is the introduction of a U.I. system into an environment in which no scheme previously existed. As benefit is paid to all participants for each week of leisure, we must introduce some disincentive to participation. In the absence of any such disincentive all individuals would simply declare themselves participants and receive benefit, whether they actually intend to do any work or not. We therefore impose the institutional constraint that, in order to be counted as a participant for the purposes of the U.I. scheme, each individual must work some minimum number of weeks. This minimum may also be thought of as the 'qualifying period' for unemployment insurance. Once the minimum number of weeks has been worked each participant is free to vary labour supply as he or she wishes.

In all we will deal with four variants of the model in this chapter, each case corresponding to an alternative view of how the labour market operates and hence to 'alternative theories of distribution'.[1] The four cases are:

(i) The 'Neoclassical' case

(ii) The 'Brittain/Harberger' case

(iii) The 'Keynesian' case

(iv) The 'Ricardian' case

In general we would expect the incidence results to differ depending on which case we choose, or in other words, on the view that is taken about the operation of the labour market. In the Neoclassical case the labour market clears and there is a positively sloped aggregate labour supply function. It is this case, in particular, which requires the construction of the more detailed labour supply function referred to above. The Brittain/Harberger model is so named because it illustrates the theoretical underpinnings of the labour burden assumption associated with those two authors. It is also 'neoclassical', in the sense that the labour market clears, but in this case the aggregate supply of labour curve is taken to be vertical. In contrast, in the Keynesian case, involuntary unemployment can exist due to a rigid money wage, and the level of employment is demand determined. Finally, in the Ricardian case we assume a rigid real (rather than money) wage due (e.g.,) to union power. In this case also employment will be demand determined, and involuntary unemployment can exist. The use of the term 'Ricardian' may be rather confusing and requires some comment. It is, in fact, something of a misnomer and is only retained as a shorthand designation of the rigid real wage case.

The Ricardian element is the analogy with Ricardo's 'short-run' analysis of taxation which rests on the assumption of a real wage that is irreducible at the subsistence level. On this point see Blaug (1968, pp. 138-139) and Shoup (1960, Chapter X). Ricardo's familiar conclusion that most taxes are paid ultimately out of profits seems to be based on this notion. If it is not possible for real wages to fall, then the tax burden must fall on profits, the residual category in the Ricardian system. Ricardo's statement (1911, p. 198) that 'a tax on wages is wholly a tax on profits' is of course the direct opposite to the labour burden assumption discussed in Chapter 4 above. Our so-called 'Ricardian' case is also based on irreducible real wages, though not fixed at subsistance, but at some level arbitrarily given by past history and defended (e.g.,) by trade unions. In other respects, of course, the model is not at all Ricardian. Apart from the rigid real wage, it is nothing other than a standard textbook macro model. It is intended simply to illustrate the case of what Sir John Hicks (1975, p. 10) has called 'real wage resistance'.

It will be as well at the outset to comment on some omissions and possible weaknesses of the following analysis. It will be remarked, for example, that in the modelling of the tax side of the U.I. scheme no account is taken of the taxable ceiling on earnings, which, as we have seen, applies in many real world U.I. systems. For analytical tractability, a simple proportional tax rate is assumed. There are a number of possible defences for this procedure, the simplest of which is the observation that proportional taxes, though not common, are not unknown in practice (cf. the case of Italy, referred to in Chapter 2 above). More generally, the wage rate W in a macro model is presumably some kind of average wage rate, and in cases where the taxable ceiling is high relative to average wages, a proportional tax function will be the appropriate macro specification.[2] Also, as will be discussed in more detail in Chapter 7 below, it is the case that the most elastic labour supply responses to changes in both tax and benefit rates are to be found among the so-called 'secondary workers' (e.g., married women, teen-agers), who for various reasons may be less strongly attached to the labour force than 'primary workers'. But the secondary workers are also often the lowest paid, and therefore may very well be facing a proportional tax rate below the income ceiling. For these reasons, the assumption of a proportional tax rate does not seem to be unreasonable in a macro model.

Another possible drawback is that the analysis is restricted to a closed economy framework. Of course, this is not uncommon in the public finance literature and is quite defencible in that context. On the other hand, we must recognise that closed economy models do not necessarily give a complete picture for countries with very open economies such as Canada and the United Kingdom. The attitude that is taken here is that the working out of the closed economy results is a necessary first step on the path to a more complete analysis, and is therefore, a legitimate exercise in itself. An obvious extension would be to work out similar results in a simple Mundell/Fleming framework involving flexible exchange rates and the 'small open economy' assumption. It may be doubted, however, if these results would be greatly different from their closed economy counterparts to be reported below, essentially because the dominating force in our model is the domestic supply side. A more useful or interesting extension to the open economy would need to take into account the recent advances in open economy macroeconomics, and would take us rather far afield from our present purposes. Such an extension however, must be on the agenda for future research.

A final omission from the present chapter, in this case for the sake of brevity only, is the case of 'differential savings propensities' referred to in Chapter 4, section 4.3, above. However, we will return to this issue in Chapter 7.

In what follows, we will be interested in the impact of tax rate increases on four key endogenous magnitudes, the level of employment, the general price level, real gross capital income, and the after-tax real wage rate.[3]

6.2 The Basic Model - The Short-Run Neoclassical Case

To illustrate the model we choose the 'Neoclassical' case. The equations of the model are as follows:

(6.1) $Z = PQ - (1-tw)WN - 2twWN$

(6.2) $PIg = s(Z + (1-tw)WN + UB) \qquad 0 < s < 1$

(6.3) $Ig = I(r) + \delta K \qquad I_r < 0, 0 < \delta < 1$

(6.4) $\frac{M}{P} = L(Q,r) \qquad L_Q > 0,\ L_r < 0$

(6.5) $UB = bU$

(6.6) $UB = 2twWN$

(6.7) $Q = F(K,N) \qquad F_N, F_K > 0, F_{NN}, F_{KK} < 0$

(6.8) $$\frac{(1+tw)W}{P} = F_N$$

(6.9) $$K = \bar{K}$$

(6.10) $$U = XH^* - N$$

(6.11) $$N = XH$$

(6.12) $$X = X\left(\frac{W(1-tw)+\theta b}{P}\right) \qquad X' > 0$$

(6.13) $$H = H\left(\frac{W(1-tw)-b}{P}\right) \qquad H \geq \bar{H},\ H' > 0$$

(6.14) $$\theta = \frac{H^* - \bar{H}}{\bar{H}}$$

Endogenous Variables: Z, P, Q, W, N, Ig, UB, U, b, r, K, X, H, θ. (14)

Exogenous Variables and Parameters: tw, s, δ, M, H^*, $\bar{K}$, $\bar{H}$.

6.3 Definition of Variables

Z = Gross capital income in nominal terms.

P = General price level.

Q = Real output.

tw = Payroll tax rate.

W = Weekly nominal wage rate.

N = Employment in standard working 'weeks' per 'year'.

Ig = Real gross investment.

I(r) = Real net investment.

s = Aggregate (marginal and average) saving propensity.

UB = Total unemployment benefit payments in nominal terms.

U = Unemployment

b = Unemployment benefit rate.

r = Interest rate (real and nominal)

δ = Depreciation rate.

H = Annual Average weeks of work for participants.

K = Real capital stock.

M = Nominal money supply.

X = Number of participants in the labour force.

H* = Maximum number of standard working 'weeks' available in the 'year'.

$\bar{H}$ = Qualifying period for unemployment insurance.

θ = Shorthand notation for the term $\left(\frac{H^* - \bar{H}}{\bar{H}}\right)$

6.4 The Equations of the Model

In this section we will attempt to describe equations (6.1) to (6.14) in more detail. Equation (6.1) is the definition of nominal gross capital income. The term (1-tw) WN is the net-of-tax wage bill and 2twWN is total payroll tax receipts, (employer and employee portions).

Equation (6.2) is the 'investment = savings' equation. Note that we assume a proportional savings function which is constant across all sources of income. As mentioned in Chapter 4 above, we take the view that the effect of unemployment insurance on individual savings is not likely to be significant except to the extent that the taxation side lowers disposable income or the benefit side raises it. In these circumstances, a proportional savings function may be chosen for analytical simplicity. The case of differential savings propensities across income sources will be considered in Chapter 7 below.

Equations (6.3), (6.4), and (6.7) are standard, being the gross investment function, the demand for money function, and the production function respectively. Equation (6.8) is standard also, describing the demand for labour in the terms set out in Chapter 4 above. The marginal product of labour is equated to the gross real wage rate. Equation (6.9) simply states that the capital stock is fixed in this short-run case.

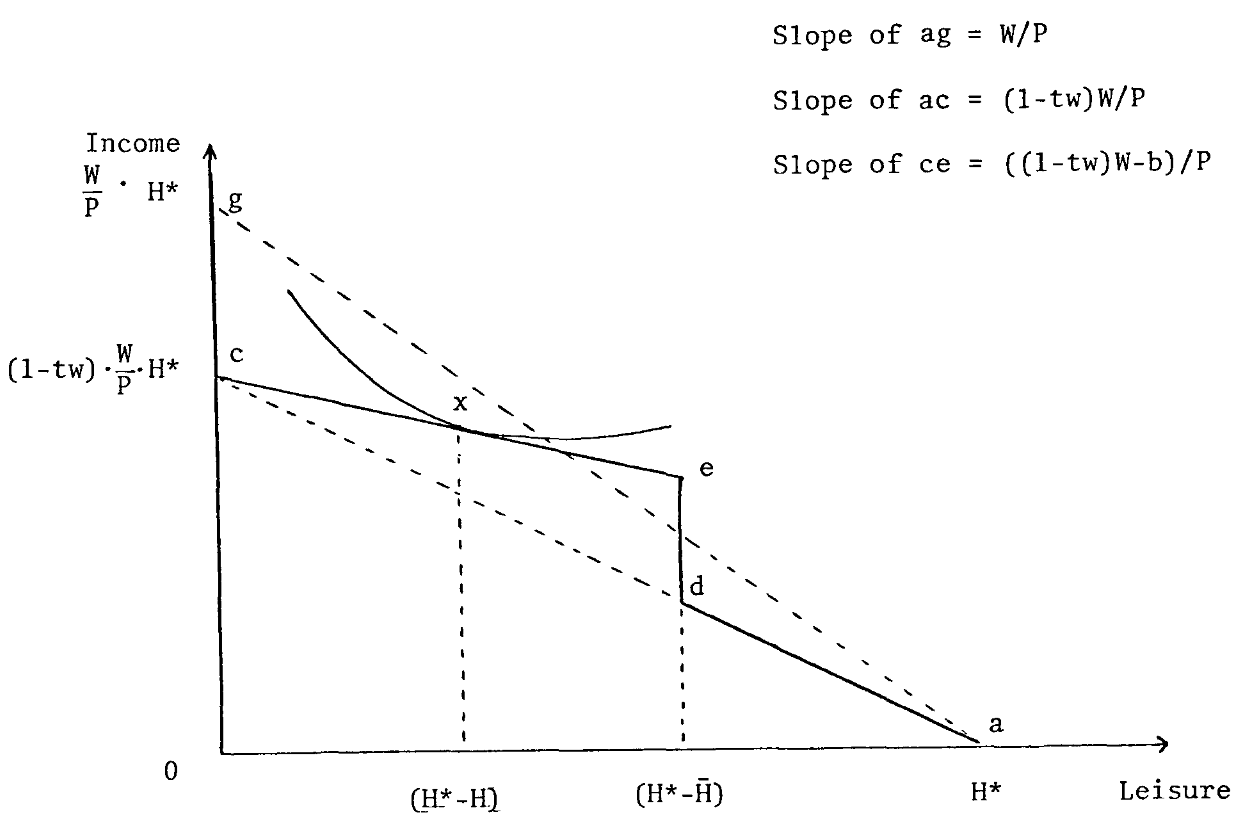
The hypothetical U.I. scheme is described in equations (6.5), (6.6) and (6.10). Equation (6.10) defines unemployment as set out in section 6.1 above, and equation (6.5), therefore, is simply the expression for total unemployment benefit payments. Equation (6.6) represents the balanced budget assumption, that benefits are financed entirely by payroll tax receipts.

The aggregate labour supply function is embodied in equations (6.11) through (6.14). This is an aspect of the model which requires rather more detailed discussion, to which we now turn in sections 6.5 through 6.8 to follow.

6.5 The Labour/Leisure Choice under Unemployment Insurance

The nature of the constraints facing an individual making a labour/leisure choice in the presence of unemployment insurance, are illustrated in the following diagram. The economic agent is assumed to possess a utility function in which real income and leisure enter as positive arguments, and a time horizon of one 'year'. His problem is to allocate his time over the year between work and leisure, in such a way as to maximise utility subject to the constraints imposed upon him by the available real wage rate and the parameters of the U.I. scheme.

Figure 6.1 The Individual Budget Constraint under Unemployment Insurance[4]



In figure 6.1, ab represents the budget line in the absence of any U.I. scheme. The intercepts will be H* (the individual consumes the maximum amount of leisure), and W/P·H* (the individual consumes no leisure and earns the maximum amount of real income), respectively. The slope of ab is equal to the real wage rate W/P, the relative price of labour and leisure. The imposition of a payroll tax at rate tw, in the absence of any other change, would shift the budget line in to ac with slope (1-tw)W/P. In addition, however, payment of U.I. benefits on the terms set out above increases the effective wage rate for each week worked in the range above the qualifying period. In this range, the budget line will shift back up to ce, with slope $((1-tw)W-b)/P$. Therefore, taking into account both tax and benefit rates and the qualifying period, the actual budget constraint in the presence of the U.I. scheme is the 'kinked' line adec.

The individual will locate somewhere along the adec locus, precisely where will depend on his or her particular indifference map. For illustrative purposes only we show a point of tangency at x, along ce. While it is clearly possible for an individual to locate anywhere along adec including the segment da (implying that an individual works for less than the qualifying period), location along that segment would require a rather specific slope for the individual indifference curve. In the general case, one would expect either a location along ce (working for at least the qualifying period) or a corner solution at a (non-participation). We may rule out location along da, either by administrative fiat (e.g., the assumption in section 6.1 that the minimum length of a labour contract is at least equal to the qualifying period), or by imposing appropriate restrictions on the individual utility function.

6.6 Micro Underpinnings of the Aggregate Labour Supply Function

At the aggregate level the labour supply function is written as follows:

(6.15) $N^S = XH$.

Here, X is the number of participants and H is the average number of weeks supplied by each participant. Both these aggregate functions are assumed to be continuous and differentiable. The question is how can such an aggregate function be generated from reasonable micro underpinnings, given the constraints faced by the individual agent as illustrated in figure 6.1? Each worker faces two decisions, (a) whether or not to participate, and (b) having decided to participate, how many weeks of work will he actually supply? We will assume that these decisions may be treated sequentially in order to arrive at the separate participation and weeks functions X and H.

By way of illustration, assume a very simple linear utility function for each worker with constant marginal utility of leisure, for example:

(6.16) $U_i = U_i(Y_i, L_i) = Y_i + \gamma_i L_i$

Where, U_i = Utility of the ith individual

L_i = Leisure consumed by the ith individual

Y_i = Income of the ith individual

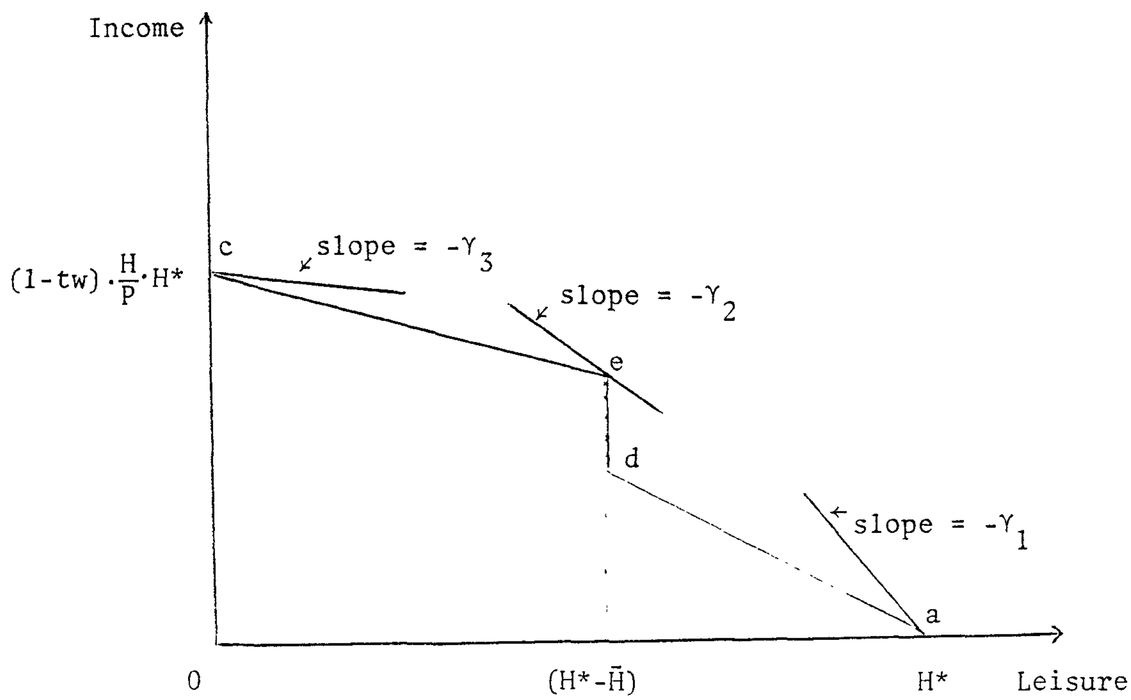
γ_i = Marginal utility of leisure for the ith individual

It is assumed that γ_i differs across individuals and that they can therefore be ranked according to their 'desire for leisure'. The above formulation clearly implies linear indifference curves with slope:

(6.17) $$\left.\frac{dY_i}{dL_i}\right|_{dU_i=0} = -\gamma_i$$

Under these circumstances, and as illustrated in Figure 6.2 below, the individual will choose only one of three alternatives. He will either (a) do no work at all, (b) work for exactly the qualifying period, or (c) work for every week during the year and take no leisure. In terms of the diagram he will locate at either a, e, or c depending on the slope of the indifference curve (i.e., on his value of γ_i).

Figure 6.2 The Labour/Leisure Choice under Unemployment Insurance with Linear Indifference Curves



6.7 The Decision to Participate and the Aggregate Participation Function

In the framework set out above the participation decision (the decision to do at least some work) boils down to the choice between locating at a (non-participation) or (at a minimum) at e (participation). There must be some critical value of γ_i which marks the borderline between participation and non-participation in this sense. Presumably the individual will participate as soon as the minimum return to participation (MRP) is greater than the return to non-participation (RNP). The minimum return to participation will be earned by working for exactly the qualifying period at the prevailing after-tax real wage rate and thereafter receiving unemployment benefit. Clearly:

$$(6.18) \quad MRP = \bar{H}\,\frac{W(1-tw)}{P} + \frac{b}{P}\,(H^*-\bar{H}) + \gamma_i(H^*-\bar{H})$$

Whereas:

$$(6.19) \quad RNP = \gamma_i H^*$$

When MRP > RNP the individual will participate, but when RNP > MRP the individual will not participate. The critical value of γ_i is therefore given at the point where MRP = RNP, or by the equation:

$$(6.20) \quad \gamma_i H^* = \bar{H}\frac{W(1-tw)}{P} + \frac{b}{P}\,(H^*-\bar{H}) + \gamma_i(H^*-\bar{H})$$

Grouping terms in γ_i, (6.20) may be rearranged as follows:

$$(6.21) \quad \gamma_i H^* - \gamma_i H^* + \gamma_i \bar{H} = \bar{H}\frac{W(1-tw)}{P} + \frac{b}{P}\,(H^*-\bar{H})$$

Cancelling the first two terms on the L.H.S., and dividing through by $\bar{H}$, we obtain:

$$(6.22) \quad \gamma_i = \frac{W(1-tw)}{P} + \frac{b}{P}\left(\frac{H^*-\bar{H}}{\bar{H}}\right)$$

Therefore, recalling that $(H^*-\bar{H})/\bar{H} = \theta$, the critical value of γ_i is:

$$(6.23) \quad \gamma_i = \frac{W(1-tw) + \theta b}{P}$$

Thus for individual i, the decision to participate depends upon whether his or her $\gamma_i \gtrless (W(1-tw) + \theta b)/P$, i.e., on whether L.H.S. $\gtrless$ R.H.S. in (6.23). Participation will occur only when L.H.S. < R.H.S.

For each individual i, whether or not to participate is clearly a discrete or 'all or nothing' decision. However, if there are many individuals, each with different γ_i, the aggregate participation function may reasonably be approximated by a continuous function.[5] As the R.H.S. in (6.23) increases, the greater will be the number of individuals for whom it is true that $\gamma_i < (W(1-tw) + \theta b)/P$ and hence the greater the aggregate number of participants. Hence our aggregate participation function:

$$(6.12) \quad X = X\left(\frac{W(1-tw) + \theta b}{P}\right) \qquad X' > 0$$

6.8 <u>The 'Weeks' Decision, The Aggregate 'Weeks' Function, and the Aggregate Labour Supply Function.</u>

Having made the participation decision (whether to work or not to work) the individual must then make a further decision as to precisely how many weeks of work effort he will supply. In our simplified framework, with linear indifference curves, he has two choices, (a) to work only for the length of the qualifying period, or (b) to work for the maximum number of weeks and take no leisure at all. There will be another critical value of γ_i which will represent the borderline between these two decisions. Referring back to Figure 6.2, it is obvious that the critical value occurs where the slope of the indifference curve coincides with that of the budget line segment ce. In other words, where:

$$(6.24) \quad -\gamma_i = -\left(\frac{W(1-tw)-b}{P}\right)$$

Hence, the critical value of γ_i is given by:

$$(6.25) \quad \gamma_i = \frac{W(1-tw)-b}{P}$$

If $\gamma_i > (W(1-tw)-b)/P$ the participant will work only for the qualifying period, (i.e., locate at point e in Figure 6.2), but for $\gamma_i < (W(1-tw)-b)/P$ he or she will work for the maximum number of weeks available (locate at point c in Figure 6.2).

Recall that the aggregate weeks function specified in (6.13) above indicated the average number of weeks worked conditional upon participation, and was a continuous function of the expression on the R.H.S. of (6.25). We move from (6.25) to (6.13) as follows: First, note that the average number of weeks worked by participants is given by:

(6.26) $H = pH^* + (1-p)\bar{H}$

Where p is the proportion of participants who work for the maximum number of weeks. Ceteris paribus, and with a large number of individuals, each with different γ_i, p will be a positive and continuous function of the R.H.S. of (6.25). As $(W(1-tw)-b)/P$ increases, the greater will be the number of participants for whom it is true that $\gamma_i < (W(1-tw)-b)/P$, and hence the greater the proportion of participants who are working for the maximum number of hours. In a general functional form, therefore, (6.26) becomes:

(6.13) $H = H\left(\frac{W(1-tw)-b}{b}\right) \qquad H' > 0$

Which is the original (average) weeks function conditional upon participation.

