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FH-ORANI: A FISCAL ORANI WITH HORRIDGE EXTENSION

by

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ABSTRACT

This paper describes FH-ORANI, an extended version of the ORANI model that includes a full accounting of all government revenues and expenditures, consolidated across commonwealth, state and local levels of government. A feature of the revenue side is that provision is made for progressivity in direct taxes on labour income. On the expenditure side, spending on unemployment benefits and other kinds of transfer payment depends explicitly on the number of people employed, unemployed or not in the workforce. A theory of labour supply is included to explain the number of people in each of these employment status categories. The income-expenditure link is closed with an aggregate consumption function relating household consumption to disposable income, net of direct taxes and net of the share of capital rentals accruing to foreigners. Finally, ORANI's real rate of return, which guides both the allocation of investment across industries in the short run and the level of industry capital stocks in the long run, is redefined to be net of taxation as well as depreciation. With these features, the FH-ORANI extensions represent not just an accounting exercise, but also a significant enhancement of ORANI's theoretical structure.

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PREFACE

This paper documents an extension to the ORANI model, both its theoretical structure and the data and computing techniques used for its implementation within the Industries Assistance Commission.

ORANI is a formal, policy-oriented model built as part of the IMPACT Project. Its value has been demonstrated time and again. Within the Industries Assistance Commission, it has been used as a tool to help make transparent the effects of various policies. Transparency is achieved because the model's formal structure, underlying assumptions and empirical content are open to scrutiny. Such openness is made possible only by the extensive, publicly available documentation of the model in all its facets.

With increasing success in recent times. practitioners have succeeded in capturing, within special versions of ORANI, the detailed knowledge about particular industries, processes and products that is available from industry experts and others with little or no background as modellers. The incorporation of such realistic detail in turn has convinced the clientele of the relevance of the modelling work, and because of the involvement of a wider group, has improved access to its results.

The model contributes to policy transparency because its focus is economy-wide and because it is ideally suited to making conditional projections. Only an economy-wide model which recognises linkages between industries can hope to capture unintended consequences of policies designed initially to act on a single industry or sector. To isolate the effects of individual policies from the general noise in the economy, a model needs to answer questions of the form - "What would happen if policy x were implemented (or removed), conditional on all other exogenous factors being held constant?"

The fiscal extension to ORANI outlined in this paper will help the Industries Assistance Commission examine the impact on industry of a broader range of policies and refine the nature of the conditional projections made by ORANI. On the one hand, the impact of various macroeconomic fiscal policies on industry can now be studied. On the

other, analysis of the microeconomic instruments of industry policy can now be "corrected" for their incidental expansionary or contractionary effects on the government budget.

The documentation of the fiscal extension in this paper has been prepared in the spirit of maintaining model transparency. It provides comprehensive technical documentation as well as some more intuitive explanations of how the extension works and what it can achieve. It also provides sufficient information for other researchers or policy analysts to implement the fiscal extension themselves.

Since the work documented in this paper was completed, the general technology for implementing large linearised models or model extensions has taken a quantum leap forward. The TABLO software developed at the IMPACT Research Centre by Ken Pearson and George Codsi automates and/or circumvents the need for many of the mechanical steps described in the tables to Chapters 4 and 5. These tables nevertheless remain as a historical record of the tedium that can be avoided using TABLO, while they outline in conceptual terms steps that must still be undertaken, albeit more easily, when implementing and solving models of this type.

I owe a large debt of gratitude to David Vincent for the encouragement and freedom to complete a project such as this. I received valuable comments from Robert McDougall and members of the University of Melbourne's Workshop on Computable General Equilibrium Modelling. Various people assisted on the computing side, but Alexandra Strzelecki deserves special mention, along with Greg Ayling and Sue Valentine. My thanks also go to Cathy Frylink, Margaret Smart and Roberta Wise for their high-quality typing. Finally, my thanks go to Professor Allan Powell, who went through the entire document and provided extensive comments.