The aggregate labour supply function, (6.11) and (6.15) above, is then simply the product of the aggregate participation function (6.12) and the average 'weeks given participation' function (6.13), viz:

(6.15) $N^S = XH$

6.9 The Solution of the Neoclassical Case

Returning to the Neoclassical version of our general equilibrium model, equations (6.1) to (6.14), we may now illustrate the solution method. First, we substitute equation (6.9) into (6.3) and (6.7), equation (6.6) into (6.2) and (6.5), (6.10) into (6.5), and (6.3) and (6.1) into (6.2). In addition, for the time being we allow equation (6.11) to stand for the entire labour supply section of the model, postponing consideration of the details of labour supply until later. We may now consider the following subset of equations:

(6.27) $I(r) + \delta\bar{K} = sQ$

(6.4) $M/P = L(Q,r)$

(6.28) $2twWN = {}^{b}(XH^{*}-N)$

(6.29) $Q = F(\bar{K},N)$

(6.8) $(1+tw)W/P = F_N$

(6.11) $N = XH$

Totally differentiating the sub-system and setting initial values of $P=1$, and $tw = b = 0$, we obtain:

(6.30) $I_r dr = sdQ$

(6.31) $-MdP = L_Q dQ + L_r dr$

(6.32) $2WNdtw = (XH^{*} - N)db$

(6.33) $dQ = F_N dN$

(6.34) $dW + Wdtw - WdP = F_{NN} dN$

(6.35) $dN = XdH + HdX$

Then, solving (6.31) for dr and substituting into (6.30) we obtain:

(6.36) $-MI_r dP = (sL_r + I_r L_Q)\ F_N dN$

For convenience, we will use the following definitions:

(6.37) $(sL_r + I_r L_Q)F_N = E$ $(E < 0)$

(6.38) $MI_r = C$ $(C < 0)$

And recall:

(6.10) $U = XH^{*} - N$ $(U > 0)$

Using these definitions, and substituting (6.37) and (6.38) into (6.36), and (6.10) into (6.32), the sub-system of equations becomes:

(6.39) $EdN + CdP = 0$

(6.40) $Udb = 2WNdtw$

(6.41) $F_{NN}dN + WdP - dW = W\,dtw$

(6.42) $dN = XdH + HdX$

Now totally differentiate (6.12), recalling the initial values P=1, and tw = b = 0. The result is:

(6.43) $dX = X'(dW - Wdtw + \theta db - WdP)$

Similarly, totally differentiate (6.13):

(6.44) $dH = H'(dW - Wdtw - db - WdP)$

Then, substituting (6.43) and (6.44) into (6.42), we obtain:

(6.45) $dN = (XH'+HX')dW - W(XH'+HX')dP + (\theta HX' - XH')db - W(XH'+HX')dtw$

We now need some additional definitions:

(6.46) $A = (XH' + HX')$ $(A > 0)$

(6.47) $B = (\theta HX' - XH')$ $(B \gtrless 0?)$

Note that the sign of B is ambiguous. Substituting (6.46) and (6.47) into (6.45), changes in labour supply may be expressed as follows:

(6.48) $dN + WAdP - AdW - Bdb = -WAdtw$

The complete equation system is now reduced to the following:

(6.39) $EdN + C\,dP = 0$

(6.40) $Udb = 2WNdtw$

(6.41) $F_{NN}dN + WdP - dW = Wdtw$

(6.48) $dN + WAdP - AdW - Bdb = -WAdtw$

In matrix form:

$$(6.49)\quad \begin{bmatrix} E & C & 0 & 0 \\ 0 & 0 & 0 & U \\ F_{NN} & W & -1 & 0 \\ 1 & WA & -A & -B \end{bmatrix} \begin{bmatrix} dN \\ dP \\ dW \\ db \end{bmatrix} = \begin{bmatrix} 0 \\ 2WN \\ W \\ -WA \end{bmatrix} \begin{bmatrix} dtw \end{bmatrix}$$

Using Cramer's Rule we may solve for the following comparative static derivatives:

$$(6.50)\quad \frac{\partial N}{\partial tw} = \frac{2W(NB-UA)}{U(1-AF_{NN})}$$

$$(6.51)\quad \frac{\partial P}{\partial tw} = \frac{2EW(NB-UA)}{-UC(1-AF_{NN})}$$

$$(6.52)\quad \frac{\partial W}{\partial tw} = \frac{2EW^2(NB-UA)+CWF_{NN}(UA-2NB)+CWU}{-UC(1-AF_{NN})}$$

$$(6.53)\quad \frac{\partial b}{\partial tw} = \frac{2WN}{U}$$

Recall, however, that we are ultimately interested in the effects of payroll tax changes on employment, prices, real gross capital income, and the after-tax real wage rate. We have two of these in (6.50) and (6.51), but we also need to find the effects of tax changes on the latter magnitudes. Note from (6.1) that real gross capital income may be expressed as follows:

$$(6.54)\quad \frac{Z}{P} = Q - \frac{(1+tw)WN}{P}$$

Differentiating (6.54) with respect to tw, and recalling the initial values of P=1 and tw=0, we obtain:

(6.55) $$\frac{\partial(Z/P)}{\partial tw} = -N\,\frac{\partial W}{\partial tw} - WN\,(1 - \frac{\partial P}{\partial tw})$$

Similarly, we may also differentiate the expression for the after-tax real wage rate with respect to tw, yielding:

(6.56) $$\frac{\partial(W(1-tw)/P)}{\partial tw} = \frac{\partial W}{\partial tw} - W\,(1 + \frac{\partial P}{\partial W})$$

Now we may substitute (6.52) and (6.53) into (6.55) and (6.56), to obtain the expressions we need. These are:

(6.57) $$\frac{\partial(Z/P)}{\partial tw} = \frac{2NWF_{NN}(NB-UA)}{-U(1-AF_{NN})}$$

(6.58) $$\frac{\partial(W(1-tw)/P)}{\partial tw} = \frac{2W(U-NBF_{NN})}{-U(1-AF_{NN})}$$

Finally, therefore, we are in a position to summarise the qualitative incidence results in the Neoclassical case. These are as follows:

$$\frac{\partial N}{\partial tw} = \frac{2W(NB-UA)}{U(1-AF_{NN})}\ , \qquad \frac{\partial(Z/P)}{\partial tw} = \frac{2NWF_{NN}(NB-UA)}{-U(1-AF_{NN})}\ ,$$

$$\frac{\partial P}{\partial tw} = \frac{E2W(NB-UA)}{-UC(1-AF_{NN})}\ , \qquad \frac{\partial(W(1-tw)/P)}{\partial tw} = \frac{2W(U-NBF_{NN})}{-U(1-AF_{NN})}\ ,$$

Clearly the sign of each of these comparative static multipliers is ambiguous, depending upon the sign of the term B. The various possibilities are recorded in Table 6.1 below.

Table 6.1 Signs of the Comparative Static Multipliers in the Neoclassical Case

Comparative Static Multiplier	Sign For $B < 0$ (1)	Sign For $B > 0$ (2)	Sign For $B = 0$ (3)
$\frac{\partial N}{\partial tw}$	-	?	-
$\frac{\partial P}{\partial tw}$	+	?	+
$\frac{\partial (Z/P)}{\partial tw}$	-	?	-
$\frac{\partial (W(1-tw)/P)}{\partial tw}$	?	-	-

From Table 6.1 we can see that in the case of $B < 0$, for example, an increase in the payroll tax rate will reduce employment, increase the price level (i.e., there will be some forward shifting), and reduce real capital income. The effect on the after-tax wage rate is ambiguous. This is clearly a very different result than would be implied by the labour burden assumption discussed in Chapter 4. Obviously the sign of the term B is crucial for the results, and we therefore turn to a discussion of the interpretation of this term in the next section.

6.10 Interpretation of the Ambiguous Term 'B'

Recall the definition of B as follows:

$$B = (\theta HX' - XH') \tag{6.47}$$

We will now attempt to provide a coherent interpretation of this term via some algebraic manipulation. First, divide (6.47) through by N, recalling that $N = XH$:

$$\frac{B}{N} = \frac{\theta HX' - XH'}{XH} \tag{6.59}$$

And, cancelling:

$$(6.60) \quad \frac{B}{N} = \frac{\theta X'}{X} - \frac{H'}{H}$$

Then, multiply through by W, giving:

$$(6.61) \quad \frac{BW}{N} = \frac{\theta X'W}{X} - \frac{H'W}{H}$$

In slightly different notation (6.61) may be written as:

$$(6.62) \quad \frac{BW}{N} = \theta \frac{\partial X}{\partial W} \cdot \frac{W}{X} - \frac{\partial H}{\partial W} \cdot \frac{W}{H}$$

But $\frac{\partial X}{\partial W} \cdot \frac{W}{X} = \eta_{XW}$ = the participation elasticity, and $\frac{\partial H}{\partial W} \cdot \frac{W}{H} = \eta_{HW}$ = the weeks elasticity. Therefore, finally, multiplying (6.62) through by N and dividing through by W, we have:

$$(6.63) \quad B = \frac{N(\theta\eta_{XW} - \eta_{HW})}{W}$$

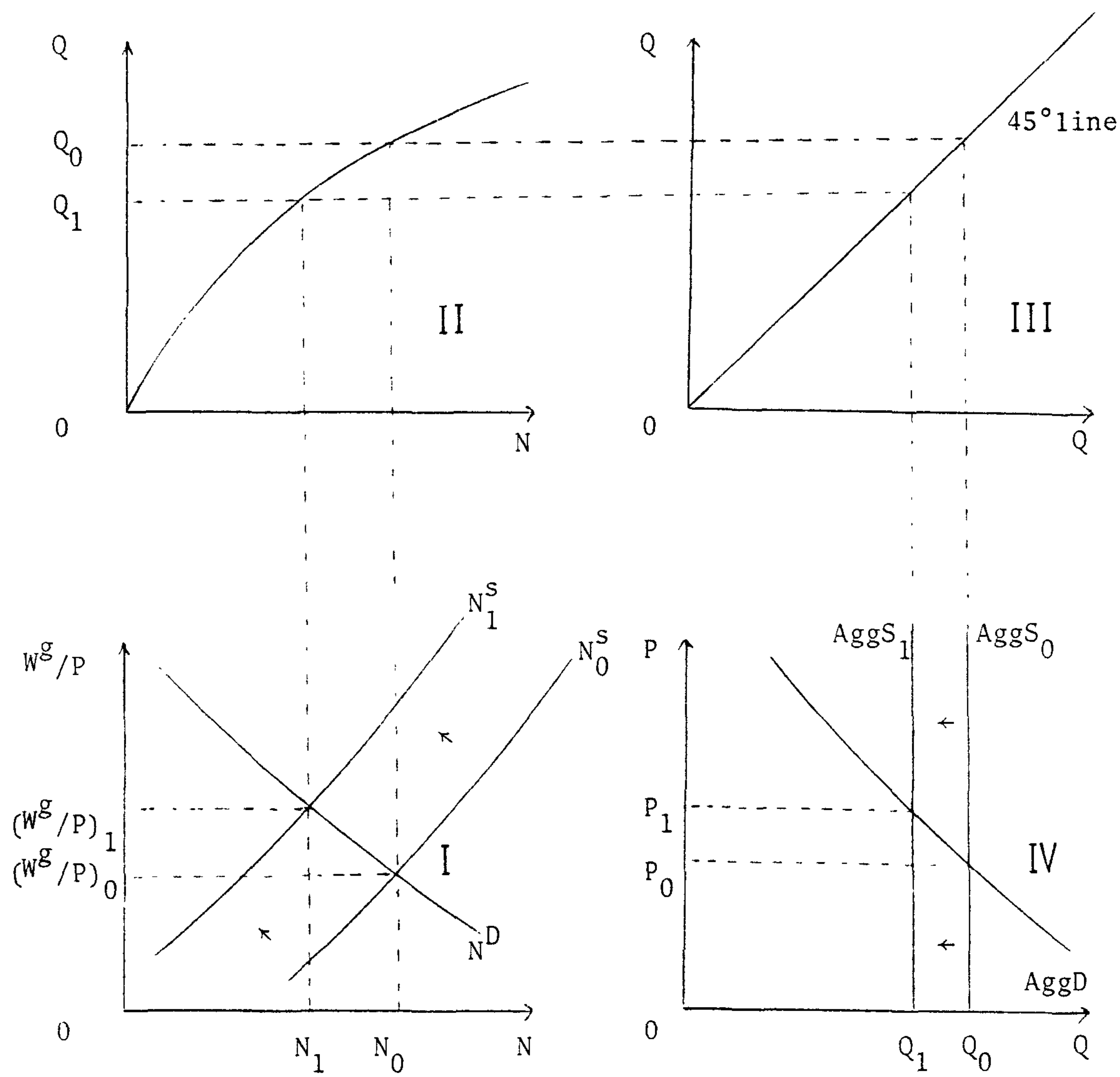
It can now be seen that the sign of B depends upon the relative sizes of the participation elasticity (weighted by the parameter θ) and the weeks elasticity. In Chapter 7 below, we will present evidence to show that the empirical magnitude of the participation elasticity is likely to be less than the weeks elasticity (as we have defined these concepts) by a factor of 2 or 3. If this evidence is accepted, it means that ultimately the sign of B depends upon the value of the parameter θ. Recalling the definition of θ in equation (6.14), it will be observed that this parameter indicates how generous the U.I. scheme is in terms of the length of the qualifying period. The longer is the qualifying period (i.e., the less generous the U.I. scheme is in this sense), the lower will be the value of θ and, hence, the more likely it will be that

B is negative. From Table 6.1, it can be seen that incidence results in the case of $B < 0$ (i.e., the weighted participation elasticity is less than the weeks elasticity), and in the borderline case of $B = 0$, are reasonably clearcut. It should be emphasised that the remaining case of $B > 0$ does not necessarily overturn these results, it simply makes some of the signs ambiguous. In Chapter 7 below we will use plausible parameter values to establish how likely it is that a generous qualifying period will cause 'perverse' results.

6.11 A Graphical Exposition of the Neoclassical Case

The effects of payroll tax changes in the Neoclassical case may be made clearer by reference to Figure 6.3 following, which is essentially the familiar four-quadrant diagram used in elementary macroeconomic analysis. In Figure 6.3, Quadrant I is a representation of the aggregate labour market in which both the demand for and the supply of labour are graphed against the gross real wage ($W^g/P = W(1+tw)/P$). Quadrant II shows the production function in which output, Q, is graphed against the only variable input, labour N. Quadrant III contains only a 45° line to facilitate a transition of the Q axis from the vertical to the horizontal. Finally, Quadrant IV depicts the aggregate demand and supply schedules in the goods market. Initially, the economy is in equilibrium with employment N_0, output Q_0, price level P_0, and real gross wage rate $(W^g/P)_0$. As has already been revealed by the algebra the macro effects of a payroll tax increase will depend crucially on the labour supply response. If it may be assumed (as is done in Figure 6.3) that the tax increase will shift the labour supply curve up and to the left, without changing the slope, the analysis is actually rather straightforward. In that case, the

Figure 6.3 The Macro Effects of Payroll Tax Changes in the Neoclassical Case.



tax is simply reducing the incentive to work, and in terms of our diagram, the macroeconomic impact is to shift the (vertical) aggregate supply curve to the left. Output and employment fall to Q_1, and N_1, respectively, and the price level rises to P_1. Although the gross real wage rate clearly rises to $(W^g/P)_1$, it is not possible to determine from the diagram what will be the effect on the after-tax real wage. Recall that the shift in the labour supply curve is made up of the net effects of the change in taxes plus the change in benefits. This means that the vertical distance between the pre-tax and post-tax labour supply curves is not now attributable to the tax alone.

More generally, of course, it is not possible to predict a priori exactly what the labour supply response will be. In other words, it is not clear that the shift of the labour supply curve will be exactly as depicted in Figure 6.3. We have seen that both the participation and weeks functions depend on tax and benefit rates, with the benefit rate entering as a negative argument in the one case and as a positive argument in the other. Moreover, tax and benefit rates are related via the budget constraint. Hence the sign ambiguities reported in Table 6.1.

6.12 The Brittain/Harberger Case

We now move on to the next case in our taxonomy, the Brittain/Harberger case. As the name indicates this will illustrate, in more detail, the theoretical basis of the labour burden assumption discussed in Chapter 4 above. This version of the model is still 'neoclassical' in the sense that the labour market clears, but now equations (6.11) through (6.14), representing the supply side of the labour market, are dropped. They are replaced by a single equation indicating that the supply of labour is completely inelastic, viz.:

(6.64) $N = \bar{N}$ $(\bar{N} = \text{constant})$

With the implication that:

(6.65) $H' = X' = 0$

From (6.64) we note:

(6.66) $dN = 0$

So that the equation system, formerly (6.39) to (6.42) is now reduced to:

(6.67) $CdP \qquad\qquad = \quad 0$

(6.68) $\qquad\qquad Udb \quad = \quad 2WNdtw$

(6.69) $WdP - dW \qquad = \quad W\,dtw$

In matrix form:

$$\begin{bmatrix} C & 0 & 0 \\ 0 & 0 & U \\ W & -1 & 0 \end{bmatrix} \begin{bmatrix} dP \\ dW \\ db \end{bmatrix} = \begin{bmatrix} 0 \\ 2WN \\ W \end{bmatrix} \begin{bmatrix} dtw \end{bmatrix} \tag{6.70}$$

Invoking Cramer's Rule once more, we obtain the following comparative static derivatives:

(6.71) $\frac{\partial P}{\partial tw} = 0$

(6.72) $\frac{\partial W}{\partial tw} = -W$

(6.73) $\frac{\partial b}{\partial tw} = \frac{2WN}{U}$

Further, we may then substitute (6.71) and (6.72) into (6.55) and (6.56) to yield:

(6.74) $\frac{\partial (Z/P)}{\partial tw} = 0$

(6.75) $\frac{\partial (W(1-tw)/P)}{\partial tw} = -2W$

Therefore, the results for the Brittain/Harberger case may be summarized as follows (signs in parenthesis):

$$\frac{\partial N}{\partial tw} = 0, \qquad \frac{\partial (Z/P)}{\partial tw} = 0,$$

$$\frac{\partial P}{\partial tw} = 0, \qquad \frac{\partial (W(1-tw)/P)}{\partial tw} = -2W \qquad (<0),$$

This is exactly the result predicted in Chapter 4, that labour bears the full burden of taxation with no effect on prices, employment, or capital income. By comparing these results with those of the Neoclassical case, we can see that it is the assumption of an inelastic supply of labour curve which is crucial for the B/H results.

6.13 The Keynesian Case

We now turn to the Keynesian case in which the money wage is fixed (by explicit or implicit contract) over the time horizon that we are dealing with. Formally we replace equation (6.11), the labour market clearing equation, with:

(6.76) $W = \bar{W}$ $(\bar{W} = \text{constant})$

Note that even though actual employment is now demand determined, the supply side of the labour market is still relevant in determining the level of unemployment. However, in this particular case, because of our assumption that b=0 initially, we can disregard equations (6.12) through (6.14) just as in the B/H case above. The assumption that b=0 prevents changes in unemployment from entering the solution.[6] In the Keynesian case in Chapter 7 below the assumption b=0 is dropped, and the labour supply equations will once more play a rôle. In any event, from (6.76) we have:

(6.77) $dW = 0$

So that the equation system (6.39) to (6.42) is replaced by:

(6.78) $\quad EdN + CdP = 0$

(6.79) $\quad Udb = 2WNdtw$

(6.80) $\quad F_{NN}dN + WdP = Wdtw$

In matrix form:

$$(6.81) \quad \begin{bmatrix} E & C & 0 \\ 0 & 0 & U \\ F_{NN} & W & 0 \end{bmatrix} \begin{bmatrix} dN \\ dP \\ db \end{bmatrix} = \begin{bmatrix} 0 \\ 2WN \\ W \end{bmatrix} \begin{bmatrix} dtw \end{bmatrix}$$

Application of Cramer's Rule then yields:

$$(6.82) \quad \frac{\partial N}{\partial tw} = \frac{CW}{CF_{NN} - EW}$$

$$(6.83) \quad \frac{\partial P}{\partial tw} = \frac{-EW}{CF_{NN} - EW}$$

$$(6.84) \quad \frac{\partial b}{\partial tw} = \frac{2WN}{U}$$

And substituting (6.77) and (6.81) into (6.55) and (6.56), we obtain:

$$(6.85) \quad \frac{\partial (Z/P)}{\partial tw} = -\frac{WNCF_{NN}}{CF_{NN} - EW}$$

$$(6.86) \quad \frac{\partial (W(1-tw)/P)}{\partial tw} = -\frac{W(CF_{NN} - 2EW)}{CF_{NN} - EW}$$

The results in the Keynesian case may therefore be summarised as follows (signs in parenthesis):

$$\frac{\partial N}{\partial tw} = \frac{CW}{CF_{NN} - EW} \quad (<0), \qquad \frac{\partial (Z/P)}{\partial tw} = -\frac{WNCF_{NN}}{CF_{NN} - EW} \quad (<0),$$

$$\frac{\partial P}{\partial tw} = \frac{-EW}{CF_{NN} - EW} \quad (>0), \qquad \frac{\partial (W(1-tw)/P)}{\partial tw} = -\frac{W(CF_{NN} - 2EW)}{CF_{NN} - EW} \quad (<0),$$

Here the results are very clearcut and in opposition to the previous B/H case. Employment falls, the price level rises, and both capital and labour incomes fall.

6.14 The Ricardian Case

In the so-called 'Ricardian' case the effect of 'real wage resistance' is illustrated by the assumption that the after-tax wage rate is exogenous. Equation (6.11) is replaced with:

$$(6.87) \quad \frac{(1-tw)W}{P} = k \qquad\qquad (k = \text{constant})$$

As in the Keynesian case, the level of employment is demand determined, and the supply side of the labour market is relevant only in determining the residual level of unemployment. In the case of an initial value of b=0, we may disregard the labour supply equations (6.12) through (6.14) for the same reasons as before. Totally differentiating (6.87), and recalling, once more, the initial values P=1 and tw=b=0, we obtain:

$$(6.88) \quad dW - Wdtw - WdP = 0$$

Which means that the equation system (6.39) to (6.42) is replaced by:

$$(6.89) \quad EdN + CdP = 0$$

$$(6.90) \quad Udb = 2WNdtw$$

$$(6.91) \quad F_{NN}dN + WdP - dW = Wdtw$$

$$(6.92) \quad WdP - dW = -Wdtw$$

In matrix form:

$$(6.93)\quad \begin{bmatrix} E & C & 0 & 0 \\ 0 & 0 & 0 & U \\ F_{NN} & W & -1 & 0 \\ 0 & W & -1 & 0 \end{bmatrix} \begin{bmatrix} dN \\ dP \\ dW \\ db \end{bmatrix} = \begin{bmatrix} 0 \\ 2WN \\ W \\ -W \end{bmatrix} \begin{bmatrix} dtw \end{bmatrix}$$

Using Cramer's Rule we obtain the following comparative static derivatives:

$$(6.94)\quad \frac{\partial N}{\partial tw} = \frac{2W}{F_{NN}}$$

$$(6.95)\quad \frac{\partial P}{\partial tw} = \frac{-2EW}{CF_{NN}}$$

$$(6.96)\quad \frac{\partial W}{\partial tw} = \frac{W(CF_{NN} - 2EW)}{CF_{NN}}$$

$$(6.97)\quad \frac{\partial b}{\partial tw} = \frac{2WN}{U}$$

Substituting (6.95) and (6.96) into (6.55):

$$(6.98)\quad \frac{\partial (Z/P)}{\partial tw} = -2WN$$

And by assumption:

$$(6.99)\quad \frac{\partial (W(1-tw)/P)}{\partial tw} = 0$$

The results for the Ricardian case may therefore be summarised as follows (signs in parenthesis):

$$\frac{\partial N}{\partial tw} = \frac{2W}{F_{NN}} \quad (<0), \qquad \frac{\partial (Z/P)}{\partial tw} = -2WN \quad (<0),$$

$$\frac{\partial P}{\partial tw} = \frac{-2EW}{CF_{NN}} \quad (>0), \qquad \frac{\partial (W(1-tw)/P)}{\partial tw} = 0 \ ,$$

Apart from (obviously) the effect on the after-tax real wage rate, the changes are all in the same direction as the Keynesian case.

6.15 Summary of the Comparative Static Results

Finally, it will be useful to have a summary of the results obtained in this chapter. In Table 6.2 below we will report the direction of tax-induced changes in each of the four key endogenous variables, for each case.

Table 6.2 Summary of the Direction of Changes in Endogenous Variables for an Increase in the Payroll Tax Rate

Endogenous Variable	Direction of Changes in the Different Cases:					
	Neoclassical (B<0) (1)	Neoclassical (B>0) (2)	Neoclassical (B=0) (3)	B/H (4)	Keynesian (5)	Ricardian (6)
Employment	-	?	-	0	-	-
Price Level	+	?	+	0	+	+
Real Gross Capital Income	-	?	-	0	-	-
After-Tax Real Wage Rate	?	-	-	-	-	0

Clearly, apart from the B/H case and the ambiguities already discussed in sections 6.9 and 6.10 above, a common pattern seems to emerge. In most of these short-run cases, except where the supply of labour curve is completely inelastic, a balanced budget payroll tax increase seems likely to reduce employment (and output), increase the price level, and reduce both real capital income and the after-tax real wage rate.