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1 INTRODUCTION

ORANI is a multi-sectoral, comparative static, computable general equilibrium model of the Australian economy (Dixon, Parmenter, Sutton and Vincent 1982, hereafter DPSV) which has proved useful in analysing a wide range of policy issues. Within government agencies such as the Industries Assistance Commission, applications have most frequently focused on the effects of changes in industry assistance - tariff changes, either across-the-board or to particular industries, and more recently changes in bounty or quota protection to industries and changes in commodity taxation on particular commodity groups. Elsewhere, the model has been used to study such issues as wages policy and the effects of the mineral resources boom. Powell and Lawson (1986) and Powell (1988) contain detailed bibliographies of applications within and outside government.

Applications by official agencies have nevertheless highlighted the difficulty of using the standard version of ORANI to examine the implications of various policies for the government's budget. These implications aside, the incidence of gains and losses from a variety of policy actions and other shocks have been sharply identified.

For example, it has been argued on a priori grounds that bounties are a more appropriate instrument than tariffs in the provision of industry assistance; bounties distort only producer prices, while tariffs also distort consumer prices (IAC 1984). Standard ORANI can be used to quantify the bounty levels that would provide assistance equivalent to that of prevailing tariffs. The loss of government tariff revenue and the increased government expenditure on bounties can also be calculated from the results ex post. However, standard ORANI cannot easily be used to quantify assistance packages which are constrained to fall within an explicit government budget requirement. Similarly, standard ORANI has been used to quantify the combination of real wage reduction and increase in aggregate demand required to increase labour employment. But only through supplementary analysis, with simple assumptions about the effects of income tax cuts on labour supply, could these results be used to examine the implications of a tax-wage bargain (Corden and Dixon 1980).

In its standard form, ORANI contains a full set of industry- and commodity-specific indirect taxes and subsidies - the production, consumption and trade taxes that form the arsenal of traditional industry assistance. However, it does not add the separate items together to form a single tax revenue aggregate which could be targeted in the evaluation of policies subject to a government budget constraint. Nor does standard ORANI include the direct tax, depreciation and investment allowance items that are traditional instruments of macro fiscal policy, but which have also been used in a discriminatory fashion to provide budgetary assistance to specific sectors. Finally, standard ORANI does not show the way in which all these government direct or indirect tax instruments, expenditure items or transfers can be used as demand management tools to influence the macro environment in which all industry operates.

A fiscal extension to ORANI should therefore, at minimum, account for the missing government direct taxes and transfers and bring all the government revenue and expenditure items together to show how the government budget can influence aggregate demand not only directly, through government expenditure, but also indirectly, through the impact of direct taxes and transfers on the disposable income of individuals.

A first step in this direction was the NAGA extension of ORANI provided by Meagher (1983) and Meagher and Parmenter (1985). This extension introduced direct taxation on labour and capital income, albeit at an aggregate level and with the tax regime assumed to be proportional, i.e., with average (and marginal) tax rates constant. It also introduced government transfer payments and recognised that total unemployment benefits were beyond direct government control, in that they depend on the number of people unemployed. In order to explain unemployment the model introduced a crude labour supply relationship. Finally, the indirect effect of tax policy on aggregate demand was introduced through a simple aggregate consumption function which relates real private consumption expenditure to real disposable income.

The fiscal extension to ORANI presented below in Chapter 2 represents a further development and refinement of the NAGA approach. Like the NAGA extension, it models revenues and expenditures consolidated across commonwealth, state and local levels of government. Two types of direct taxation continue to be defined according to the functional rather than personal distribution of income, i.e., according to the distribution of income among factors of production rather than among types of households. The resulting direct taxes on labour and non-labour income correspond roughly, but not exactly, to the concepts of personal and corporate taxation used by the Australian Tax Office, the difference being that the official definition of personal taxation includes the taxes paid on profits earned by or distributed to individuals (rather than companies), whereas these are excluded from the current concept of taxes on labour income.

In the fiscal extension, both types of tax are treated in a disaggregated fashion. The tax rates on non-labour income can therefore vary across industries, while account is also taken of industry-specific rates of depreciation and investment allowances, these being tax

deductions which affect an industry's taxable non-labour income. The industry-specific average tax rates are assumed constant. This means that direct taxes on non-labour income are treated as proportional.