Having arrived at these provisional conclusions, in Chapter 7 below we will go on to study long-run cases and to specify some dynamic adjustment mechanisms for the model. In addition, the use of plausible parameter values will help to resolve some of the ambiguities which have arisen in the present chapter.

FOOTNOTES TO CHAPTER 6

[1]The phrase is due to N. Kaldor in a paper of the same title in the 'Review of Economic Studies' (1955/56).

[2]In Canada in 1980 the annual taxable ceiling was $15,080 p.a. See the Appendix to Chapter 1 above.

[3]Refer back to Chapter 3, sections 3.3 and 3.4 for our discussion of the choice of incidence categories. In the light of the specific model set out in sections 6.2 through 6.8 below, note that although all economic agents have a common savings propensity, s, (i.e. all 'workers' are 'capitalists' to some extent) they have different utility functions over labour and leisure, ranked by the parameter γ_i. Consequently there will be differing degrees of capital accumulation across individuals, and hence changes in capital and labour income will have uneven impact on the personal distribution. In other words capital and labour income are significant incidence categories. In the broader context (i.e., stepping aside from the specific model) we may reiterate our statement of Chapter 3 that a discussion of factor pricing is an 'indispensable first step' in determining the personal distribution of income.

[4]Thanks are due to Professor J.B. Burbidge, who drew the original version of this diagram. Professor Burbidge is not to be held responsible, however, for any errors or inconsistencies in the present version.

[5]There is an analogy here with the original Keynesian development of the liquidity preference schedule in monetary theory. In that theory, individual wealth holders made an 'all or nothing' portfolio choice between bonds and real balances depending on a critical rate of interest, but it was assumed that the aggregate liquidity preference schedule is a continuous function. See (e.g.) Glahe (1977, pp. 164-171).

[6]Totally differentiating equation (6.5) gives:

$$dUB = bdU + Udb$$

But, because b = 0 initially, dU (the change in unemployment) drops out of the picture leaving:

$$dUB = Udb$$

CHAPTER 7

SOME SIMULATION EXERCISES USING STATIC AND DYNAMIC MODELS

7.1 The Simulation Models

There are two purposes of this chapter. First, to provide quantitative (numerical) estimates of the orders of magnitude of the various comparative static multipliers, for which we now have qualitative solutions only. Second, to further the analysis by moving on to a dynamic rather than a static framework, and to provide numerical illustrations of the likely time paths of the various endogenous variables as they converge to the equilibrium solution. The view is taken here that the behaviour of endogenous variables (such as the after-tax real wage rate or real capital income) during the adjustment process, is just as much a part of incidence analysis as the nature of the final equilibrium solution. In both the static and dynamic versions we will use plausible parameter values, drawn from the relevant econometric literature, to provide illustrative results.

There are, therefore, two basic models for simulation experiments. These are (i) the static model, corresponding to a long-run version of the Neoclassical closed economy model of the comparative static analysis, and (ii) the dynamic model, which differs from the static in the specification of dynamic adjustment equations for certain of the endogenous variables. The simulation package used was the TEMS (Toronto Econometric Solution Program) programme, as adapted for use at McMaster University. This is described in the Appendix to the present chapter below. We now go on to describe the models themselves in more detail:

7.2 The Static Model

Our model differs from that used in the comparative static analysis of the previous chapter in that it is 'long-run', and that specific functional forms, of the 'constant elasticity' type, are used for the various behavioural equations.[1] The basic static model is long-run in the sense that the capital stock is now allowed to adjust endogenously to its optimal value. In equilibrium the real interest rate is equal to the marginal product of capital (plus depreciation) and net investment is zero. After an exogenous shock, the capital stock will adjust until this equation is satisfied once more. Of course, only a small modification of the model will allow us to return to the short-run situation, for direct comparison with the analysis of Chapter 6. Note that the algebraic symbols used retain the meanings assigned to them earlier, except where stated. The model is as follows:

(7.1) $Z = PQ - (1-tw)WN - 2twWN$

(7.2) $PIg = s(Z + (1-tw)WN + UB)$ $\qquad 0 < s < 1$

(7.3) $Ig = In + \delta K$ $\qquad 0 < \delta < 1$

(7.4) $In = 0$

(7.5) $\frac{M}{P} = DQ^{L_1}r^{-L_2}$ $\qquad D, L_1, L_2 > 0$

(7.6) $UB = bU$

(7.7) $UB = 2twWN$

(7.8) $Q = \Phi K^{\alpha}N^{\beta}$ $\qquad \Phi > 0,\ 0 < \alpha,\ \beta < 1$

(7.9) $\frac{(1+tw)W}{P} = \frac{\beta Q}{N}$

(7.10) $r + \delta = \frac{\alpha Q}{K}$

(7.11) $U = XH^* - N$

(7.12) $N = XH$

(7.13) $X = A\left(\frac{W(1-tw) + \theta b}{P}\right)^a$ $\qquad$ $A, a > 0$

(7.14) $H = C\left(\frac{W(1-tw) - \bar{b}}{P}\right)^c$ $\qquad$ $C, c > 0$

(7.15) $\theta = \frac{H^* - \bar{H}}{\bar{H}}$

(7.16) $ATRW = \frac{(1-tw)W}{P}$

(7.17) $ATRWB = \frac{(1-tw)WN}{P}$

(7.18) $RGCINC = \frac{Z}{P}$

(7.19) $RPYTB = \frac{2twWN}{P}$

(7.20) $URTE = \left(\frac{U}{H^*X}\right) 100$

Note that equations (7.16) through (7.20) are added to the model because we require the simulation package to supply us with explicit solutions for these endogenous magnitudes. Definitions of the 'new' variables and parameters are as follows:

In = Real net investment.

ATRW = After-tax real wage rate.

ATRWB = After-tax real wage bill.

RGCINC = Real Gross capital income.

RPYTB = Real payroll tax bill.

URTE = Unemployment rate.

D = Shift parameter in the money demand function.

L_1 = Income elasticity of money demand.

L_2 = (Absolute value of) the interest elasticity of money demand.

Φ = Shift parameter in the production function.

α = Output elasticity of capital inputs.

β = Output elasticity of labour inputs.

A = Shift parameter in the participation equation.

a = Participation elasticity.

C = Shift parameter in the weeks equation.

c = Weeks elasticity.

7.3 The Dynamic Model

The dynamic model has essentially the same structure as above, but with the introduction of some sources of dynamics and other related changes. Specifically, equations (7.4), (7.7), (7.10) and (7.12) are replaced by:

(7.4') $In = K_{+1} - K$

(7.7') $M_{+1} - M = UB - 2twWN$

(7.10') $$\frac{K_{+1} - K}{K} = \lambda\left(\frac{\alpha Q}{K(r+\delta)} - 1\right)$$

(7.12') $$\frac{W_{+1} - W}{W} = \gamma\left(\frac{N-XH}{XH}\right) + \pi$$

Also, two additional equations are introduced:

(7.21) $b = \psi W$

(7.22) $\pi = \varepsilon_1(\frac{P-P_{-1}}{P_{-1}}) + \varepsilon_2\pi_{-1} + \varepsilon_3(\frac{M_{+1} - M}{M})$ $\varepsilon_1+\varepsilon_2+\varepsilon_3 = 1$

Here, K_{+1} = Capital stock next period.

M_{+1} = Nominal money supply next period.

W_{+1} = Money wage rate next period.

π = Expected inflation rate.

π_{-1} = Expected inflation rate last period.

P_{-1} = Price level last period

λ = Adjustment coefficient in the capital stock adjustment equation.

γ = Adjustment coefficient in the 'Phillips Curve'.

ψ = Benefit/wage ratio

$\varepsilon_{1,2,3}$ = Weights in the expectations generating equation for inflation.

In the most complex version of the model there are four sources of dynamics. These are, (i) a wage adjustment equation (7.12'), which is nothing other than a conventional 'expectations-augmented' Phillips Curve, (ii) a capital stock adjustment equation (7.10'), which is also conventional, (iii) the introduction of expected inflation via equation (7.22),[2] and (iv) money financing of U.I. budget deficits, equation (7.7'). This latter source of dynamics recalls the literature on the macro consequences of the government budget constraint and is sometimes dubbed 'intrinsic dynamics'. See (e.g.,) Turnovsky (1977, p. 68). It arises in this case because the benefit rate b no longer varies to necessarily balance the U.I. budget. Rather, as in many real world systems, it is tied to the money wage rate as indicated in equation

(7.21), and thus a budget deficit or surplus may appear.

The expectations generating equation for inflation, (7.22), is admittedly 'ad hoc', but our particular specification has the virtue of allowing us to experiment with a number of alternative schema. Setting $\varepsilon_3 = 0$, for example, would yield an 'adaptive expectations' mechanism at one extreme, while at the other, setting $\varepsilon_1 = \varepsilon_2 = 0$ would yield a 'perfect foresight' scheme reminiscent of those in the neoclassical monetary growth model.

7.4 Modifications of the Basic Simulation Models

While the above two models provide the basic structure for the static and dynamic simulation exercises, clearly it is possible to make a number of minor modifications and respecifications, and thereby handle a variety of different cases.

For example, as mentioned, in both the static and dynamic versions above the capital stock is an endogenous variable, and the models are therefore long-run in that sense. However, it is a simple matter to respecify the equations for an exogenous capital stock. In this way, we are able to deal with various short-run cases.

Similarly, both the models specified have variable labour supply, but the case of inelastic labour supply (which we have referred to as the Brittain/Harberger model) may be addressed simply by deleting equations (7.13) and (7.14), and treating X and H as exogenous variables. The so-called Keynesian and Ricardian cases may also be dealt with simply by replacing equation (7.12) with an appropriate equation defining either money or real wage rigidity. Presumably, the latter type of modification is more appropriate in the short-run static cases, than in either the long-run static or dynamic cases. The dynamic models, of course, already have a degree of wage rigidity built-in via the Phillips Curve.

In the dynamic case, eliminating equations (7.7') and (7.21) and restoring equation (7.7) would restore the balanced budget condition, as in the static models, and obviate the need for money financing of deficits. Of course, the main modifications in the dynamic case will consist of the various permutations of equation (7.22) by which the different expectations generating mechanisms may be specified.

7.5 The Choice of Initial Values of Endogenous and Exogenous Variables, and Parameters

A complete list of all variables and parameters, their Fortran variable names, Fortran codings in TEMS, and initial values, is available in the Appendix to this chapter. The initial values of the endogenous and exogenous variables and of the shift parameters, D, Φ, A, and C, were chosen simply to provide a consistent equilibrium solution as the starting point. In addition, two of the parameters listed in the Appendix, tw itself and $\bar{H}$, are clearly more in the nature of exogenous variables whose values are under the control of the U.I. authorities. They are treated as 'parameters' here only for convenience.

The choice of the remaining parameter values clearly requires some comment. They have been given 'plausible' values within the ranges established by the relevant empirical literature. It is relatively easy, for example, to defend values of 0.15 for the aggregate saving propensity and exponents of $\alpha = 0.25$ and $\beta = 0.75$ in an aggregate Cobb-Douglas production function. The latter were described as 'everybody's back-of-the-envelope' by R. Solow (1980, p. 6) in his recent presidential address to the American Economic Association. The chosen values of the interest and income elasticities of the demand for money (0.3 and 1.0, respectively) are also conventional, and within the ranges reported by Laidler (1977, p. 133). Similar values of the demand for money parameters were also chosen by Scarth (1978, p. 9) in an illustrative simulation exercise in a small macro model.

The choice of values for the participation and weeks elasticities in the aggregate labour supply function requires more detailed discussion and in many ways, obviously, is the key to the exercise. As a starting point, we choose values of 0.1 and 0.3, respectively, for the participation and weeks elasticities, implying an overall labour supply elasticity of 0.4.[3] It must be recognised, of course, that these values are, at best, only rough guesses or estimates of what is reasonable, and that any results based on them must be sensitivity tested with alternative values. In what follows, we will first discuss some of the findings of the empirical literature on labour supply, and then set out the 'rule-of-thumb' calculations, based on that literature, by which we arrive at the above figures.

We may recall that the conclusion that labour bears the U.I.

tax burden rests largely on the assumption that aggregate labour supply is wage inelastic. For example, referring to the combined payroll tax in the U.S. (OADSHI plus U.I.), Musgrave and Musgrave (1980, p. 507) state:

> 'Since the tax is general and labour supply on the whole is fairly inelastic, the burden may be taken to fall largely on labour.'

This was also Brittain's original position, of course, viz. (1972a, p. 39):

> 'There is little if any evidence that payroll taxes have had substantial employment effects.'

It is interesting that both these assertions are made without any actual reference to the empirical literature. In fact, as it turns out, they are inconsistent both with the literature on 'U.I. induced unemployment' (as we have seen in Chapter 5 above), and with the majority of estimated labour supply functions. Although the latter do often indicate essentially inelastic labour supply curves for some particular sub-groups of workers (such as prime age males), there is no evidence that the aggregate labour supply curve is likely to be perfectly inelastic.

From the large literature on labour economics, we have referred in particular to Boskin (1973), Cain and Watts (1973), C.V. Brown (1980), Greenhalgh (1977) and (1980), Gunderson (1980), Hall (1973), Lightman and O'Cleireacain (1978), Lucas and Rapping (1970), McNabb (1977), Masters and Garfinkel (1977), Rosen (1980) and Rosen and Quandt (1978).

This list includes textbooks, surveys, and individual studies, and covers a wide range of topics in the estimation of labour supply functions. Each study has its own particular focus of interest, its own methodology, time period, data set, functional forms and estimation problems, and to attempt to summarise them concisely for our purposes is a formidable, and perhaps even inherently impossible, task. C.V. Brown's volume provides one accessible and reasonably up-to-date survey, and is comprehensive in terms of topics covered, while being necessarily selective of individual studies discussed. In particular, Brown reviews the various types of econometric methodology which have been used and the different data sets which have been available, the latter including cross-section survey data, interview data, and, unusually for the social sciences, experimental data from the various NIT[4] experiments in the U.S..

We cannot attempt to provide a full survey here, but will note one relevant fact which does stand out clearly in the literature. This is that there is a basic distinction to be made between the so-called 'primary' workers, such as prime age males, and 'secondary' workers such as married women or teenagers, who for one reason or another are less strongly attached to the labour force. The wage elasticity of labour supply of the former group is indeed close to zero, and may even be (slightly) negative, implying a (slightly) backward-bending labour supply function. On the other hand, the labour supply elasticities of secondary workers are significantly positive. As the aggregate supply of labour is made up of both primary and secondary workers, the implication is that an aggregate labour supply function (conceived of as some kind of weighted average of the labour supply of the different sub-groups), is likely to have a positive slope with respect to the wage argument. The distinction between primary and secondary workers is brought out most clearly in the work of Boskin (1973). He estimated labour supply functions for different sub-groups of the U.S. population disaggregated by age, race, sex, and family position, using cross-section data provided by the 'Survey of Economic Opportunity' of 1967. Boskin's estimated labour supply elasticities range from -0.07 for 'white prime age males' to 1.60 for 'black elderly women'. The highest recorded elasticity for any male group was 0.18 for 'white elderly males' and the lowest for any female group was -0.04 for 'white female heads of families'. All elasticities for other female groups were positive (1973, p. 177). Due to a sequential development of the labour supply function similar to that presented in Chapter 6 above, Boskin was able to report separate 'participation' and 'hours' effects, although these were reported as regression coefficients rather than elasticities. For 'prime age males' the participation effect of changes in own wages was zero, with the hours effect slightly positive. For most sub-groups of secondary workers both participation and hours effects are positive, (1973, pp. 169-172).

Recently the authors of two working papers in the N.B.E.R. series, Hall (1979) and Fullerton (1980) have attempted, for different reasons, to calculate the order of magnitude of the <u>aggregate</u> labour supply function, as opposed to the elasticities for different sub-groups. Fullerton (1980, pp. 17-19) makes a survey of the econometric literature, which is itself based on the earlier unpublished survey by M.R. Killingsworth (1976). He decides upon a representative male labour supply elasticity for the U.S. of -0.10 (all males taken together), and a female labour supply elasticity of 0.90 (all females taken together), with both estimates erring on the high side, if anything. Fullerton also makes the point (p. 19) that there is 'about a 1.7 ratio of males to females in the (U.S.) labour force' which would imply weights of 63%/37% in calculating the aggregate labour supply elasticity. For reasons which are not entirely clear however, Fullerton prefers to use the proportions of male and female <u>income</u> in total income as weights (rather than numbers in the labour force), and for this reason comes up with a rather low estimate of 0.15 as the overall labour supply elasticity.[5] Hall (1979, pp. 17-19) also makes a survey of the literature, but his estimate of the aggregate labour supply elasticity is rather higher at 0.4. This is based on an estimated male elasticity of 0.26 (which seems to be rather higher than that of most other commentators),[6] a female elasticity of 0.66, and implicit weights of about 60/40. C.V. Brown, in the study referred to above, also attempts a representative estimate of male and female labour supply elasticities, although unlike Hall and Fullerton, he does not go on to draw out the implications for the aggregate labour supply function. According to Brown (1980, p. 108):

> 'the following 'stylized facts' ... would seem to be supported by the current evidence ... for men the price elasticity (of labour supply) is low and negative, perhaps 0.0 to -0.4 ... for women price elasticity is positive and higher, perhaps 0.8 to 2.0 or 3.0.'

One of the problems for our purposes with much of the literature, is that separate weeks (hours) and participation elasticities, as required by our specification of the labour supply function, are not often reported. One exception to this is the work of Greenhalgh (1977) and (1980), who has estimated labour supply functions for married women in Great Britain, using cross-section data from the 'General Household Survey' of 1971. In her most recent paper, Greenhalgh reports the elasticities of 'probability of participation' and 'annual hours of work for participants' with respect to the wife's gross hourly wage rate. The estimated elasticities, evaluated at sample means, are recorded in Table 7.1 below.

Table 7.1 Greenhalgh's Estimated Elasticities of Participation and Annual Hours of Work for Married Women in Great Britain.

Participation Elasticity (1)	Annual Hours of Work Elasticity (2)	Total Labour Supply Elasticity (3)
0.355	0.717	1.072
	(or)[7] 0.637	(or) 0.992

Source - C. Greenhalgh (1980, p. 307).

As far as the total labour supply elasticity is concerned it is clear that these results are similar to what has been obtained elsewhere, and in addition, they are presented in a particularly convenient form for our purposes.

At this stage, having discussed some of the labour supply literature, we now turn to the calculation of the initial labour supply parameter specifications in this study. We arrive at these specifications as follows:

(i) We assume that the labour force consists of roughly 60% primary workers (e.g., prime age males) and 40% secondary workers (e.g., married women).

(ii) For primary workers both weeks and participation elasticities are taken to be zero. For secondary workers, using the orders of magnitude indicated by Greenhalgh's work, the participation elasticity is taken to be 0.3,[8] and the weeks elasticity 0.7, giving an overall labour supply elasticity for secondary workers of 1.0.

(iii) Weights of 60% and 40%, respectively, are applied to the primary and secondary workers elasticities, yielding an aggregate weeks elasticity of roughly 0.3, and an aggregate participation elasticity of 0.1. The overall aggregate labour supply elasticity of 0.4 agrees with Hall's estimate, even though it is arrived at by a rather different method.

The remaining parameters, for which values must be chosen, are δ, λ, γ, ψ and the ε_i. (The latter four, of course, will be relevant only in the dynamic cases.) In our model the (macro) depreciation rate, δ, determines (with the aggregate savings propensity), the equilibrium capital/labour ratio. The original specification is $\delta = 0.05$, which gives a plausible K/Q ratio of 3. The adjustment coefficient in the capital stock adjustment equation, λ, is given a value of 0.125. This is consistent with the empirical evidence surveyed by Hall (1977) and Tobin and Brainard (1977). Bailey and Scarth (1979, p. 13) suggest the somewhat lower value of 0.1, but obviously this is not a completely different order of magnitude. For γ, the adjustment coefficient in the Phillips curve, we initially specify $\gamma = 0.3$. This clearly gives a degree of 'stickiness' to the wage adjustment process. As mentioned before, the benefit/wage ratio, ψ, is strictly speaking not a parameter, but a policy variable under the control of the U.I. authorities. Finally, the ε_i, the weights in the expectations generating mechanism, will be varied according to the type of expectations scheme that is being specified.

It must be recognised, of course, that a considerable amount of rule-of-thumb reckoning has gone into selecting the above initial parameter values. Sensitivity testing of any simulation results will therefore be essential. Nonetheless, all of the values chosen above can be defended on the grounds that they are both 'conventional' and 'plausible'. None of the magnitudes is outside the ranges established either by the empirical literature or by economists' typical 'back-of-the-envelope' calculations.

7.6 Results of the Simulation Experiments

A large number of simulation experiments have been run in both the static and dynamic cases. As mentioned above, information on the methodology used, involving the TEMS computer package, is available in the Appendix to Chapter 7. In this and the following sections in the text, we will present some of the results of the simulations. Clearly, the number of permutations of different models, different parameter values, and different exogenous events, is literally infinite. All that can be done here, therefore, is to present selected simulations results, hopefully the most interesting. Fortunately, recognisable 'patterns' of results emerge, and it is often possible to allow a given set of results to stand as a proxy for a number of others. It was often found that changes in parameter values lead to changes in precise magnitudes, but not necessarily in the general characteristics of the solution. In what follows, we will discuss the static simulation results first, followed by their dynamic counterparts.

7.7 Selected Results of the Static Simulations

It will be recalled that in all of the static models the U.I. budget is balanced. In Musgravian terminology we are dealing with 'budget' incidence. Therefore, either the U.I. benefit rate or the payroll tax rate must be treated as an endogenous variable. As tax incidence is our primary focus of attention, we will take the tax rate to be exogenous and the benefit rate to be endogenous. Of course, in another context the model would be equally well adapted to addressing the effects of changes in benefit rates (with endogenous tax rate), i.e., the questions which have arisen in the literature on insurance-induced unemployment. In our case, however, we are left with two parameters of the U.I. system which may be varied by the authorities. These are:

(a) The payroll tax rate, (tw).

(b) The qualifying period, ($\bar{H}$).

We are interested in the effects of increases or decreases in the payroll tax rates in the context of the original parameter values set out in section 7.5. Sensitivity testing will consist of carrying out the same experiments with differing parameter values, such as different labour supply elasticities. This will include changes in payroll tax rates under different qualifying period regimes.

Table 7.2 reports the results of our basic case, in which the exogenous event is an increase in the payroll tax rate by one percentage point from 1% to 2%. Allowing for the matching employer contribution, this represents an overall payroll tax increase from 2% to 4%.

Compare first the results in the long-run Neoclassical case with those in the long-run B/H case. This is essentially a comparison between a model with a fully specified aggregate supply of labour function and the familiar case in which an inelastic labour supply curve is assumed. In the B/H case, as predicted, labour bears the full burden of the tax increase in the sense that both the after-tax real wage rate, and the after-tax real wage bill, decline by the amount of the increase.[9] There are no effects on employment, output, the price level, or the unemployment rate itself. In the long-run neoclassical model, however, with a more realistic labour supply function, a rather different picture emerges. Employment and output both fall (i.e., there are negative 'employment effects') and, to the extent that the general price level rises, there is some 'forward shifting'. The real incomes of <u>both</u> capital and labour fall, and because of the employment effects, the total fall in income is greater than the tax burden itself. Note, in passing, that in this particular case (given the particular model specification, and parameter values) the fall in the after-tax real wage rate in the Neoclassical case is not greatly different that in the B/H case. This is <u>not</u> a general result, but its occurence here does point out once again a common fallacy in the empirical literature. Clearly, labour does not bear the 'full burden' in the Neoclassical case, as capital income is also depressed. In the absence of additional information about employment

Table 7.2 Results of a One Percentage Point Increase in the Payroll Tax Rate with the Original Data Set and Parameter Values, (tw↑ 1% point).

Endogenous Variable (1)	Long-Run Neoclassical (2)	Long-Run B/H (3)	Short-Run Neoclassical (4)	Short-Run B/H (5)	Short-Run Keynesian (6)	Short-Run Ricardian (7)
	Percentage Changes in the Different Cases:					
Output	-2.52%		-1.68%		-1.13%	-5.65%
Employment	-2.39%		-2.22%		-1.48%	-7.50%
Price Level	+2.49%		+0.96%		+0.64%	+3.12%
Unemployment Rate	+18.01%		+16.85%		+13.08%	+43.90%
Real Gross Capital Income	-3.03%		-1.82%		-1.11%	-5.69%
Real After-Tax Wage Rate	-2.00%	-1.99%	-1.44%	-1.99%	-1.64%	
Real After-Tax Wage Bill	-4.33%	-1.98%	-3.61%	-1.98%	-3.09%	-7.49%

Note - A blank space indicates 'no change'.

effects, empirical evidence on wage behaviour alone cannot give a complete picture of tax incidence.

We should make some comment on the rather large increase in the unemployment rate in the Neoclassical case (+18.01%). This is not, of course, an increase in percentage points. With the high initial unemployment rate of 15%, it translates into an increase of about 2 3/4 percentage points. The increase is nonetheless of a higher order of magnitude than the other changes and arises because of two special circumstances of our model. These are, (a) the particular definition of unemployment that has been adopted (discussed in Chapter 6 above), and (b) the balanced budget assumption. Due to the latter assumption recall that the benefit rate is an endogenous variable, and therefore with an increase in tax revenues must be allowed to rise. As a result there will be an induced increase in the participation rate, which combined with the actual fall in employment, will contribute to the large increase in the unemployment rate.

Turning now to the short-run cases in Table 7.2, we note that the short-run Neoclassical and B/H cases yield the same pattern of results as their long-run counterparts except for the fact, as might be expected, that the short-run changes in the Neoclassical model are not quite as large. In addition, short-run results are presented for the Keynesian and Ricardian models, dealing with the cases of money and real wage rigidity respectively. As far as the Ricardian case is concerned, in these numerical estimates we assume that, over a fairly short time horizon, trade unions can defend a particular level of the after-tax real wage as perceived by employees. The introduction of Keynesian and Ricardian modifications does not, in fact, cause us to alter fundamentally the conclusions derived from the Neoclassical case. The rigid money wage does tend to modify the impact of most of the changes, with the exception of the change in the after-tax real wage rate. The point here is that given an increase in both the tax rate and the price level, a contractually determined money wage is something of a liability from the point of view of the individual worker. On the other hand, because of a less drastic fall in employment as compared with the Neoclassical case, the reduction in the total real wage bill is somewhat modified. In the Ricardian case, as might be expected, the defence of the real wage rate is achieved at the expense of larger falls in employment and the total real wage bill, and a much larger increase in the unemployment rate.

We restrict our discussion of the Keynesian and Ricardian case to the short-run, on the grounds that it is difficult to defend the assumptions of money or real wage rigidity over the longer time horizon.

7.8 Sensitivity Testing

The results in section 7.7 have been sensitivity tested in a number of ways. A partial list of the experiments that have been carried out is as follows:

(i) Reductions rather than increases in the payroll tax rate, (e.g., to tw = 0.005).

(ii) Very much larger increases in the payroll tax rate, (e.g. to tw = 0.05).

(iii) Repeating the experiment with a 'more generous' qualifying period, (e.g., $\bar{H}$ = 10).

(iv) Repeating the experiment with a 'less generous' qualifying period, (e.g., $\bar{H}$ = 30).

(v) Repeating the experiment with a 'more elastic' labour supply function, (e.g., a = 0.2, c = 0.6).

(vi) Repeating the experiment with a 'less elastic' labour supply function, (e.g., a = 0.05, c = 0.15).

(vii) Changing the ratio between the weeks and participation elasticities, (e.g. to a = 0.2, c = 0.2).

(viii) Various combinations of the above.

(ix) Examining the effect of the removing the U.I. scheme entirely.

Clearly all these changes will lead to changes in the precise magnitudes of the effects of increases in the payroll tax rate. However, it is fair to say that the results of 7.7 are robust over a wide range of sensitivity tests, in the sense that the same pattern of results emerges and, in particular, that the various comparative static multipliers have the same sign. We obviously will not want to report the results of all of the sensitivity tests that have been carried out, but the following two sections 7.9 and 7.10 will discuss some of them in more detail. In section 7.9 we report the actual results of some of the sensitivity tests, while while in section 7.10 we will take up the issue of the possibility of 'perverse' results which was first raised in Chapter 6.

7.9 Illustrative Results of the Sensitivity Testing

For illustrative purposes we record the results of some of our sensitivity tests in Tables 7.3 through 7.8 to follow. Table 7.3, for example, shows the results of a one percentage point payroll tax increase in the presence of a more generous qualifying period, while Table 7.4 shows the effects of a similar increase with a qualifying period which

Table 7.3 Results of an Increase in the Payroll Tax Rate of One Percentage Point with a More Generous Qualifying Period, (tw↑ 1% point with $\bar{H}$ = 10, A = 176.013)

Endogenous Variable	Percentage Changes in the Different Cases:					
	Long-Run Neoclassical	Long-Run B/H	Short-Run Neoclassical	Short-Run B/H	Short-Run Keynesian	Short-run Ricardian
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output	-1.57%	N/A	-1.05%	N/A	-1.13%	-5.65%
Employment	-1.51%	N/A	-1.39%	N/A	-1.48%	-7.50%
Price Level	+1.51%	N/A	+0.60%	N/A	+0.64%	+3.12%
Unemployment Rate	+17.93%	N/A	+17.12%	N/A	+17.47%	+45.76%
Real Gross Capital Income	-1.73%	N/A	-1.07%	N/A	-1.11%	-5.69%
Real After-Tax Wage Rate	-1.99%	N/A	-1.65%	N/A	-1.64%	
Real After-Tax Wage Bill	-3.46%	N/A	-3.01%	N.A	-3.09%	-7.49%

Note - A blank space indicates 'no change'.

Table 7.4 Results of an Increase in the Payroll Tax Rate of One Percentage Point with a Less Generous Qualifying Period, ($tw \uparrow 1\%$ point with $\bar{H}$ = 30, A = 181.60)

Endogenous Variable (1)	Long-Run Neoclassical (2)	Long-Run B/H (3)	Short-Run Neoclassical (4)	Short-Run B/H (5)	Short-Run Keynesian (6)	Short-run Ricardian (7)
	Percentage Changes in the Different Cases:					
Output	-2.80%	N/A	-1.99%	N/A	-1.13%	-5.65%
Employment	-2.88%	N/A	-2.67%	N/A	-1.48%	-7.50%
Price Level	+2.97%	N/A	+1.10%	N/A	+0.64%	+3.12%
Unemployment Rate	+17.23%	N/A	+16.81%	N/A	+10.59%	+42.94%
Real Gross Capital Income	-2.50%	N/A	-1.82%	N/A	-1.11%	-5.69%
Real After-Tax Wage Rate	-1.99%	N/A	-1.33%	N/A	-1.64%	
Real After-Tax Wage Bill	-4.80%	N/A	-3.96%	N/A	-3.09%	-7.49%

Note - A blank space indicates 'no change'.

Table 7.5 Results of an Increase in the Payroll Tax Rate of One Percentage Point with a More Elastic Labour Supply Function, ($tw\uparrow$ 1% point with $a = 0.2$, $c = 0.6$, $A = 160.5$, $C = 26.24$)

Endogenous Variable	Percentage Changes in the Different Cases:					
	Long-Run Neoclassical	Long-Run B/H	Short-Run Neoclassical	Short-Run B/H	Short-Run Keynesian	Short-Run Ricardian
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output	-4.06%	N/A	-2.59%	N/A	-1.13%	-5.65%
Employment	-3.88%	N/A	-3.52%	N/A	-1.48%	-7.50%
Price Level	+4.15%	N/A	+1.39%	N/A	+0.64%	+3.12%
Unemployment Rate	+28.21%	N/A	+26.35%	N/A	+16.96%	+45.88%
Real Gross Capital Income	-4.56%	N/A	-2.05%	N/A	-1.11%	-5.69%
Real After-Tax Wage Rate	-2.01%	N/A	-1.13%	N/A	-1.64%	
Real After-Tax Wage Bill	-5.80%	N/A	-4.60%	N/A	-3.09%	-7.49%

Note - A blank space indicates 'no change'.

Table 7.6 Results of a Reduction in the Payroll Tax Rate of One Percentage Point, Effectively Removing the U.I. Scheme, (tw↓ 1% point).

Endogenous Variable	Percentage Changes in the Different Cases:					
	Long-Run Neoclassical	Long-Run B/H	Short-Run Neoclassical	Short-Run B/H	Short-Run Keynesian	Short-Run Ricardian
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output	+2.74%		+1.87%		+1.14%	+5.89%
Employment	+2.74%		+2.50%		+1.50%	+7.98%
Price Level	-2.51%		-1.00%		-0.63%	-3.14%
Unemployment Rate	-23.64%		-22.55%		-16.74%	-54.22%
Real Gross Capital Income	+2.62%		+1.80%		+1.20%	+6.04%
Real After-Tax Wage Rate	+1.99%	+2.01%	+1.38%	+2.01%	+1.65%	
Real After-Tax Wage Bill	+4.79%	+2.02%	+3.93%	+2.02%	+3.18%	+7.99%

Note - A blank space indicates 'no change'.

Table 7.7 Results of an Increase in the Payroll Tax Rate of One Percentage Point with Equal Weeks and Partipation Elasticities, (tw↑ 1% with a = 0.2, c = 0.2, A = 160.5, C = 37.06)

Endogenous Variable (1)	Long-Run Neoclassical (2)	Long-Run B/H (3)	Short-Run Neoclassical (4)	Short-Run B/H (5)	Short-Run Keynesian (6)	Short-Run Ricardian (7)
Output	-0.64%	N/A	-0.43%	N/A	-1.13%	-5.65%
Employment	-0.64%	N/A	-0.58%	N/A	-1.48%	-7.50%
Price Level	+0.65%	N/A	+0.25%	N/A	+0.64%	+3.12%
Unemployment Rate	+13.04%	N/A	+12.83%	N/A	+16.96%	+45.88%
Real Gross Capital Income	-0.61%	N/A	-0.41%	N/A	-1.11%	-5.69%
Real After-Tax Wage Rate	-1.99%	N/A	-1.85%	N/A	-1.64%	
Real After-Tax Wage Bill	-2.61%	N/A	-2.41%	N/A	-3.09%	-7.49%

Note - A blank space indicates 'no change'.

Table 7.8 Results of an Increase in the Payroll Tax Rate of One Percentage with Equal Weeks and Participation Elasticities and a More Generous Qualifying Period (tw↑1% with $\bar{H}$ = 10, a = 0.2, c = 0.2, A = 153.5, C = 37.06)

Endogenous Variable (1)	Long-Run Neoclassical (2)	Long-Run B/H (3)	Short-Run Neoclassical (4)	Short-Run B/H (5)	Short-Run Keynesian (6)	Short-Run Ricardian (7)
	Percentage Changes in the Different Cases:					
Output	+1.42%	N/A	+0.96%	N/A	-1.13%	-5.65%
Employment	+1.47%	N/A	+1.30%	N/A	-1.48%	-7.50%
Price Level	-1.46%	N/A	-0.54%	N/A	+0.64%	+3.12%
Unemployment Rate	+13.52%	N/A	+13.37%	N/A	+23.95%	+49.01%
Real Gross Capital Income	+1.74%	N/A	+1.21%	N/A	-1.11%	-5.69%
Real After-Tax Wage Rate	-1.97%	N/A	-2.31%	N/A	-1.64%	
Real After-Tax Wage Bill	-0.52%	N/A	-1.02%	N/A	-3.09%	-7.49%

Note - A blank space indicates 'no change'.

is less generous. Table 7.5 repeats the 1% point increase in the context of a more elastic labour supply function. In each of these cases it can be seen that precise magnitudes are changed but that the general pattern of the solution is not. Note that the main differences between Tables 7.2 through 7.5 occur in the two Neoclassical cases. In the Keynesian and Ricardian cases, only the change in the unemployment rate differs across Tables. This is because the parameters we are changing have their impact on the model through their effect on labour supply. As we saw in Chapter 6 above, the effect on labour supply will only have limited relevance in cases of wage rigidity.

In Table 7.6 we record the results of the interesting case of a one percentage point reduction in the payroll tax rate, rather than an increase. This has the effect of removing the U.I. scheme completely. Here the results obviously go in the opposite direction to those in the case of payroll tax increases. Without the U.I. scheme, output and employment would be higher, the price level and the unemployment rate itself would be lower, and both capital and labour income would be higher. This illustrates payroll tax incidence 'in reverse' as it were.

In Tables 7.7 and 7.8 we examine the effects of changes in the relative size of the participation and weeks elasticities in the labour supply function. Specifically, instead of the weeks elasticity being very much greater than the participation elasticity (as in the original specification), they are now made equal (both at a value of 0.2) while the overall labour supply elasticity is unchanged (at 0.4). In Table 7.7, in which the change in these two elasticities is the only change, the effects of a 1% point increase in the payroll tax are still in the same direction as the basic case of Table 7.2, although the magnitudes are very much reduced. In Table 7.8, however, in which there is the additional change of a more generous qualifying period ($\bar{H}$ = 10), a very different pattern of results emerges. In the two Neoclassical cases the payroll tax increase has opposite effects from what we have come to expect, i.e., employment and output are increased, the price level is reduced, and so on. Table 7.8 is clearly an example of what we referred to as 'perverse' results in Chapter 6. We now turn to a more general discussion of this issue in section 7.10 below.

7.10 The Possibility of 'Perverse' Results

As was indicated by the qualitative analysis of Chapter 6 and by the results reported in Table 7.8, there are parameter values for which we obtain results which differ from the standard case ('perverse' results). In this section we will attempt to establish quantitatively, within the confines of the model, the parameter values necessary for these perverse results to occur.

The possibility of perverse results, in our model, arises because whereas increases in payroll tax rates unambiguously reduce both participation and weeks worked by participants, increase in benefit rates (which occur because of the balanced budget assumption) have opposite effects on these two variables. Benefit rate increases tend to reduce average weeks worked by participants (reinforcing the effect of taxes in that respect), but to increase participation (which tends to offset the effect of the taxes). Note also that the effect of the benefit rate on participation is weighted by the parameter θ, and thus depends on how generous the U.I. scheme is in terms of the qualifying period. Perverse results can only occur if the positive effect of the benefit rate on participation is strong enough to offset completely the other effects of both benefits and taxes. We may recall from Chapter 6 that a necessary, but not sufficient, condition for this is that the term 'B' is positive, which itself depends on the relative size of the weeks elasticity and the weighted participation elasticity. In other words the chance of perverse results is greater the larger the participation elasticity is relative to the weeks elasticity, and the larger is θ (i.e., the more 'generous' is the qualifying period). When the weighted participation elasticity is greater than the weeks elasticity this means that the overall effect of the benefit side on labour supply is positive. Obviously this is <u>necessary</u> for 'perverse' results, it is not <u>sufficient</u> however because the effect of the taxes still has to be taken into account also. Recall the expression for 'B' from equation (6.63) above. Viz.:

$$(7.23) \qquad B = \frac{N(\theta\eta_{XW} - \eta_{HW})}{W} .$$

In the notation of this chapter (7.23) will become:

$$(7.24) \qquad B = \frac{N(\theta a - c)}{W}$$

where $a = \eta_{XW}$ = Participation Elasticity,

and $c = \eta_{HW}$ = Weeks Elasticity.

Now define the expression:

$$(7.25) \qquad \phi = \theta a/c .$$

The sign of B clearly depends on the sign of ϕ. For B to be positive implies that ϕ is greater than unity, i.e., that the weighted participation elasticity is greater than the weeks elasticity. The important question, of course, is precisely <u>how</u> much greater than unity does ϕ need to be before perverse results will occur. Further, do the values of θ, a, and c needed to generate this critical value of ϕ fall within the ranges that may be regarded as 'plausible'. It is apparent that the parameter values in the case reported in Table 7.8 do lead to perverse results, while those in Table 7.7 do not. In the former case the relevant parameter values are $a = c = 0.2$, and $\theta = 4.2$, implying $\phi = 4.2$. In the latter we have $a = c = 0.2$, and $\theta = 1.6$, implying $\phi = 1.6$. The critical value of ϕ, therefore, lies somewhere between 1.6 and 4.2.

In Table 7.9 we report the results of some further sensitivity testing designed to narrow down the range of estimates of the critical value of ϕ. These were carried on the context of the long-run Neoclassical case only. The procedure followed was to retain values of $a = c = 0.2$ but to change the length of the qualifying period, $\bar{H}$, in successive experiments, thus changing θ and ϕ. Of course, similar results would be obtained by holding the qualifying period constant and changing the relationship between the weeks and participation elasticities. From Table 7.9 it is apparent that the critical value of ϕ is around 2.25. This is right on the borderline between the perverse and standard results. Values of ϕ slightly below 2.25 (e.g., the value of $\phi = 2.059$ in Example 3) definitely give the standard results, while values slightly above 2.25 (e.g., $\phi = 2.466$ in Example 1) definitely give perverse results.

The remaining question is how likely or plausible are the parameter values which would be required to generate a value of ϕ greater than 2.25. This would imply a relatively high value of the participation elasticity to the weeks elasticity (rather than the other way round) and/or a 'generous' qualifying period regime. As far as the ratio of participation to weeks elasticity is concerned, it will be recalled that in our original

Table 7.9 Testing for 'Perverse' Results

Endogenous Variable (1)	Percentage Changes in the Different Cases: Example 1, ϕ=2.466 (2)	Example 2, ϕ=2.25 (3)	Example 3, ϕ=2.059 (4)
Output	+0.25%	+0.03%	-0.21%
Employment	+0.20%	+0.01%	-0.20%
Price Level	-0.17%	+0.01%	+0.18%
Unemployment Rate	+12.75%	+12.94%	+13.10%
Real Gross Capital Income	+0.12%	-0.04%	-0.22%
Real After-Tax Wage Rate	-2.00%	-2.00%	-2.00%
Real After-Tax Wage Bill	-0.79%	-1.98%	-2.18%

Note - for Example 1, $\bar{H}$ = 15 for Example 2, $\bar{H}$ = 16 for Example 3, $\bar{H}$ = 17

	Example 1	Example 2	Example 3
	$\bar{H}$ = 15	$\bar{H}$ = 16	$\bar{H}$ = 17
	a = 0.2	a = 0.2	a = 0.2
	A = 158.0	A = 158.6	A = 159.1
	c = 0.2	c = 0.2	c = 0.2
	C = 37.06	C = 37.06	C = 37.06

specifications we took the view that the aggregate participation elasticity was likely to be much less than the weeks elasticity, by a factor of about 3. This was based on the empirical evidence presented by Greenhalgh (1980) on the labour supply functions of married women (taken to be 'typical' secondary workers), and the weighting procedure discussed in section 7.5. While such a balance between participation and weeks elasticities seems intuitively reasonable it must be recognized that our original specifications may well be vunerable to criticism either of the quality of the empirical evidence presented or the weighting procedure or both. This question of the relative size of weeks and participation elasticities in the aggregate labour supply function is obviously crucial to the type of issue we are discussing here and, so far, there really is very little empirical evidence to go on. It is apparent that the provision of such evidence would be one of the most fruitful areas for future empirical research. Turning now to the issue of the qualifying period, we may remark that our parameter θ, although it is squeezed into an artificial time period of one year, is basically a measure of the terms on which the duration of U.I. benefits is determined. For example, in the original specification working for 20 weeks will entitle an individual for up to 32 weeks of benefit. This relationship, it will be recalled, was associated with a θ value of 1.6, and there was no question of perverse results in that instance because the θ value was also associated with a low ratio of the participation elasticity to the weeks elasticity. Given the latter ratio of 1/3, θ would have to be as high as 6.75 before perverse results would occur (i.e., to generate a θ value as high as 2.25). Under these circumstances a qualifying period regime in which 7 weeks of work qualified an individual for 45 weeks of benefit (surely an extraordinarily generous U.I. scheme) would still not lead to perverse results. Under the 1979 rules in the Canadian U.I. scheme (discussed in Chapter 2 above) the most favourable 'terms' that an individual could obtain would be to work for 26 weeks and receive 38 weeks of benefit in Phases 1 and 2. Additional weeks of benefit might have been available in Phase 3 but these were contingent on the national unemployment rate, and not on weeks worked in the qualifying period. These terms would imply a θ value of 2.46. The individual who worked for only 20 weeks could obtain a maximum of 30 weeks of benefit, implying a θ value of 1.5. Somewhere between 2.46 and 1.5 would therefore seem to be a reasonable real world approximation to our parameter θ. With our original specifications of the weeks and participation elasticities these values would not bring us into the range of perverse results. The higher θ value of 2.46 would only imply a ϕ value of 0.82, well within the standard range. Note, however, that were the participation and weeks elasticities equal (e.g. at the familiar $a = c = 0.2$) the high θ value of 2.46 would also imply a ϕ value of 2.46, and there would be a problem. So we return to the conclusion that it is the relationship between the participation and week elasticities which is crucial. If we retain the original specifications, it is unlikely that any plausible U.I. scheme could be sufficiently generous to lead to perverse results. If, however, these specifications are wrong and the participation and weeks elasticities are more nearly equal, then a plausible U.I. scheme may very well lead to what we have dubbed 'perverse' results.

7.11 The Case of Differential Savings Propensities

As a final example of illustrative static results we now turn to the case of differential savings propensities. From the discussion of Chapter 4, it will be recalled that certain of the early 'Keynesian' economists, such as Seymour Harris (1941), made the suggestion that under certain circumstances, demand side effects might cause increases in payroll tax rates to have rather different results from those we have been discussing here. This would be the case where the propensity to save out of unemployment benefits was substantially less than out of other income, and particularly when the economy was in a situation of excess capacity. Increases in payroll tax rates (which were used to finance increases in U.I. benefits) would then have the effect of transferring income from groups with relatively high savings propensities to a group with a low savings propensity. The resulting stimulus to aggregate demand would increase output, employment, and capital income and if not the real wage rate, at least the aggregate real wage bill.

To examine this view, a number of simulation experiments have been run in the context of a model in which the propensity to save out of U.I. benefits is zero. In Table 7.10 we report the results of one such experiment, the usual one percentage point increase in the payroll tax rate with the original parameter values (including the original savings propensity out of earned income $s = 0.15$). Table 7.11 checks these results with a payroll tax change in the opposite direction, a reduction of one percentage point. From Table 7.10 note that in the

Table 7.10 Results of an Increase in the Payroll Tax Rate of One Percentage Point, in the Case of Differential Savings Propensities, (tw↑ 1% point).

Endogenous Variable (1)	Long-Run Neoclassical (2)	Long-Run B/H (3)	Short-Run Neoclassical (4)	Short-Run B/H (5)	Short-Run Keynesian (6)	Short-Run Ricardian (7)
	Percentage Changes in the Different Cases:					
Output	-3.18%	-0.52%	-1.69%		-0.55%	-5.47%
Employment	-2.56%		-2.29%		-0.76%	-7.28%
Price Level	+4.38%	+1.66%	+1.41%		+0.76%	+3.55%
Unemployment Rate	+18.54%		+16.96%		+9.76%	+42.63%
Real Gross Capital Income	-3.57%	-0.36%	-1.14%		-0.32%	-5.41%
Real After-Tax Wage Rate	-2.46%	-2.45%	-1.41%	-1.96%	-1.74%	
Real After-Tax Wage Bill	-4.97%	-2.47%	-3.68%	-1.98%	-2.50%	-7.29%

Note - A blank space indicates 'no change'.

Table 7.11 Results of a Reduction in the Payroll Tax Rate of One Percentage Point, in the Case of Differential Savings Propensities (tw↓ 1% point).