By contrast, allowance is made for tax progressivity in the tax rates on labour income. Average tax rates therefore increase as labour income increases. Standard ORANI makes provision for wage rates to vary across industries and occupations. This industry/occupational variation in wages provides a basis for initial variations in average tax rates on labour income. The various tax rates also increase at different rates as labour income increases, the speed being determined by the income tax schedule. By modelling tax progressivity, the fiscal extension takes account of a feature of the Australian tax system which appears to have had an important influence on the structure of tax receipts over time. As Norman (1985) notes, when progressive, unindexed personal taxes are combined with proportional (thus by definition indexed) corporate and commodity taxes, personal income tax receipts tend to account for a growing proportion of total government tax revenue.

The fiscal extension recognises that unemployment benefits are not the only type of government transfer payment to be conditional on employment status and therefore to vary as labour market conditions change. Those who become discouraged and leave the workforce through early retirement, for example, may then become eligible for a pension or welfare payment. Similarly, widows who enter the workforce may lose their entitlement to widows' pensions. The fiscal extension therefore distinguishes among means-tested benefits (paid only to those not in the workforce), unemployment benefits (paid only to the unemployed) and non-means-tested benefits (payable to everyone).

To explain employment status through labour force participation decisions and other key elements of labour supply, the fiscal extension draws on detailed theoretical and empirical work undertaken explicitly for Australia. The same sources also provide estimates of the behavioural parameters for aggregate consumption and savings functions, which depend on disposable income. These estimates have been obtained for Australia in the context of explaining the labour-leisure-consumption-saving choice and thereby ensure at least some consistency between the labour supply and aggregate consumption components of the

fiscal extension.

The fiscal extension to ORANI, outlined in Chapter 2, is therefore designed to address one of the deficiencies of the standard ORANI model. The extension contains a disaggregated treatment of expenditures, taxes and transfers in a fully integrated set of government accounts. As a byproduct, it models labour supply and explains aggregate household consumption and savings behaviour as responding to disposable income.

The measure of disposable income relevant for domestic consumption and savings decisions should properly be net of non-labour income accruing to foreigners. Income to foreigners depends in turn on the extent of foreign ownership of the Australian capital stock.

Foreign ownership has been recognised in an extension to standard ORANI developed by Horridge.[1] This Horridge extension models the way in which the foreign ownership share of domestic capital depends on the difference between investment and national saving. However, the existing Horridge extension does not distinguish between the household and government components of national saving. Because it is not specifically oriented to fiscal issues, it does not define the non-labour income accruing to foreigners as being net of Australian income tax or withholding tax.

Chapter 3 presents a slightly modified version of the Horridge extension which introduces the concept of foreign ownership into fiscal ORANI while maintaining the distinction between government and household behaviour. It also models the distribution of non-labour income between domestic households and foreigners as occurring after the deduction of Australian taxes.

In addition, Chapter 3 describes a small but significant change that has been made to the theoretical structure of standard ORANI when combining it with the fiscal and Horridge extensions. According to the investment theory of standard ORANI, both the allocation of investment across

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1 The Horridge extension is documented in Horridge and Powell (1984) and Horridge (1985a), (1985b), (1987).

industries in the short run and the level of industry capital stocks in the long run depend on real rates of return to capital, net of (true economic) depreciation. The change outlined in Chapter 3 is to define the rates of return relevant for the behaviour of investment and capital stocks as being net of taxation as well as depreciation. This change is consistent with so-called q theories of investment[2] and provides an important channel by which fiscal policy can affect industry activity levels, through its effect on productive capacity in the longer term.

The full model - fiscal ORANI with Horridge extension - comprises three main components: the ORANI model core, which is just standard ORANI with its modified definition of industry rates of return; the fiscal extension described in Chapter 2; and the modified Horridge extension described in Chapter 3. Chapter 4 describes how the full model can be implemented.