Endogenous Variable (1)	Long-Run Neoclassical (2)	Long-Run B/H (3)	Short-Run Neoclassical (4)	Short-Run B/H (5)	Short-Run Keynesian (6)	Short-Run Ricardian (7)
	Percentage Changes in the Different Cases:					
Output	+3.40%	+0.47%	+1.84%		+0.70%	+5.90%
Employment	+2.19%		+2.48%		+0.90%	+8.03%
Price Level	-4.16%	-1.52%	-1.40%		-0.81%	-3.57%
Unemployment Rate	-24.00%		-22.08%		-13.00%	-54.05%
Real Gross Capital Income	+3.42%	+0.65%	+1.91%		+0.93%	+6.23%
Real After-Tax Wage Rate	+2.52%	+2.55%	+1.42%	+2.04%	+1.85%	
Real After-Tax Wage Bill	+5.49%	+2.52%	+3.91%	+2.02%	+2.75%	+8.02%

Note - A blank space indicates 'no change'.

short-run cases, particularly in the so-called Keynesian and Ricardian cases, there does appear to be some modification of the effects on employment and output, as compared with the case of common savings propensities. However, there is no radical change of direction of these effects, at least for these plausible parameter values. What is interesting though, is that in the long-run cases the result is quite the opposite of that suggested by the Keynesians. Negative effects on employment and output appear to be intensified. Note that now there is even a fall of output even in the B/H case, in which employment is constant by assumption. The point is that in the long-run cases the capital stock is variable, and that the reduction in the aggregate savings propensity (caused by the transfer of income to the unemployed), whatever its short-run effects, reduces the long-run ability or willingness of society to maintain the capital stock at its original level. The capital stock will in fact decline, leading to the observed reductions in output. In the short-run cases, it is only the fact that the capital stock is held constant which allows the short-run effects of the increase in aggregate demand to predominate. On this evidence, the transfer of resources to the unemployed, even if they have a savings propensity of zero, does not appear to have the overwhelmingly beneficial effects once suggested by Keynesian economists. Essentially what the transfer accomplishes, of course, is a switch to present consumption at the expense of future consumption.[10]

7.12 Selected Results of the Dynamic Simulations

We now turn to the dynamic simulations. Corresponding to the six cases of the static simulations, the results of most of the dynamic simulations have been compared across four cases, viz.:

(i) Neoclassical with unbalanced U.I. budget and money financing.

(ii) B/H with unbalanced U.I. budget and money financing.

(iii) Neoclassical with balanced U.I. budget.

(iv) B/H with balanced U.I. budget.

What is meant by an 'unbalanced' U.I. budget here is the case in which the benefit rate is tied to the money wage rate, allowing deficits or surpluses to develop. The case of the 'balanced' U.I. budget corresponds to the situation in the static simulations where budget surpluses or deficits do not appear because the benefit rate is an endogenous variable. In the cases with an unbalanced budget there are three parameters of the U.I. scheme which are under the control of the authorities. These are:

(a) The payroll tax rate, (tw).

(b) The qualifying period ($\bar{H}$).

(c) The benefit/wage ratio (ψ).

Our concern is with the effect of changes in the payroll tax rate, but it should be remarked that the model is equally well adapted for the study of the effects of changes in the other two parameters, the qualifying period and the benefit rate. These, it will be recalled were the central issues of the literature on insurance-induced unemployment, discussed in Chapter 5.

Sensitivity testing in the dynamic simulations will consist not so much of changing labour supply elasticities and other parameters (as much of this ground has been covered in the discussion of the static simulations) but of experimenting with different dynamic structures. In particular, this will entail changing the number of sources of dynamics in the system, and using alternative expectations generating mechanisms.

7.13 Four Representative Experiments

The first four sets of results to be reported are chosen because they are representative of the general pattern of dynamic behaviour which seems to emerge throughout. We will find that changes in the dynamic structure of the models will certainly change magnitudes and lengthen or shorten lags but that most of the graphs, nonetheless, do turn out to have the same underlying shape as in the first four cases to be reported here.

Note that all the dynamic experiments have a 20 period time horizon. The change in the payroll tax rate is assumed to occur in the first period and is permanent. Results are reported in graphical form, with percentage deviations of the endogenous variables (from the initial equilibrium values) being plotted against time. For the sake of brevity we will construct graphs only for the following key endogenous variables, employment, the price level, real capital income, and the after-tax real wage.

Our first four experiments are all long-run in the sense that they involve the maximum number of sources of dynamics including a capital stock adjustment equation. Inflationary expectations depend partly on recent inflationary experience and partly on the current rate of growth of the nominal money supply. We set parameter values of $\varepsilon_1 = \varepsilon_3 = 0.5$, and $\varepsilon_2 = 0$, in equation (7.22) and refer to this as the case of 'mixed' expectations. The exogenous event is the familiar one of a one percentage point increase in the payroll tax rate.

In Figure 7.1 (the long-run Neoclassical case with unbalanced U.I. budget), the real variables, employment, real capital income, and the after-tax real wage rate, eventually converge to new equilibrium values which are lower than in the initial equilibrium. Thus the results are consistant with the static simulations and labour and capital share the long-run tax burden. During this same period the after-tax real wage rate is, if anything, not depressed by as much as it eventually will be. In other words, with the type of adjustment lags assumed here, relatively more of the tax burden falls on capital income in the short-run than in the long-run. One interesting feature of this case with an 'unbalanced' U.I. budget is that the price level falls continuously. Nominal variables do not converge to new constant levels. What is occuring is that the tax increase leads to a budget surplus and a reduction in the money supply (via equation (7.7')), and hence to a deflation. As the benefit rate is tied to the money wage rate, which is itself falling during the deflation, there is no mechanism to redress the budget surplus.

Figure 7.1 Long-Run Neoclassical Case with Mixed Expectations and an Unbalanced U.I. Budget.

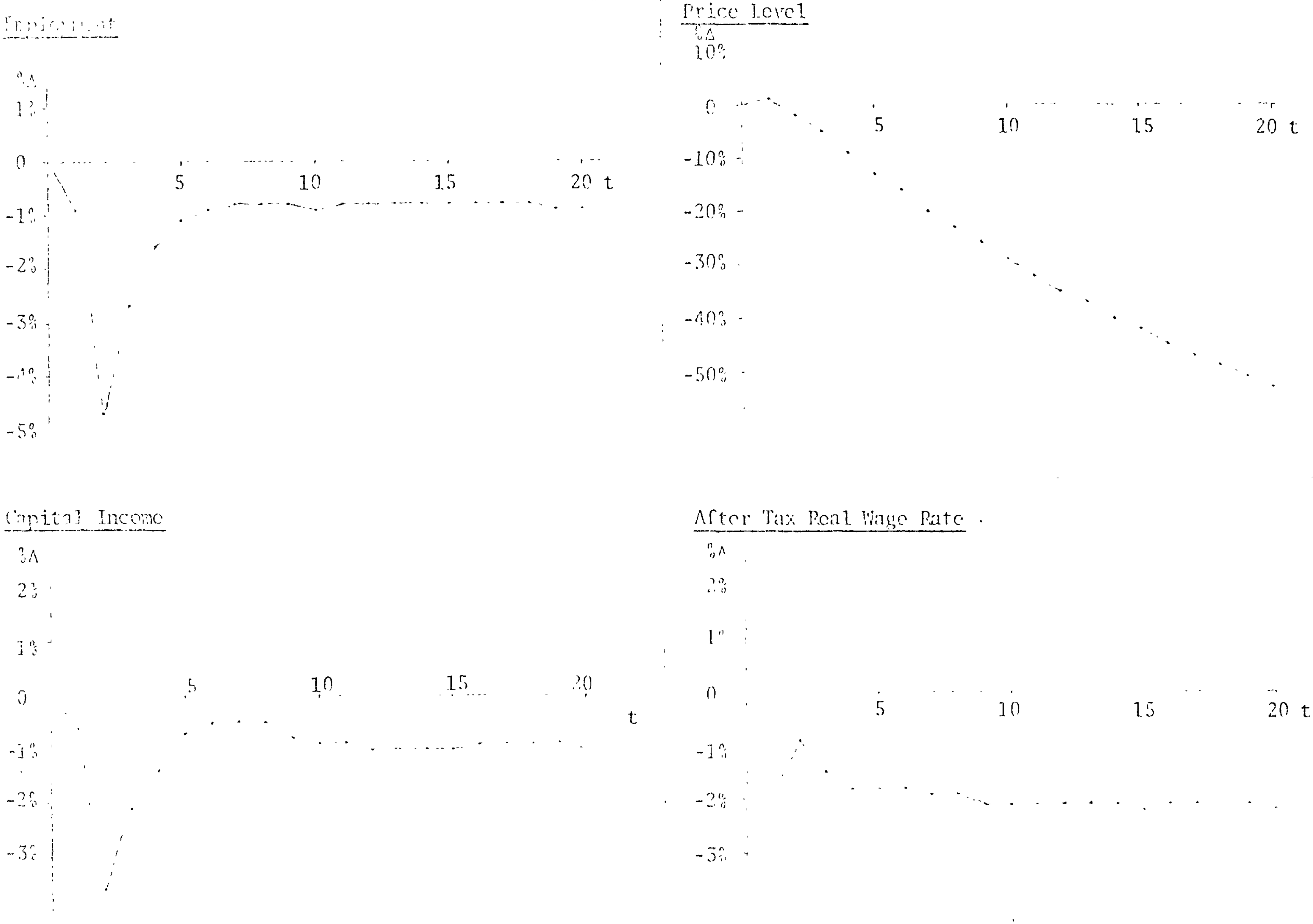


Figure 7.2 Long-Run B/H Case with Mixed Expectations and an Unbalanced U.I. Budget.

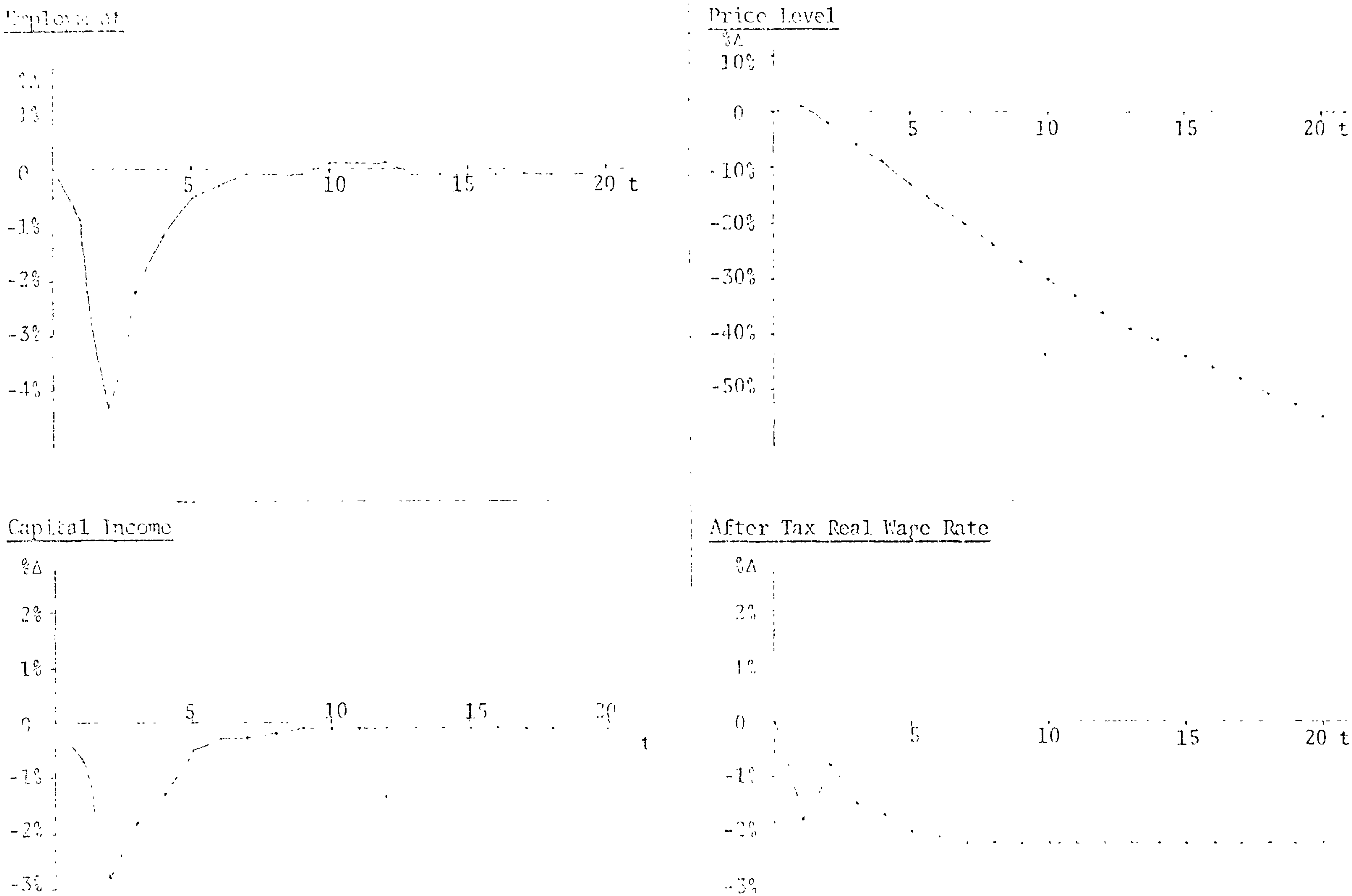


Figure 7.3 Long-Run Neoclassical Case with Mixed Expectations and a Balanced U.I. Budget.

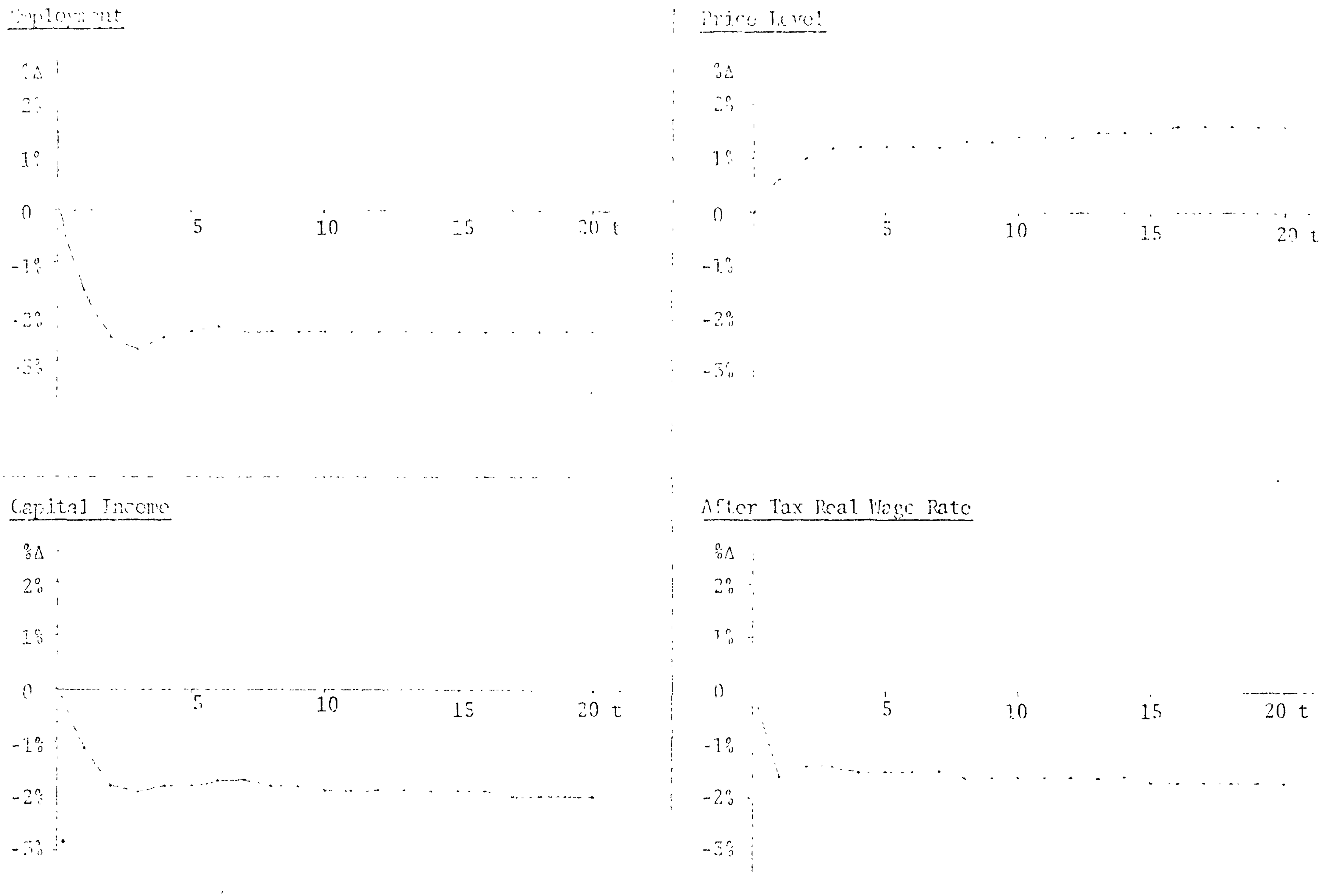
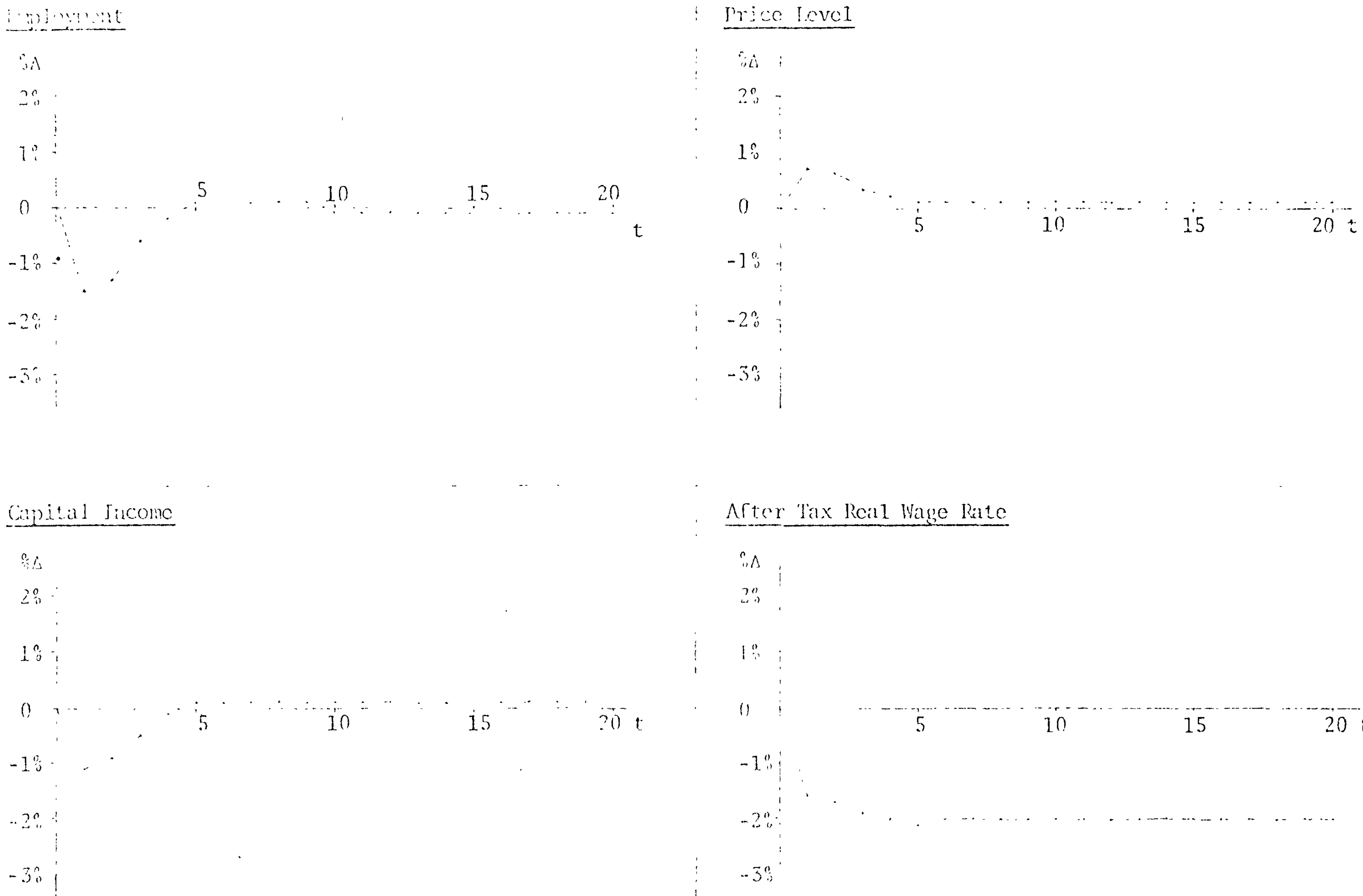


Figure 7.4 Long-Run B/H Case with Mixed Expectations and Balanced U.I. Budget.



The practical importance of this result is that it is not very meaningful to talk of 'forward shifting' of payroll taxes (to consumer prices) in the case where budget surpluses are allowed to develop. Note from the graph that prices do rise a little in the first period, but that thereafter the deflation develops and prices fall continuously. Looking ahead to other results, we should note that this pattern of price changes seems to occur in every case with an unbalanced U.I. budget, and therefore appears to be a general result. (In the case of payroll tax decreases, of course, money financed deficits lead to continuous <u>in</u>flation).

In Figure 7.2 (the long-run B/H case with an unbalanced U.I. budget) a similar pattern of results emerges. Because of the inelastic labour supply function, and just as in the static case, the long-run burden of the tax is borne entirely by labour. However, because of the less than instantaneous adjustment of the wage rate and capital stock etc., there is a period during which both employment and capital income are depressed below the equilibrium level. This is an important result because, as we have argued earlier, the behaviour of analogous variables during the adjustment period is as valid a part of incidence analysis as the final equilibrium values. What is shown here is that once dynamic adjustments are taken into account, then <u>even in the B/H case with inelastic labour supply</u>, it is possible for capital to bear some of the tax burden. As predicted the pattern of price changes in this unbalanced budget case is exactly similar to that in Figure 7.1.

In Figures 7.3 and 7.4 we revert to the same assumption as in the static simulations, that the U.I. budget is balanced at each point in time, with the benefit rate becoming endogenous to achieve this. In the Neoclassical balanced budget case of Figure 7.3, we note that employment and capital income now fall smoothly to their own equilibrium values. Further, that in this case we can speak of 'forward shifting', in that the price level gradually rises to a new higher long-run equilibrium value. In the B/H balanced budget case, labour again bears the long-run burden, but there is still a period in which employment temporarily falls and in which capital shares some of the short-run burden. There is also a temporary phenomenon of forward shifting. The price level initially rises to a new higher value, before falling back to the long-run equilibrium level.

7.14 Alternative Expectations Schemes

As mentioned above, our particular method of specifying the expectations generating mechanisms for inflation (as set out in equation (7.22)) enables us to experiment with alternative expectations schemes by changing the values of the coefficients ε_i. Some examples of the results of this procedure are given in Figures 7.5 through 7.12. Figures 7.5 and 7.6 illustrate the unbalanced budget Neoclassical and B/H cases with a form of adaptive expectations in which $\varepsilon_1 = \varepsilon_2 = 0.5$, and $\varepsilon_3 = 0$, (i.e., the current expected inflation rate is a weighted average of actual and expected inflation rates in the immediate past), while Figures 7.7 and 7.8 show the corresponding balanced budget cases. Figures 7.9 through 7.12, on the other hand, employ a 'perfect foresight' scheme in which the expected inflation rate is equal to the rate of monetary growth, ($\varepsilon_3 = 1.0$, $\varepsilon_1 = \varepsilon_2 = 0$). It is clear that the type of expectations scheme specified makes a good deal of difference to the amplitude of the changes, but that as predicted the underlying

Figure 7.5 Long-Run Neoclassical Case with Adaptive Expectations and Unbalanced U.I. Budget.

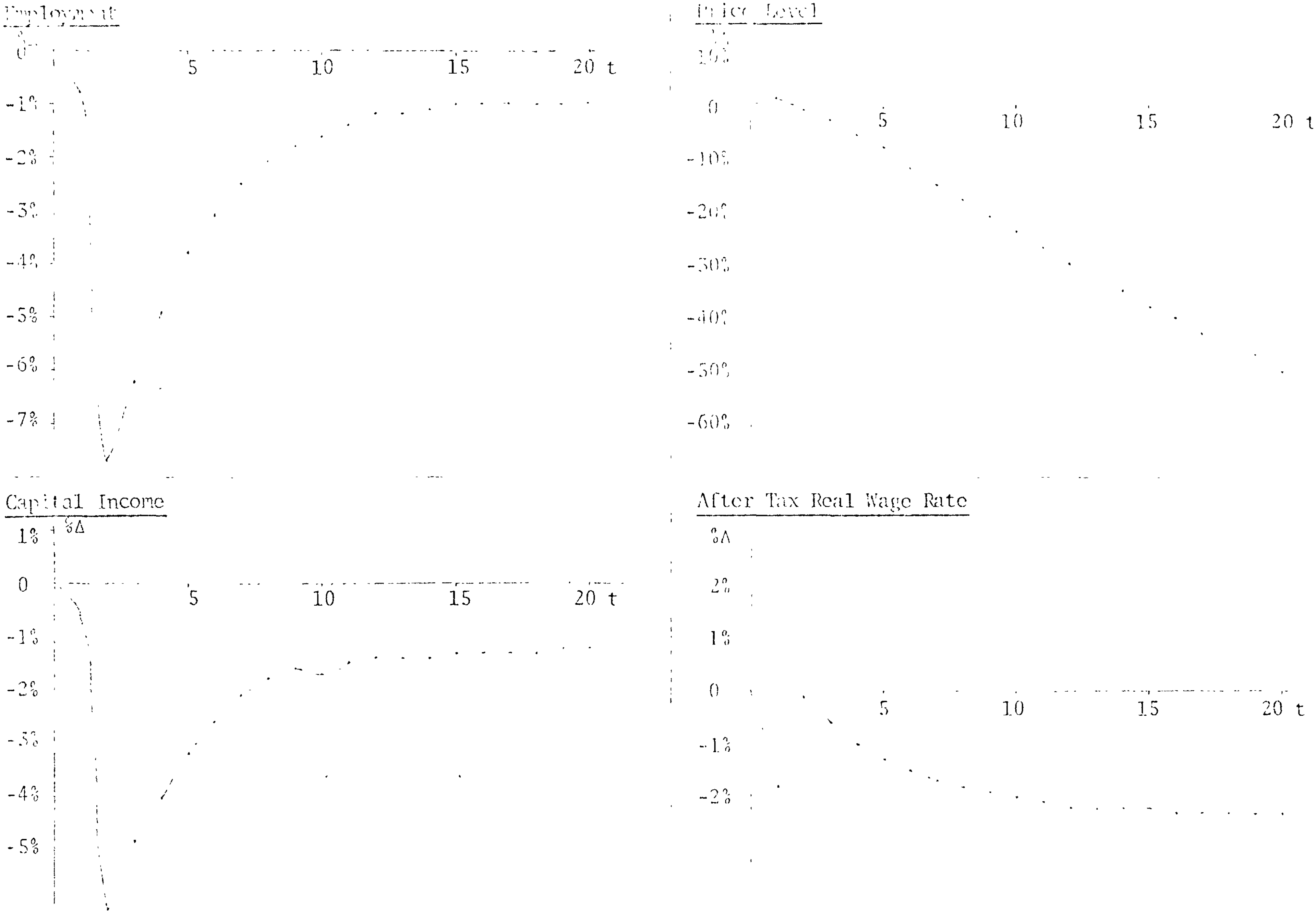


Figure 7.6 Long-Run B/H Case with Adaptive Expectations and Unbalanced U.I. Budget.

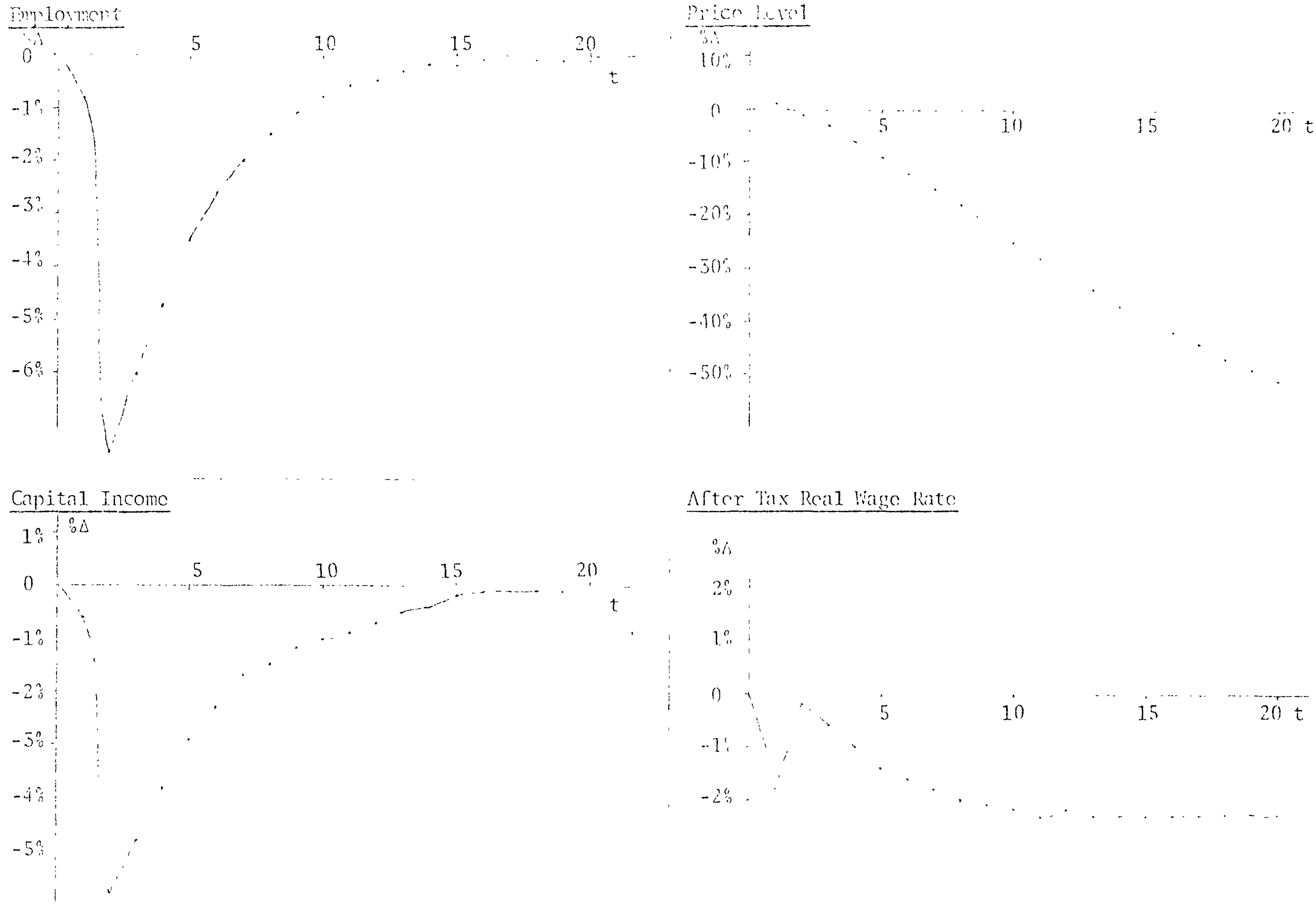


Figure 7.7 Long-Run Neoclassical Case with Adaptive Expectations and Balanced U.I. Budget.

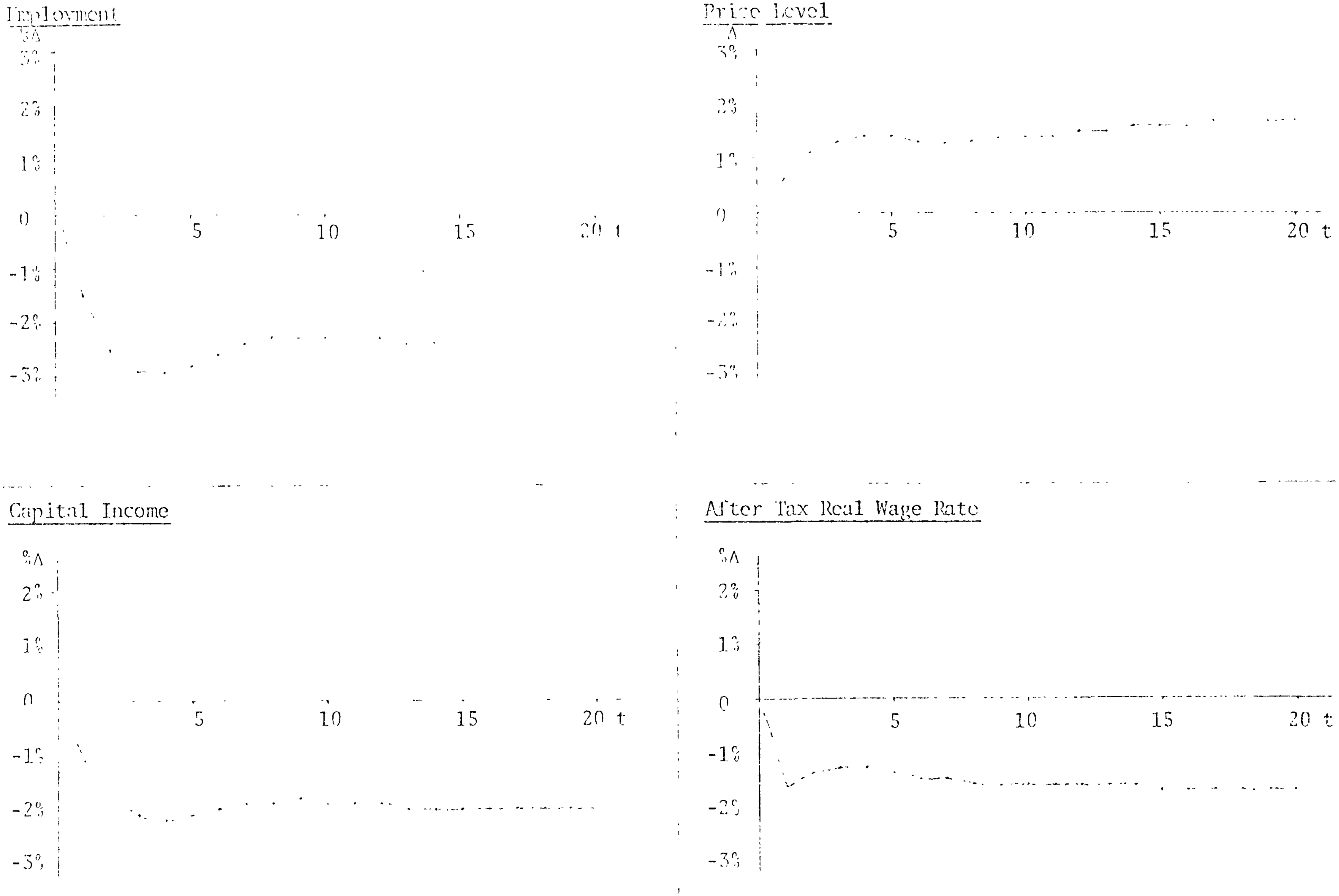


Figure 7.8 Long-Run B/H Case with Adaptive Expectations and Balanced U.I. Budget

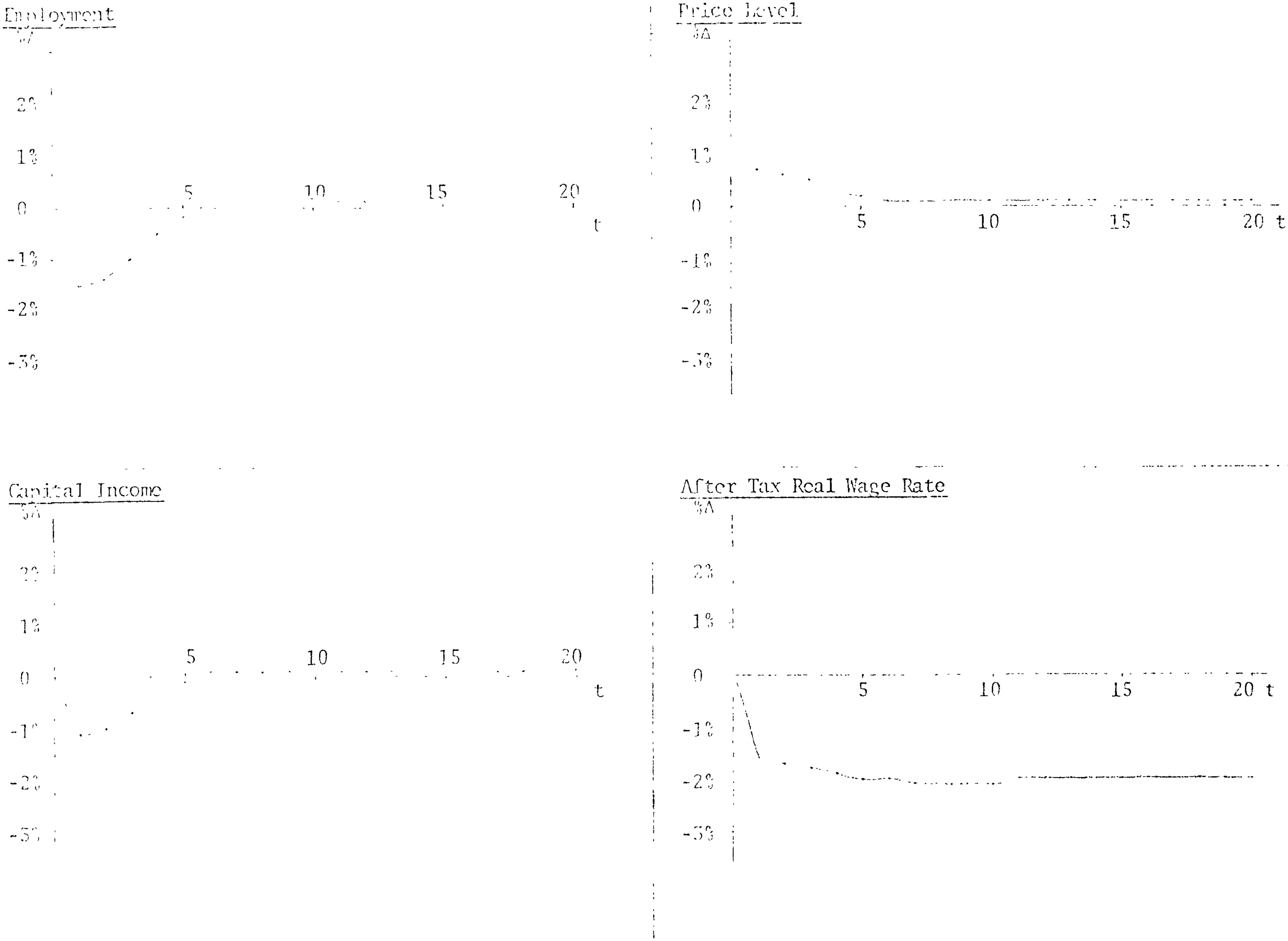


Figure 7.9 Long-Run Neoclassical Case with Perfect Foresight Expectations and Unbalanced U.I. Budget.

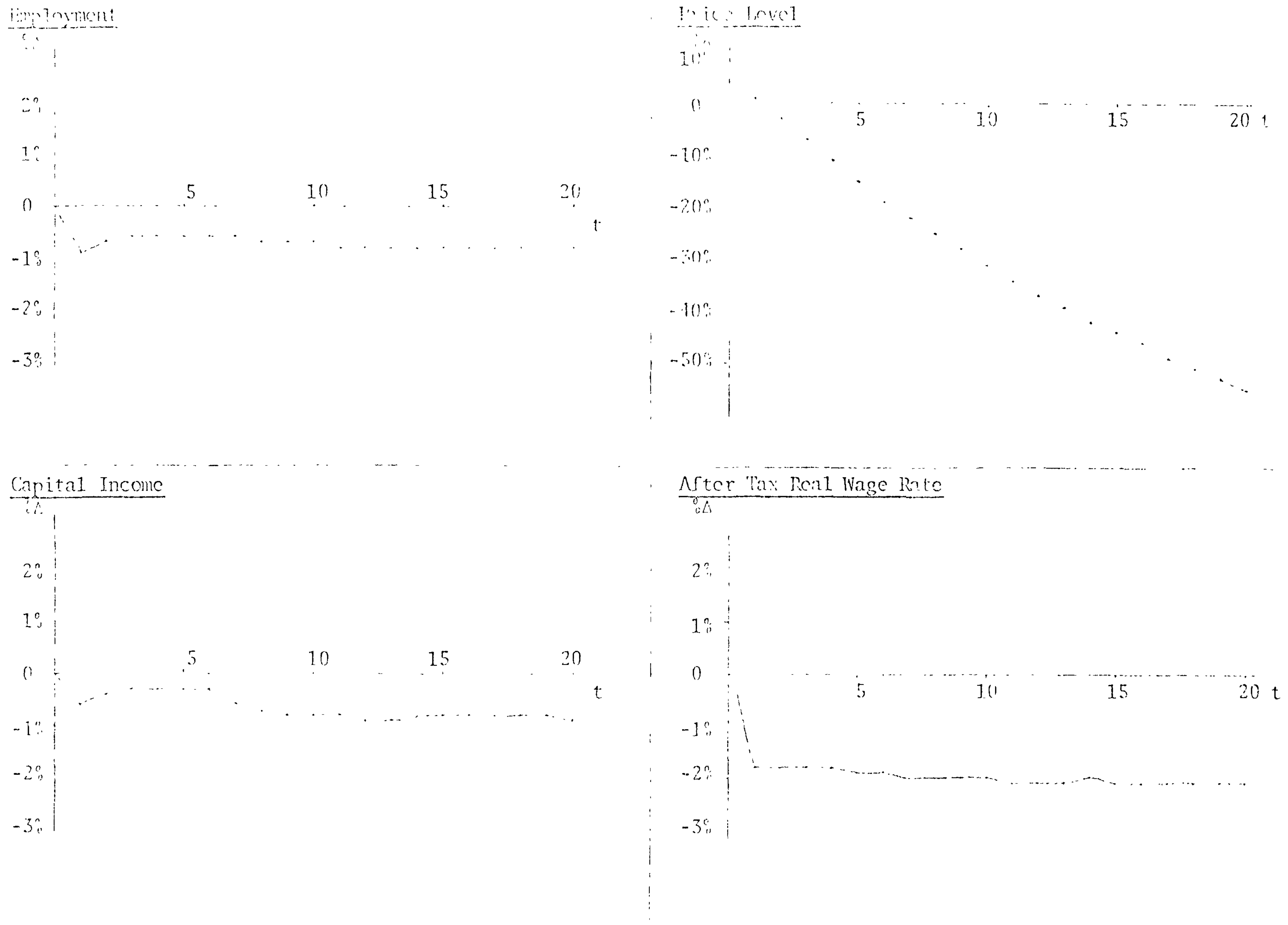


Figure 7.10 Long-Run B/H Case with Perfect Foresight Expectations and Unbalanced U.I. Budget.

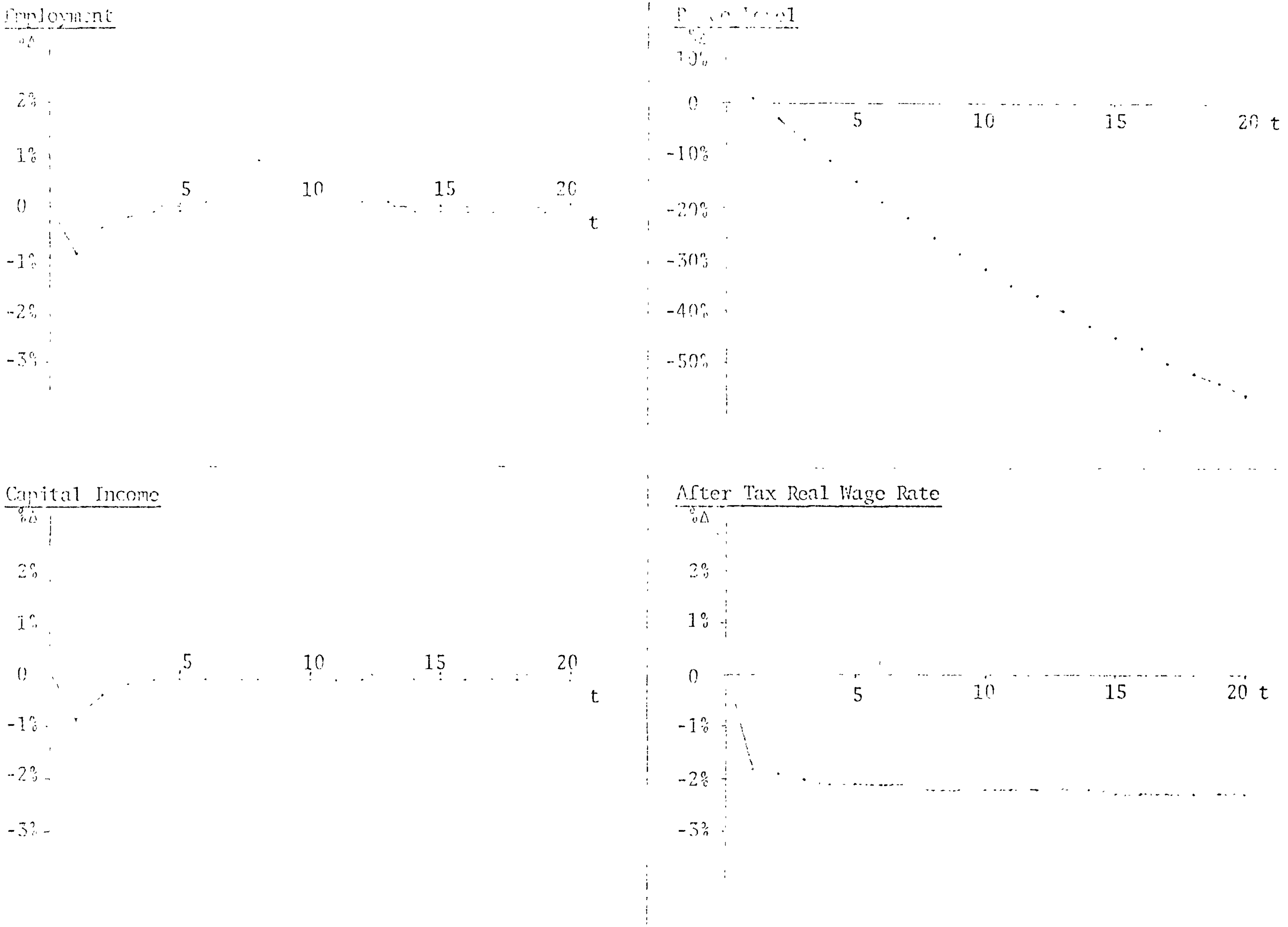


Figure 7.11 Long-Run Neoclassical Case with Perfect Foresight Expectations and Balanced U.I. Budget.