The first requirement for implementation is to reduce the fiscal and Horridge extensions to manageable size. The fiscal extension in particular contains a relatively large number of equations involving a large number of fiscal variables. Its large size is primarily a result of the disaggregated treatment of direct taxes on labour and non-labour income. Its size can be reduced by eliminating some of the variables and equations that are unlikely to be of direct interest, by a process of algebraic substitution.[3] Chapter 4 outlines the condensed versions of the fiscal and Horridge extensions that are used in computer implementation.

The condensed versions of standard ORANI, its fiscal extension and the modified Horridge extension together comprise a full model that still contains a large number of equations and variables, with many more variables than equations. The second requirement for implementation is

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2 The q theory was first advanced by Tobin (1969). Recent studies include Chirinko (1987), Mayer (1986), McMillin (1985) and Ueda and Yoshikawa (1986).

3 The same process was used in standard ORANI to produce the condensed version described in Tables 32.1 and 32.2 of DPSV. The advent of TABLO (Codsi and Pearson 1987, 1988a) means that future modifiers of ORANI will be spared the algebra required for the substitutions, though they will still be required to nominate which variables are of no direct interest.

to specify a closure - that is, to designate a number of variables as exogenous - so that the model contains only as many endogenous variables as equations. As with standard ORANI, great flexibility is provided in the choice of model closure. In some closures of FH-ORANI, the fiscal extension will simply provide accounting detail on government budget items as an adjunct to the standard ORANI results. In other closures, where exogenous variables are swapped between standard ORANI and the fiscal extension, government budget constraints can be introduced or fiscal policy targeting exercises undertaken that were hitherto difficult or impossible with standard ORANI alone. Some of these options are discussed in detail.

The third requirement for implementation is to collect together the condensed versions of standard ORANI and the fiscal and Horridge extensions, and to solve the full FH-ORANI model as efficiently as possible. The equations of the full model are implemented and solved using the GEMPACK general purpose software system for computable general equilibrium models (Pearson 1988, Codsi and Pearson 1988b). A general outline of this process is also given in Chapter 4.

One feature of standard ORANI which carries over to the full FH-ORANI model is the very detailed treatment of commodity taxes. Some of the equations of FH-ORANI therefore contain a large number of commodity tax rate variables which in the implemented version are combined together, along with various technical change variables, into composite variables - one per affected equation.

Formerly, in non-fiscal applications of standard ORANI, its composite variables were held constant and could essentially be ignored. In fiscal applications of FH-ORANI involving policy changes to commodity tax rates, its composite variables cannot be ignored. If the effects of a change in one particular commodity tax rate are required, the effects of that change on all composite variables in FH-ORANI must first be computed outside the model. The associated changes in the composite variables can then be fed into FH-ORANI as exogenous shocks to evaluate the effects of the tax change on all the other economic variables.

Chapter 5 outlines the treatment of commodity taxes in FH-ORANI in more detail and describes a computer program called YUKS that has been written to compute, for any change or combination of changes to commodity tax variables, the associated changes in all composite variables. The YUKS program must be run prior to solving FH-ORANI in applications involving commodity taxes.

The YUKS program, like FH-ORANI itself, requires a fiscal-Horridge database as one of its inputs. Chapter 6 describes a fiscal-Horridge database that has been constructed for the year 1978-79 as an extension to the standard ORANI database for that year.[4]

With an implemented version of FH-ORANI and a fiscal-Horridge database, the full model is ready for use in a wide range of applications. Chapter 7 provides one such application - the analysis of the short and long term effects of matched reductions in government spending and taxation. This issue has been of recent policy interest and was part of the tax reform debate.

Finally, Chapter 8 outlines directions for further research.

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4 The 1978-79 standard ORANI database is an updated version of the 1977-78 database that is described in Bruce (1985) and listed in Blampied (1985).

2 THE THEORETICAL STRUCTURE OF THE FISCAL EXTENSION

This chapter outlines the theoretical structure of a fiscal extension to the standard ORANI model.

The body of the chapter describes the equations of the fiscal extension, some of which play a key behavioural role but many of which are simply book-keeping equations keeping track of the many separate government revenue and expenditure items. Table 2.1 shows the fiscal accounting framework (consolidated across commonwealth, state and local levels of government) created by the fiscal extension. It also gives a brief description of how each government revenue, expenditure or transfer item is modelled.

This chapter also explains the relationships between parts of the fiscal extension, and between it and the standard ORANI model core. The formal details of the fiscal extension are given in Tables 2.2 to 2.4 at the end of this chapter which present, in turn, the equations, the variables, and the coefficients and parameters of the model. Table 2.4 also explains the way in which the model's coefficients can be calculated from a fiscal database.[5] Chapter 6 explains the construction of the database for the fiscal extension and gives values for its components.

A broad overview of the fiscal extension is in order before its equations are described in more detail. The equations in Table 2.2 can be divided into sets whose general functions are as follows.

The first two sets of equations (a) and (b) in Table 2.2 define in modelling terms the separate components of factor costs. In standard ORANI, primary factor demands in each industry are modelled as functions

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5 In fact, coefficients are distinguished from parameters because values for coefficients (such as cost or sales shares) are calculated from a database that portrays the economy in a particular year-of-record, whereas values for parameters (such as substitution elasticities or policy parameters) cannot be inferred from such a database. One implication is that when a large change solution of the type described in DPSV, Section 8 is computed, coefficients will be updated but parameters will not. As yet, however, no large change solution procedure has been developed for FH-ORANI.

of industry activity levels and relative factor costs. The various components of factor cost are included in the standard ORANI database's measure of total factor cost but they are not identified separately in the standard ORANI model. In the fiscal extension, gross factor costs are broken up as follows. Firstly, the payroll and property taxes paid on factors of production are defined as the difference between gross factor costs and gross factor earnings. Secondly, the direct taxes paid by factors of production are defined as the difference between gross

TABLE 2.1: ACCOUNTING FRAMEWORK OF THE GOVERNMENT BUDGET IN THE FISCAL EXTENSION (CONSOLIDATED ACROSS LEVELS OF GOVERNMENT)

Government Revenue	Government Expenditure
1. Direct taxes on labour income (by occupation and industry, progressive, can be indexed or unindexed, levied on gross labour earnings)	1. Consumption expenditure (from standard ORANI)
2. Direct taxes on non-labour income (by industry, proportional, levied on gross operating surplus net of depreciation and investment allowances)	2. Investment expenditure (a fixed share of the total investment from standard ORANI)
3. Payroll taxes (by industry, levied on wage bills)	3. Unemployment benefits (paid to unemployed)
4. Property taxes i.e., rates and land tax (by industry, levied on capital values)	4. Means-tested transfers (paid to those not in workforce)
5. Commodity taxes on intermediate inputs, inputs to capital creation, household consumption, exports and imports (from standard ORANI)	5. Non-means-tested transfers (paid to everyone)
6. Other indirect taxes (from standard ORANI)	6. "Other" outlays (linked to movements in nominal GDP)
7. "Other" revenue (linked to movements in nominal GDP)	
Total government revenue	Total government expenditure

factor earnings and disposable factor income.[6]

The next four sets of equations (c) through (f) aggregate those other components of government revenue modelled explicitly in standard ORANI, and combine them with payroll, property and direct taxes to form a measure of total government revenue.

In the equation set (g) the separate components of government expenditure are added to form a measure of total government expenditure. One component is government final consumption expenditure on goods and services from standard ORANI. The fiscal extension also identifies the government share of total investment expenditure and introduces government transfer payments to various segments of the population.

The fiscal extension then defines in equation set (h) two measures of the difference between government revenue and expenditure. The first measure includes investment expenditure in the definition of total expenditure and thus calculates the government borrowing requirement. The second measure excludes investment expenditure and therefore calculates the government deficit on current account.