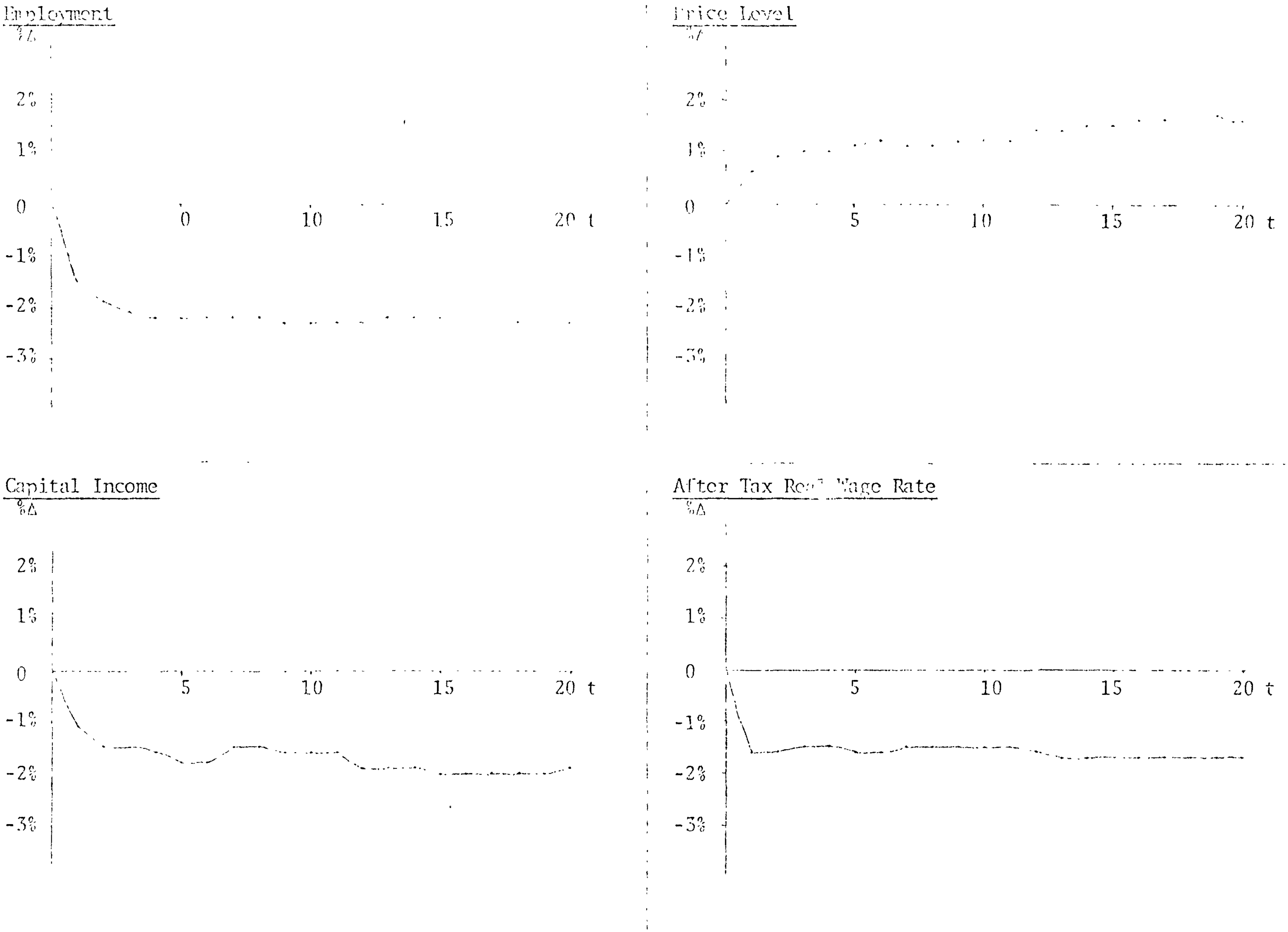
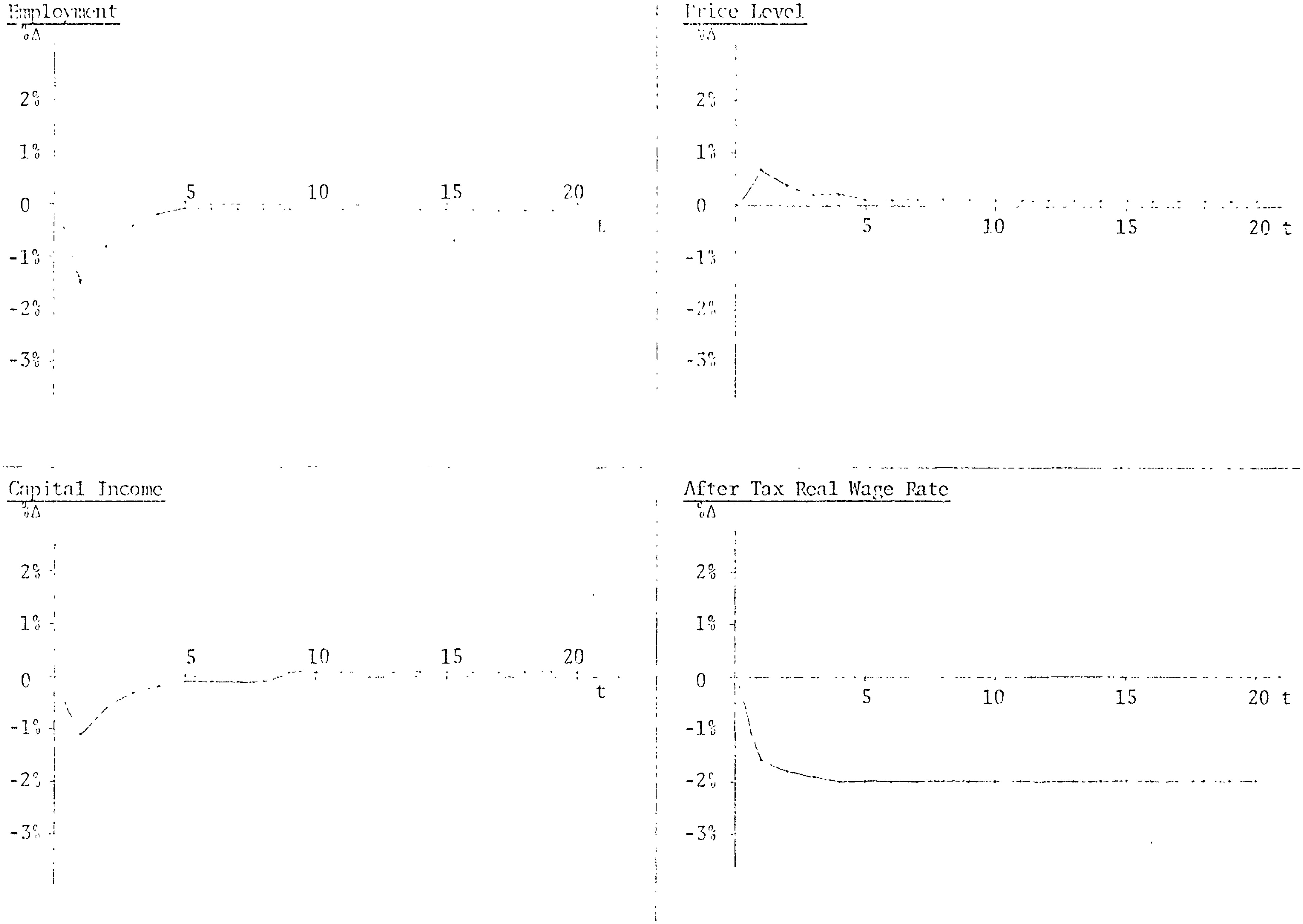


Figure 7.12 Long-Run B/H Case with Perfect Foresight Expectations and Balanced U.I. Budget.



shape of the graphs does not change. For the unbalanced budget changes (absolute incidence) adaptive expectations greatly increases the maximum fall in employment and capital income, to around -7½% and -6% respectively. This is true also in the B/H case. In contrast in the balanced budget cases, Figures 7.7 and 7.8, with adaptive expectations the graphs are quite similar to the mixed expectations cases of Figures 7.3 and 7.4. With perfect foresight expectations amplitudes are greatly reduced, and in the unbalanced budget cases maximum changes in employment and capital income do not reach more than 1%. However we do not have to overturn out general conclusions. It is still true that there is a period during which employment and capital income fall below the eventual equilibrium levels, even in the B/H case. For the balanced budget cases, the results with perfect foresight expectations again look remarkably similar to those in Figures 7.3 and 7.4.

7.15 Cases With Fewer Sources of Dynamics

A number of simulation experiments were tried with fewer sources of dynamics. For example, in some cases the capital stock adjustment equation was dropped, making those cases 'short-run' in the sense that the capital stock would then be constant. Other cases involved wage adjustment dynamics only. Once again, the results corresponded to one or other of the original experiments in Figures 7.1 through 7.4, depending on whether we were dealing with a Neoclassical or B/H case, and a balanced or unbalanced U.I. budget. To illustrate, Figures 7.13 and 7.14 depict 'short-run' Neoclassical and B/H cases with mixed expectations and unbalanced U.I. budgets. In these cases the resemblance to Figures 7.1 and 7.2 is apparent. Finally, in Figures 7.15 and 7.16 we have

Neoclassical and B/H cases with wage dynamics only. These must be balanced budget cases, of course, as money financed deficits or surpluses are ruled out by assumption. As stated the results are similar to those in Figures 7.3 and 7.4.

7.16 Other Sensitivity Tests for the Dynamic Simulations

In addition to the cases reported and illustrated above a number of other sensitivity tests have been carried out in the context of the dynamic simulations. These have involved:

(i) Different values for various parameters, including higher and lower values of s (e.g., $s = 0.1$ and $s = 0.2$), a lower value of δ (e.g. $\delta = 0.025$), and 'faster'adjustment coefficients (e.g. $\lambda = 0.2$ and $\gamma = 0.6$).

(ii) Different weights in the mixed and adaptive expectations schemes, (i.e., different values of the ε_i).

(iii) Different specifications of the demand for money function, including a 'quantity theory' specification on the one hand, and a specification in which the demand for real balances depends on the rate of inflation, on the other.

(iv) Various combinations of the above.

In general the results of the various experiments confirmed what was stated in Section 7.13 above, that changes in parameter values do 'change precise magnitudes and lengthen or shorten lags', but that the underlying shapes of the graphs do not change.

Figure 7.15 Short-Run Neoclassical Case with Mixed Expectations and Unbalanced U.I. Budget.

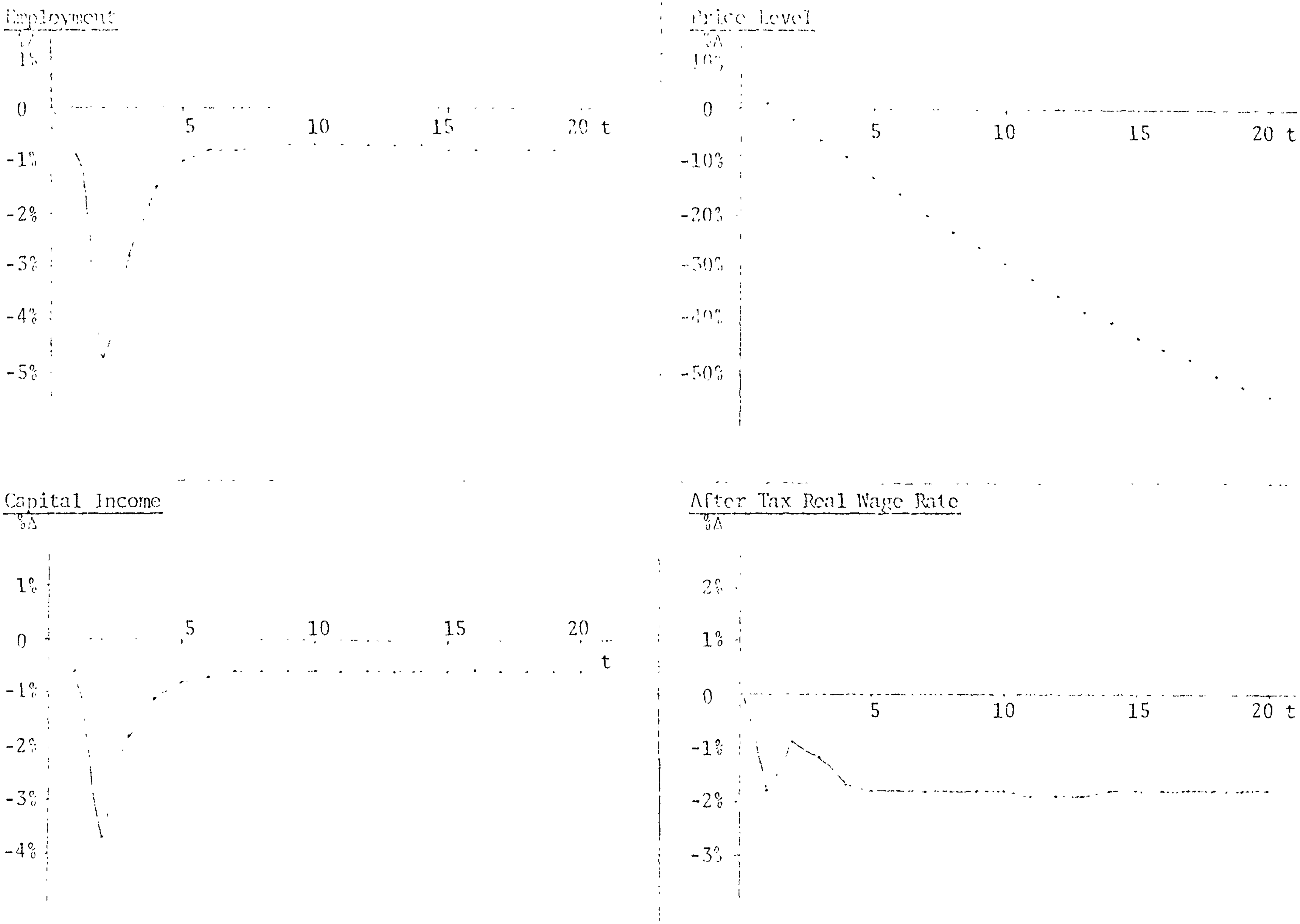


Figure 7.14 Short-Run B/H Case with Mixed Expectations and Unbalanced U.I. Budget.

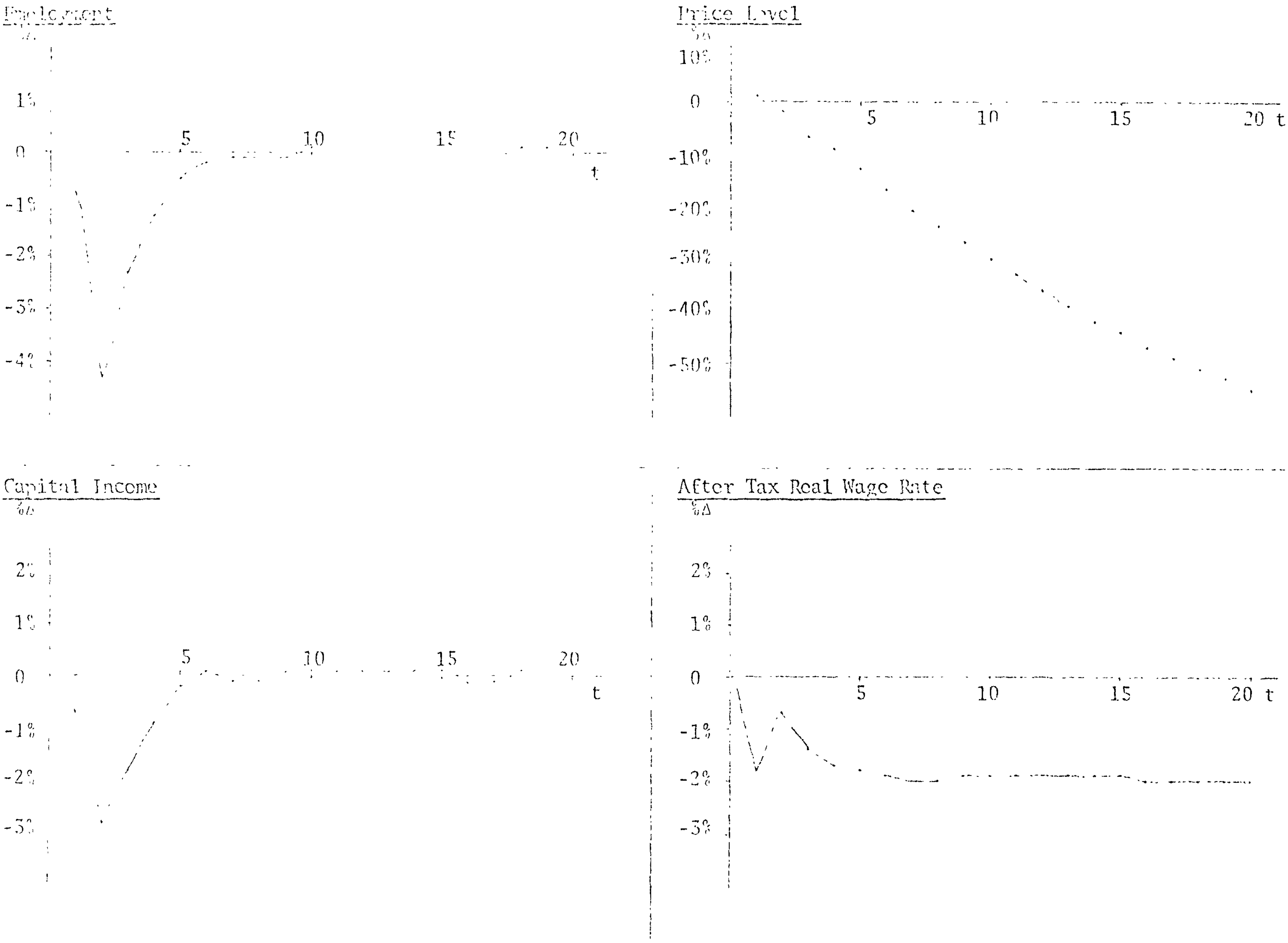


Figure 7.15 Neoclassical Case with Wage Dynamics Only.

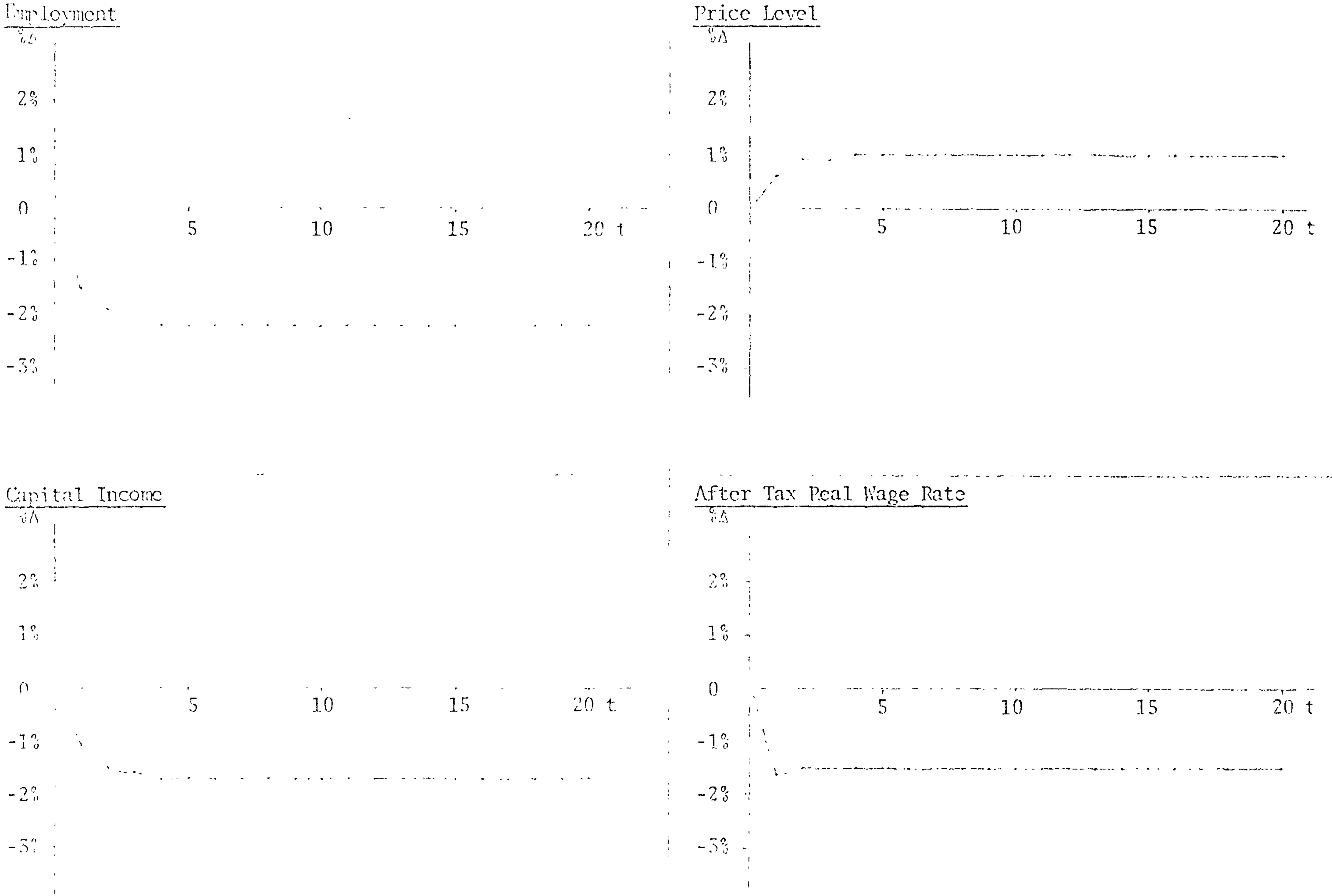
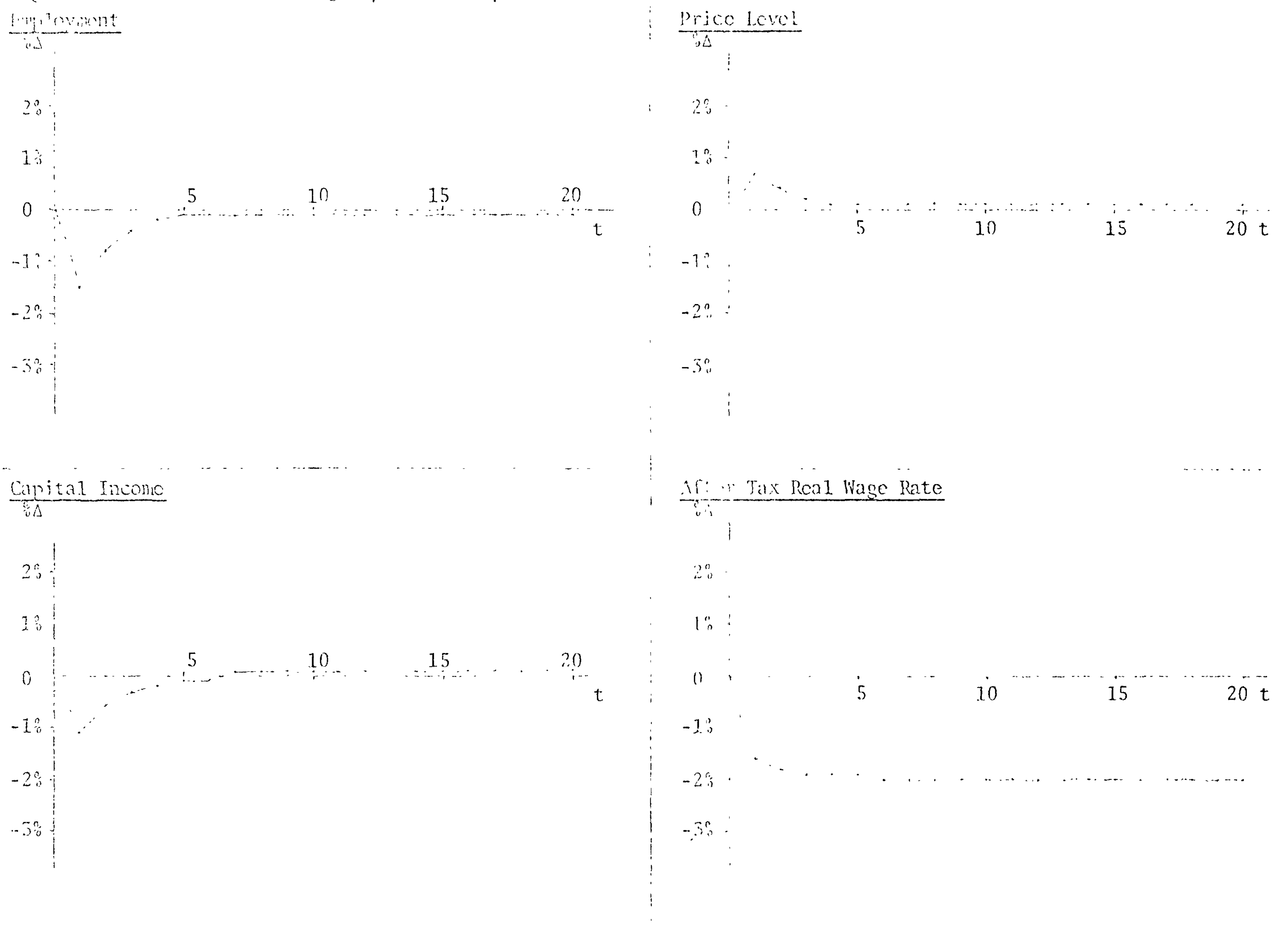


Figure 7.16 B/H Case with Wage Dynamics Only.