There follows a set of equations (i) which defines labour supplies and unemployment in order to determine the number of people in each employment status category, and therefore in each transfer payment category. Here the fiscal extension recognises that the labour demand equations in standard ORANI define a demand for person-hours - the product of persons and hours per person (Powell 1983). The labour supply equations therefore explain supplies in both these dimensions. Unemployment is then defined unambiguously as the difference between the supply of and demand for persons, a definition which recognises that

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6 A major difference between the 1977-78 and 1978-79 versions of the standard ORANI database is that in the later version, payroll and property taxes are counted as part of the payment for factors of production (labour, land and fixed capital) rather than being included as "other costs". Dee (1986b) describes how payroll and property taxes were extracted from the input-output category Indirect Taxes nec to enable this reallocation. A brief summary of this process, along with the resulting payroll and property tax estimates, is given in Chapter 6.

hours per person may also adjust. Likewise, the number of persons not in the workforce is defined unambiguously as the difference between the number of people in the population and the number of people in the workforce.

The fiscal extension then defines aggregate consumption in equation set (j) as a function of aggregate disposable income, where the latter includes both disposable factor income and government transfer payments.

The income tax regime is described in equation set (k) by specifying how the average tax rate on labour income increases as labour income itself increases, thus capturing personal income tax progressivity. Nevertheless, the modelling is flexible enough to allow alternative tax regimes to be modelled by the introduction of exogenous changes to the average tax rates.

Finally, the fiscal extension in equation set (l) defines aggregate nominal GDP at market prices, a quantity to which the omnibus "other" government revenue and expenditure items have been indexed.

The equations written in Table 2.2 at the end of this chapter contain variables that are denominated throughout as percentage changes. Imagine that at some point in time, a sustained shock is injected into the model through one or more of the exogenous variables, and that after a hypothesized length of time T it can be assumed that all endogenous variables have settled down to their new equilibrium values. The percentage changes measure the amounts by which the variables, after time T, will differ from the values they would have had <u>at that time</u> in the absence of the shock.

The equations in percentage change form are derived from underlying level form equations by logarithmic differentiation. Unless otherwise stated, the explanation that follows will focus on the underlying level forms, since the intuition here may be easier. However, the level form version of an equation will not be written down, nor its percentage change form derived, unless it is felt that the mathematical derivation is less than immediately obvious.

2.1 Income and Factor Taxes - Labour

Several steps are required in order to define the separate components of labour costs - payroll taxes, direct taxes on labour income and disposable labour income. Various labour values y, either costs, gross earnings or disposable income are first defined in equations (F1)-(F3) of Table 2.2 as the product (or sum, in percentage change terms) of the quantity of labour employed x and various pre- or post-tax wage rates p.

The revenues r from the direct and indirect labour taxes are then defined as an average tax rate t multiplied by the appropriate tax base for that tax, the base being some labour value measure. Thus payroll taxes are levied on labour costs in (F6) while direct taxes are levied on gross earnings in (F4).[7]

The tax revenue wedges are then specified in (F5) and (F7) as the differences between the various labour value measures, payroll tax revenue being the difference between labour costs and gross earnings, and direct labour tax revenue being the difference between gross earnings and disposable income.

Finally, payroll and direct tax revenues are aggregated across occupations and industries in (F8) and (F9) to give total tax revenue measures, while in (F10) and (F11) economy-wide before- and after-income tax wage rates are defined for use later in the model.

2.2 Income and Factor Taxes - Non-Labour

The modelling here is slightly more complicated since standard ORANI identifies more than one source of non-labour income. Fixed capital and agricultural land each attract a property tax, while the sum of gross earnings to these factors, together with the return to working capital, form the tax base for direct taxes on non-labour income once depreciation and investment allowances have been deducted.

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7 In fact Australia's tax rules apply payroll taxes to payrolls, the gross labour earnings concept. Since the tax rate is proportional, however, conversion can be done by side calculations, e.g., a 5 per cent rate on earnings is equivalent to a 4.76 per cent rate on total labour costs.

In standard ORANI, working capital forms a part of "other cost tickets", the remaining part representing other indirect taxes net of indirect subsidies. Furthermore, standard ORANI assumes the "quantity" demanded of other cost tickets increases directly with industry activity levels, while the "price" of other cost tickets can be either shifted exogenously or indexed to the consumer price index.

Although working capital and indirect taxes have been assumed to perform a similar role in production decisions, their tax implications differ. Working capital forms part of the tax base for direct taxes on non-labour inputs, while indirect taxes (net) are themselves a tax revenue item. The fiscal extension must therefore distinguish between the two. It seems reasonable to maintain the assumption that the quantity of working capital (cash balances, inventories, etc.) increases with industry activity levels. The quantity will then move in the same proportion as other cost tickets overall - the percentage change will equal that of other costs. This is the rationale for using the quantity of other costs as a proxy for the quantity of working capital in (F14), an equation which defines the factor cost y for working capital. Equations (F12) and (F13) similarly define factor cost values y for fixed capital and agricultural land.

Elsewhere in the model, however, equation (F29) defines the price of working capital as the product (or sum, in percentage change terms) of an indexing term and a shift variable. The latter is usually set exogenously to zero change. Equation (F28) relates the price of working capital to the overall price of other costs. The relationship is derived by noting that the value of working capital, when multiplied by an appropriate scaling factor to represent other indirect taxes, equals the value of other costs. When it is also noted that the quantities of working capital and other costs move together, the relationship simplifies to one between (the percentage changes in) the price of working capital, the price of other cost tickets and the indirect-tax-related scaling factor.

One implication is that if separate assumptions are made to specify exogenously the price of working capital using equation (F29), and the price of other cost tickets using equation (22.7) of DPSV, then the tax-

related scaling factor would have to adjust endogenously to reflect the additional relationship in (F28) between the values of working capital and other cost tickets. More reasonably, assumptions could be made about the price of working capital and the tax-related scaling factor, with the price of other costs determined endogenously. In general, only two out of the three entities can be specified exogenously by the model user. More detail is given when the model closure is discussed in Chapter 4.

Returning to the non-labour tax section of the model, equations (F15) and (F16) of Table 2.2 define property tax revenue on fixed capital and agricultural land as the product of an average property tax rate and a tax base. The choice of tax base requires some explanation. Rates and land tax are levied not on gross factor costs or any flow income stream but on unimproved capital values.[8] Standard ORANI defines a capital value for fixed capital, though not for agricultural land. It is, however, a replacement cost concept, with the price for capital valuation Π being the cost of a unit of newly created capital. It is neither a historic cost, market value nor unimproved value concept.[9]

Unimproved values are determined by the tax authorities and revised from time to time, presumably to allow some de facto indexing of property tax revenue. If the time horizon which the model user has in mind is long enough to suppose that unimproved values will be adjusted upwards in the same proportion as the replacement cost of capital (which in this context could be interpreted as an industry-specific investment goods price index), then the indexing parameter h in equation (F15) can be set to unity and nominal revenue from property taxes on fixed capital will

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8 This is not to deny that property tax payments must be met from flow factor earnings.

9 A market value concept can be defined once a market for existing capital is introduced. Trade can occur because second-hand machines are reusable within, if not between industries, or because financial claims to the returns from existing capital are tradeable. The latter approach requires financial assets. Work is underway to introduce financial assets into a computable general equilibrium framework for Australia (Adams 1986, 1987a, 1987b). Dee (1986c) contains an example of introducing financial assets in an overseas context.

be so indexed.[10] Alternatively, if it is supposed that over a short term horizon unimproved values will not be adjusted, then the indexing parameter h in (F15) can be set to zero and nominal revenue from property taxes on fixed capital will then be tied to the quantity of capital alone, with no effective price or valuation adjustment.[11] Either way, the indexing parameter h should be interpreted as an invariant policy parameter, its value depending on the frequency with which tax authorities revise unimproved values relative to the hypothesized length of time required for the model variables to reach their new equilibrium values in the face of a shock.

In the case of agricultural land, no capital value concept is defined in standard ORANI. For the purpose of indexing property taxes on agricultural land, the appropriate valuation concept can be assumed to move in proportion to the flow rental price of agricultural land. This assumption implies in turn that all increases in agricultural land productivity are capitalised so that the gross rate of return (the flow rental price divided by the capital value) is constant. Over a time horizon long enough for this assumption to be reasonable, the indexing parameter in (F16) can be set to unity and property taxes on agricultural land can be indexed to the rental price of agricultural land. Over shorter horizons, h can be set to zero and nominal revenue from property taxes on agricultural land will be tied to the quantity of agricultural land alone. Again, the indexing parameter should be thought of as an invariant policy parameter.