7.17 Concluding Remarks

In this chapter we have reported the results of selected static and dynamic simulation experiments. The static results supplement the qualitative analysis of Chapter 6 in three ways, (a) by providing numerical estimates as well as the signs of the comparative static multipliers, (b) by dealing with long-run cases, in which the capital stock is endogenous, as well as short-run cases, and (c) by resolving some of the sign ambiguities of Chapter 6 for plausible parameter values. With regard to the latter topic, we have established the ranges of parameter values which would give rise to so-called 'perverse' results. Our initial choice of parameter values made perverse results unlikely, but it is clear that there is a need for more empirical evidence in this area.

In the dynamic experiments we have examined, alternatively, (a) balanced budget cases, in which we retain the assumption that the U.I. budget is balanced at each point in time, and (b) unbalanced budget cases, in which the benefit rate is tied to the money wage rate and budget deficits or surpluses are allowed to develop. We have taken the view that the dynamic behaviour of the endogenous variables during the adjustment of the new equilibrium is an important aspect of incidence analysis in its own right. The results in the balanced budget cases tend to conform to those of the static simulations as far as the final equilibrium solution is concerned. However, because of lags in the adjustment process, it does take a few periods for the equilibrium solution to be reached. In the B/H versions the adjustment lags produce the important result that there will be a short period in which employment and capital income fall, and the price level rises, even though labour bears the full burden in the long-run. In the unbalanced budget cases we note that there is a tendency for endogenous variables to overshoot their long-run equilibrium values during the adjustment process. That is, there will be a period in which employment and capital income will be lower than they eventually will be, and the real wage rate will be higher, etc. This occurs in both the Neo-classical and B/H versions, the latter result confirming that of the balanced budget B/H cases that the labour burden does not hold in the short-run. Another result in the unbalanced budget cases is that whereas real variables do eventually converge to new equilibrium values, nominal variables do not. A tax increase, for example, will provoke a continuing budget surplus, and hence a continuing deflation. This implies that it is meaningless to talk of 'forward shifting' of taxes (to higher consumer prices) in this context.

We have experimented with various methods of generating price expectations. In the unbalanced budget cases, the main impact of different expectations schemes was on the amplitude of the 'overshooting' described above. An adaptive scheme tends to make the temporary changes much larger, while the so-called 'perfect foresight' scheme (in which the expected inflation rate is equal to the rate of monetary growth) makes them much smaller. In no case, however, did the overshooting disappear, and the underlying shapes of the graphs remained the same. In the balanced budget cases, the nature of the expectations generating scheme did not appear to make much difference. Presumably this is because the balanced budget assumption does not allow inflations or deflations to develop.

In both the static and dynamic cases sensitivity tests with different parameter values and/or different dynamic structures tend to confirm the general pattern of the above results while naturally causing differences in the precise magnitudes of the changes.

FOOTNOTES TO CHAPTER 7

[1]The constant elasticity form is specified throughout, in order to facilitate the use of estimated elasticities from the econometric literature. In a functional relationship of the form $y = k^x$, x is the elasticity of y with respect to k. I.e.,

$$\eta_{yk} = \frac{dy}{dk} \cdot \frac{k}{y} = xk^{x-1}ky^{-1} = x .$$

[2]It should be noted that our specification of the dynamic model does not allow the expected rate of inflation to impinge upon the demand for real balances via the nominal interest rate. The demand for real balances continues to be a function of the real rather than the nominal interest rate. This procedure has the advantage that it obviates the well-known convergence problems which emerge in the presence of the conventional specification, particularly under adaptive expectations. (See e.g., Cagan (1956) and B. Friedman (1975) for discussion of these issues.) Our specification can be defended on a number of grounds. See, for example, the argument by Smithin (1980) that it is the appropriate theoretical specification in models which are assumed to converge to a steady state. In this context, however, it is preferable to defend equation (7.5) by an appeal to the commonsense notion that in practice in the 'real world', the relevant measure of the real money supply is effectively indexed against inflation. By making the demand for real balances depend upon the real rather than the nominal interest rate we imply that some kind of 'interest rate' is paid on nominal balances which itself varies one-for-one with the rate of inflation. But in the 'real world' this conditions does seem to be fulfilled for broader definitions of the money supply which include time (savings) deposits at the chartered banks. If savings deposits are taken into account, a large portion of the money supply is indexed in the sense that it carries an interest rate which tends to vary directly with other nominal rates and hence with the rate of inflation. Under these circumstances it will be the composition of total real balances which will change when the rate of inflation changes rather than the total itself. The latter will vary only if the differential between the rate of return on physical and monetary assets changes (i.e., if there are changes in the real rate of interest).

[3]Recall that N = XH. Differentiating with respect to W would therefore give:

$$\frac{\partial N}{\partial W} = H\,\frac{\partial X}{\partial W} + X\,\frac{\partial H}{\partial W} .$$

Now multiply through by W, and divide through by N:

$$\frac{\partial N}{\partial W} \cdot \frac{W}{N} = \frac{WH}{N} \cdot \frac{\partial X}{\partial W} + \frac{WX}{N} \cdot \frac{\partial H}{\partial W}$$

But N = XH, therefore:

$$\frac{\partial N}{\partial W} \cdot \frac{W}{N} = \frac{W}{X} \cdot \frac{\partial X}{\partial W} + \frac{W}{H} \cdot \frac{\partial H}{\partial W}$$

or:

$$\eta_{NW} = \eta_{XW} + \eta_{HW}$$

[4]Negative income tax.

[5]Fullerton argues that 'median money income of male employed civilians has consistently been twice that of females' (1980, p. 19), and appears to use this as a justification that the male elasticity should have a greater weight in the aggregate labour supply elasticity than mere numbers in the labour force would allow. However, this reasoning does not appear to be correct. To illustrate let there be two types of workers in the labour force, primary workers, P, and secondary workers, S. Let N be total weeks worked, N_p be weeks worked by primary workers, and N_S be weeks worked by secondary workers. Further let W, the basic wage applicable to secondary workers, be consistently k times the basic wage rate, W* = kW. By definition:

$$N = N_p + N_S$$

And differentiating with respect to the basic wage rate:

$$\frac{\partial N}{\partial W} = \frac{\partial N_p}{\partial W^*} \cdot \frac{\partial W^*}{\partial W} + \frac{\partial N_S}{\partial W}$$

Or,

$$\frac{\partial N}{\partial W} = \frac{\partial N_p}{\partial W^*} \cdot k + \frac{\partial N_S}{\partial W}$$

Multiplying through by W, and divided through by N:

$$\frac{\partial N}{\partial W} \cdot \frac{W}{N} = \frac{\partial N_p}{\partial W^*} \cdot \frac{W^*}{N} + \frac{\partial N_S}{\partial W} \cdot \frac{W}{N}$$

And, finally, multiplying the first and second terms on the L.H.S. by N_p/N_p and N_S/N_S respectively:

$$\frac{\partial N}{\partial W} \cdot \frac{W}{N} = \frac{\partial N_p}{\partial W^*} \cdot \frac{W^*}{N_p} \cdot \frac{N_p}{N} + \frac{\partial N_S}{\partial W} \cdot \frac{W}{N_S} \cdot \frac{N_S}{N}$$

Or,

$$\eta_{NW} = \eta_{N_p W^*} \cdot \frac{N_p}{N} + \eta_{N_S W} \cdot \frac{N_S}{N}$$

In other words, strictly speaking it is the proportions of the number of weeks worked by males and females (to total weeks) that are the correct weights. Presumably 'numbers in the labour force' is a better proxy for this than incomes.

[6]Presumably the argument must be that those male groups with higher labour supply elasticities (e.g., the elderly and teenagers) offset the zero or negative elasticities of prime age males.

[7]The hours elasticity is calculated by two alternative methods, giving slightly different results.

[8]Note that the participation elasticities reported in the literature are always with respect to the participation rate, not the number of participants as in our specification. However, this will cause no difficulties as the elasticity is the same in either case. To illustrate, let X* be the number of available workers, X be the number who participate, and W be the wage rate. The participation rate elasticity is:

$$\eta_{X/X^*,W} = \frac{\partial(X/X^*)}{\partial W} \cdot \frac{W}{X/X^*} = \left(\frac{X^*(\partial X/\partial W)-0}{X^{*2}}\right) \cdot \frac{W}{X/X^*}$$

$$= \left(\frac{\partial X}{\partial W} \cdot \frac{1}{X^*}\right) \cdot \left(\frac{W}{1} \cdot \frac{X^*}{X}\right) = \frac{\partial X}{\partial W} \cdot \frac{W}{X} .$$

But $\frac{\partial X}{\partial W} \cdot \frac{W}{X}$ is the 'number of participants' elasticity or η_{XW}. Therefore:

$$\eta_{X/X^*,W} = \eta_{XW} . \qquad \text{Q.E.D.}$$

[9]In the TEMS programme, some allowance must be made for rounding errors as the print-out only reports values to three decimal places.

[10]This does not necessarily imply that the transfer is unjustified, (particularly in the case of genuine involuntary unemployment), only that it bears some cost.

APPENDIX TO CHAPTER 7

7A.1 Lists of Variables and Parameters, Fortran Codings, and Initial Specifications

Using the TEMS (Toronto Econometric Model Solution Program) computer package, as adapted for use at McMaster University, the various equations in the simulation models must be coded in Fortran. Current values of variables are assigned unique element numbers in consecutive order in a vector X, and parameters are similarly assigned to vector Z. Lagged values of variables (not used in the static solutions) are assigned to matrix Y. In Y, the column number n represents the value of the lag t-n, and the row number corresponds to the variable number in X. Symbols X, Y, Z, as used in the Fortran coding, should not be confused with those used coincidentally in the original equations. There follows a complete list of variables and parameters with variable names, Fortran codings, and initial specifications, as used in both the static and dynamic models:

Z	= NGCINC	= Nominal gross capital income	= X(1)	= 14412.967
P	= GPL	= General price level	= X(2)	= 1.784
Q	= OUTP	= Real output	= X(3)	= 32325.445
W	= NOMWG	= Nominal wage	= X(4)	= 4.815
N	= EMPL	= Employment	= X(5)	= 8895.052
Ig	= RGINV	= Real gross investment	= X(6)	= 4848.635
UB	= TBEN	= Total U.I. benefits paid	= X(7)	= 856.468
K	= CAPT	= Capital Stock	= X(8)	= 96972.706
r	= INTR	= Interest rate	= X(9)	= 0.033
U	= UNEMP	= Unemployment	= X(10)	= 1603.478
X	= PART	= Number of participants	= X(11)	= 201.887

H	= ACTWK	= Actual weeks supplied	= X(12) =	44.060
θ	= SCMP	= U.I. scheme chracteristics parameter	= X(13) =	1.600
	ATRW	= After-tax real wage rate	= X(14) =	2.672
	ATRWB	= After-tax real wage bill	= X(15) =	23764.677
	RGCINC	= Real gross capital income	= X(16) =	8078.331
	RPYTB	= Real payroll tax bill	= X(17) =	480.094
	URTE	= Unemployment rate	= X(18) =	15.274
b	= BENR	= Benefit rate	= X(19) =	0.534
M	= MONY	= Nominal money stock	= X(20) =	20000.0
H^*	= MAXWK	= Maximum weeks available	= X(21) =	52.0
In	= NTINV	= Real net investment	= X(22) =	0.001
K_{+1}	= CAPLD	= Capital stock next period	= X(23) =	96972.706
W_{+1}	= WGLD	= Nominal wage rate next period	= X(24) =	4.815
M_{+1}	= MYLD	= Money stock next period	= X(25) =	20000.0
π	= EXINF	= Expected inflation rate	= X(26) =	0.001

<u>Parameters</u>

tw	= Payroll tax rate	= Z(1) =	0.01
$\bar{H}$	= Qualifying period for U.I.	= Z(2) =	20.00
s	= Average propensity to save	= Z(3) =	0.15
δ	= Depreciation rate	= Z(4) =	0.05
D	= Shift parameter in money demand function	= Z(5) =	0.125
L_1	= Income elasticity of money demand	= Z(6) =	1.0
L_2	= (Absolute value of) interest elasticity of money demand	= Z(7) =	0.3
Φ	= Shift parameter in production function	= Z(8) =	2.0
α	= Output elasticity of capital inputs	= Z(9) =	0.25
β	= Output elasticity of labour inputs	= Z(10) =	0.75

A	= Shift parameter in participation equation	= Z(11) =	180.0
a	= Participation elasticity	= Z(12) =	0.1
C	= Shift parameter in weeks supplied equation	= Z(13) =	34.0
c	= Weeks supplied elasticity	= Z(14) =	0.3
λ	= Adjustment coefficient in capital stock adjustment equation	= Z(15) =	0.125
γ	= Adjustment coefficient in Phillips Curve	= Z(16) =	0.3
ψ	= Benefit rate/wage ratio in dynamic case	= Z(17) =	0.110
ε_1	= Weight in expectations generating scheme	= Z(18) =	0.5

7A.2 Preparing the Models for Simulation Experiments

In order to prepare the models for solution in TEMS the equations are rearranged such that for each endogenous variable in the system, a single equation appears normalised on that variable. No exogenous variable should appear on the L.H.S. of any equation. The equations are specified in three subroutines, S1M1, S1M2, and S1M3. S1M1 solves those equations which are not part of the simultaneous system. S1M2 solves those equations which must be solved simultaneously, and S1M3 solves equations in which L.H.S. variables do not appear in S1M1 or S1M2. After normalisation and Fortran coding, the model is ready for solution.
We will illustrate in the case of the dynamic model with an adaptive expectations scheme. The normalised equations are as follows:

S1M1

(7A.1) $$\theta = \frac{H^* - \bar{H}}{\bar{H}}$$

(7A.2) $$K = (K_{+1})_{-1}$$

(7A.3) $$W = (W_{+1})_{-1}$$

(7A.4) $M = (M_{+1})_{-1}$

SIM2

(7A.5) $Z = PQ - (1-tw)WN - 2twWN$

(7A.6) $Ig = \frac{s(Z+(1-tw)WN + UB)}{P}$

(7A.7) $In = Ig - \delta K$

(7A.8) $K_{+1} = K + In$

(7A.9) $P = \frac{Mr^{L_2}}{DQ^{L_1}}$

(7A.10) $UB = bU$

(7A.11) $M_{+1} = M + (UB - 2twWN)$

(7A.12) $Q = \Phi K^{\alpha} N^{\beta}$

(7A.13) $N = \frac{P\beta Q}{(1+tw)N}$

(7A.14) $r = (\frac{\lambda\alpha Q}{K_{+1} - (1-\lambda)K}) - \delta$

(7A.15) $b = \psi W$

(7A.16) $U = XH^{*} - N$

(7A.17) $W_{+1} = \gamma W\ (\frac{N-XH}{XH}) + (1+\pi)W$

(7A.18) $\pi = \varepsilon_1(\frac{P-P_{-1}}{P_{-1}}) + (1-\varepsilon_1)\ \pi_{-1}$

(7A.19) $X = A(\frac{W(1-tw)+\theta b}{P})^{a}$

(7A.20) $H = C\left(\frac{W(1-tw)-b}{P}\right)^{c}$

SIM3

(7A.21) $ATRW = \frac{(1-tw)W}{P}$

(7A.22) $ATRWB = \frac{(1-tw)WN}{P}$

(7A.23) $RGCINC = \frac{Z}{P}$

(7A.24) $RPYTB = \frac{2twWN}{P}$

(7A.25) $URTE = \left(\frac{U}{H*X}\right)100$

In Fortran coding, using the assignments to vectors X and Z and to matrix Y described above, the model becomes:

SIM1

(7A.26) X(13) = (X(21) - Z(21))/Z(2)

(7A.27) X(8) = Y(1,23)

(7A.28) X(4) = Y(1,24)

(7A.29) X(20) = Y(1,25)

SIM2

(7A.30) X(1) = X(2)*X(3)-(1-Z(1))*X(4)*X(5)-2*Z(1)*X(4)*X(5)

(7A.31) X(6) = (Z(3)*(X(1)+(1-Z(1))*X(4)*X(5)+X(7)))/X(2)

(7A.32) X(22) = X(6) - Z(4)*X(8)

(7A.33) X(23) = X(8)+X(22)

(7A.34) X(2) = (X(20)*X(9)**Z(7))/(Z(5)*X(3)**Z(6))

(7A.35) X(7) = X(19)*X(10)

(7A.36) X(25) = X(20)+(X(7)-2*Z(1)*X(4)*X(5))

(7A.37) X(3) = Z(8)*X(8)**Z(9)*X(5)**Z(10)

(7A.38) X(5) = (X(2)*Z(10*X(3))/((1+Z(1))*X(4))

(7A.39) X(9) = (Z(15)*Z(9)*X(3))/(X(23)-(1-Z(15))*X(8))-Z(4)

(7A.40) X(19) = Z(17)*X(4)

(7A.41) X(10) = X(11)*X(21)-X(5)

(7A.42) X(24) = Z(16)*X(4)*((X(5)-X(11)*X(12))/X(11)*X(12))+(1+X(26))*X(4)

(7A.43) X(26) = Z(18)*((X(20)-Y(1,2))+(1-Z(18))*Y(1,26)

(7A.44) X(11) = Z(11)*((X(4)*(1-Z(1))+X(13)*X(19)/X(2))**Z(12)

(7A.45) X(12) = Z(13)*((X(4)*(1-Z(1))-X(19))/X(2))**Z(14)

<u>SIM3</u>

(7A.46) X(14) = ((1-Z(1))*X(4))/X(2)

(7A.47) X(15) = ((1-Z(1))*X(4)*X(5))/Z(2)

(7A.48) X(16) = X(1)/X(2)

(7A.49) X(17) = (2*Z(1)*X(4)*X(5))/X(2)

(7A.50) X(18) = (X(10)/(X(21)*X(11))*100

CHAPTER 8

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

8.1 Conclusions

At this stage we may recall Hamermesh's complaint (quoted in Chapter 1 above) about the lack of an appropriate theoretical framework for the discussion of U.I. tax incidence. The main aim of this study has been to provide such a framework. In cases where U.I. coverage is reasonably comprehensive, and the U.I. tax can be regarded as a broad-based tax, it has been argued that the proper engine of analysis is basically the standard macroeconomic general equilibrium model. If this standard framework is regarded as being appropriate in discussions of macroeconomics per se, there is no reason why it should not also be employed to analyse public finance issues, at least where broad-based taxes are involved. The macroeconomic effects of taxation, whether they originate from the demand or supply side, are as much a part of incidence analysis as the purely distributional aspects. In fact, the macro changes have very definite feedback effects on the distribution of income, and cannot legitimately be ignored. This position is the antithesis of what may be called the 'Musgravian' view of incidence analysis, in which changes in relative factor prices are studied in a context in which the macroeconomic effects of taxation are assumed away.

In the particular case of U.I. tax incidence we do require one major modification of the standard framework, a more detailed development of the aggregate labour supply function. This reflects the view that the most important macroeconomic effects of unemployment insurance are likely to emerge from the supply side, via work incentives. In our model, aggregate labour supply is the product of separate 'participation' and 'weeks given participation' functions.

The incidence results depend largely on the effect of payroll tax changes on labour supply. We may take it that payroll tax increases themselves will have a negative impact on both the participation and weeks functions, but tax and benefit rates are connected via the U.I. budget, and benefit rate changes will also have their impact on labour supply. An increase in the benefit rate will tend to reduce average weeks worked by participants but to increase participation itself. The upshot is that a balanced budget increase in payroll tax rates has a potentially ambiguous effect on labour supply. In this study, we have attempted to reduce this ambiguity to some extent. On the basis of the qualitative analysis of Chapter 6 combined with the simulation exercises of Chapter 7 we were able to identify the crucial parameter values. It transpired that given the original parameter values chosen in Chapter 7 (which were regarded as 'plausible') the net impact on labour supply would, after all, be negative. In these circumstances, our diagram in Figure 6.3 above will provide a reasonable illustration of U.I. tax incidence. A balanced budget increase in the U.I. payroll tax will reduce output and employment, increase the general price level (there will be some 'forward shifting'), and reduce both the after-tax real wage rate and real capital income. In terms of the traditional incidence categories, the burden of taxation is shared by both capital and labour, and also by any groups (such as old-age pensioners) who receive incomes fixed in money terms. For 'unbalanced' budget changes similar results hold for the effects on output, employment, and factor incomes. However, where perpetual budget surpluses lead to perpetual deflation, we must rule out the possibility of forward shifting.

Of course, the possibility of perverse results cannot be ruled out theoretically. These might arise in two specific cases, (i) via the supply side, when the participation effect dominates and there is an increase rather than a reduction in labour supply, and (ii) via the demand side, when the aggregate demand effects of differential savings propensities are sufficiently strong in the short-run. However, as stated, if our original parameter specifications are accepted as reasonable these perverse results will not be likely to occur. Furthermore, to set against the possibility of perverse results we have seen that short-run imperfections in the labour market, such as money wage rigidity or real wage resistance, tend to reinforce the standard results.

Our conclusions conflict with the traditional 'labour burden conclusion' of payroll tax incidence, but as we have seen this view depends heavily on the assumed inelasticity of the aggregate labour supply function. The review of the labour supply literature in Chapter 7 would certainly cast doubt on this position, as do the findings of the various studies on insurance-induced unemployment. In addition, the empirical evidence which apparently supports the labour burden conclusion rests on a mistaken interpretation of a key parameter.[1] The point is that once allowance is made for the complications caused by a variable labour supply, the simplistic solution that labour bears the full tax burden is unlikely to stand.

8.2 Suggestions for Further Research

The ultimate desiderata must naturally be empirical vertification of the various propositions advanced here. For the reasons we have discussed, this would necessarily be in the context of a full-blown general equilibrium model, and it is easy to agree with Hamermesh's pessimism on the prospects for a successful completion of such an exercise at this point. We have taken the view that a thorough discussion of the theoretical issues, together with the type of simulation exercises performed in Chapter 7, would certainly advanced knowledge in this area.

The most fruitful line of empirical research at this stage would appear to be further partial equilibrium investigation of the labour supply response to the various U.I. parameters. As has been emphasised, the general equilibrium results do depend in very large part on the nature of the labour supply response to tax and benefit rate changes. As was pointed out in the discussion of Chapter 7, section 7.10, the most pressing need would appear to be for reliable estimates of <u>separate</u> weeks and participation elasticities in an <u>aggregate</u> labour supply function. Our choices for the values of aggregate weeks and participation elasticities in the simulation exercises were the most crucial, and at the same time possibly the most vulnerable of all of the parameter specifications. In the absence of other evidence the aggregate values were based on empirical evidence for a particular subset of the working population, in combination with a more or less arbitrary weighting procedure. Direct evidence on the relevant parameter magnitudes would do much more to resolve the remaining ambiguities. We have commented on one empirical methodology in which the parameters of the demand for labour function are estimated, taking labour supply for granted. It would seem much more reasonable, given the importance of the labour supply question, to concentrate on labour supply, taking labour demand for granted. The work on insurance-induced unemployment (reviewed in Chapter 5), obviously has some bearing on this issue, but leaves something to be desired in terms of the particular focus of this study. What is required is direct estimates of the effect of taxes,[2] benefit rates (not the benefit/wage ratio), and the qualifying period on participation, together with separate estimates of the effect of taxes and benefit rates on hours or weeks supplied. Such estimates would still not enable researchers to fully answer general equilibrium incidence questions, but would represent an advance over what is currently available.

In terms of theory, and as mentioned in Chapter 6 above, a further useful exercise would be to work out similar results in the open-economy context, in models which incorporate recent developments in open-economy macroeconomics. For countries with very open economies our closed economy results should be regarded only as a first step.

Finally, and also as has been mentioned at various points above, although the models developed here were primarily intended to address the tax incidence question, they may quite easily be adapted to investigate the effects of changes in other key U.I. parameters. For example, we may be interested in the effects of increases in the benefit rate with endogenous tax rates (in the balanced budget cases), increases in the benefit/wage ratio (in unbalanced budget cases), or even of changes in the qualifying period. These issues are, of course, very similar to those which have been debated in the literature on insurance-induced unemployment, and our model may be able to throw new light on them. We have not pursued this line of inquiry here, but it remains a possibility for future research.

FOOTNOTES TO CHAPTER 8

[1]Recall the view that empirical work like Brittain's has simply established the parameters of the aggregate demand for labour function. (See the discussion in Chapter 5 above.)

[2]A serious problem in obtaining such estimates in Canada is the lack of variation of the payroll tax series in practice. The fact that a tax rate has not varied much does not make it any less of burden, but it does make the empirical investigation of that burden extremely difficult.

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