Property tax revenue on fixed capital and agricultural land is specified in (F17) and (F18) as the wedge between factor costs and gross earnings for each factor. These gross earnings are added in (F19) to the factor cost of working capital to define gross operating surplus in each industry. Direct tax revenue on non-labour income becomes the wedge in (F21) between gross operating surplus and disposable non-labour income.

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10 The use of an index over all investment goods assumes there is no change in the relative price of unimproved land and its improvements.

11 Only when all direct income taxes, property taxes and other taxes are fully indexed will the real variables in FH-ORANI be homogeneous of degree zero with respect to the exchange rate and all domestic prices.

Tax revenue on non-labour income is itself defined in (F20) as the product of an average tax rate and a tax base. Taxes on non-labour income are levied on a base consisting of gross operating surplus net of depreciation and investment allowances. Although the interest paid on loans for business purposes is also deductible for companies and the self-employed in Australia, these interest payments are channelled through the financial system to become the taxable interest income of individual bank depositors and debt instrument holders who are the ultimate creditors to industry. Since this form of business deduction therefore has a taxable counterpart which is also included in the model's concept of non-labour income, business loan interest is not counted as a deduction from total non-labour income.[12] The level form equation from which (F20) derives may not be obvious, so the details will now be spelt out.

The underlying level form equation behind (F20) is as follows:

$$R_j^{YK} = T_j^{YK}[\ Y^g_{(g+1)j} - \Delta_j \Pi_j X^{(1)}_{(g+1,2)j} - A_j \Pi_j Y_j\ ] \qquad (1)$$

where T_j^{YK} and R_j^{YK} are the average tax rate and tax revenue for non-labour income in industry j, $Y^g_{(g+1)j}$ is its gross operating surplus, $X^{(1)}_{(g+1,2)j}$ and Y_j are the real capital stock and real investment in industry j, Π_j is the price of a unit of its capital. Δ_j is thus the depreciation rate for tax purposes, defined as a proportion of the value of an industry's capital stock, and A_j is the investment allowance rate, defined as a proportion of an industry's investment expenditure.[13] In standard ORANI, a rate of real economic depreciation was defined for each industry and assumed to be constant. Here, a different notation is used to reflect that depreciation for tax purposes need bear no relation to real economic depreciation. Furthermore, the depreciation rate for tax purposes is not necessarily assumed constant, so its associated percentage change variable δ_j appears in (F20) and may thus, for example, be subjected to an exogenous shock to represent a change in depreciation allowance

12 The effective tax rates implicit in the fiscal database nevertheless reflect any double taxation of dividends.

13 Both the capital stock and investment expenditure are valued at replacement cost, so that both depreciation and investment allowances are implicitly indexed.

policy. Logarithmic differentation of (1) above leads to (F20) in Table 2.2 where the lower case letters there measure percentage changes in the associated upper case variables.

Finally, property tax and direct tax revenue is aggregated across industries in equations (F22) and (F23) of Table 2.2 to obtain total tax revenue measures, while aggregate, economy-wide gross non-labour earnings and disposable non-labour income are defined in (F24) and (F25) for use later in the model.

This now completes the description of the modelling of taxes on non-labour income. It will be noted that no explicit provision has been made for a capital gains tax, even though a tax on real (i.e., indexed) capital gains at ordinary rates of personal or company income tax was introduced in Australia in June 1986.

One difficulty with incorporating a capital gains tax in the fiscal extension is that a capital gain is a dynamic concept - it measures the change in value of existing capital between the time that a shock is injected into the system and the time that variables have settled down to their new equilibrium values. FH-ORANI is not dynamic but comparative static. It can measure the amount by which the value of all capital in the new equilibrium will differ from the value it would have had at that time in the absence of the shock. This latter value need not equal the initial value of existing capital if, for example, there is some underlying trend rate of capital accumulation whereby additions are made to existing capital over time even in the absence of a shock.[14] Alternatively, there could be a trend rate of real appreciation in capital prices, even without a trend rate of physical additions.

The second difficulty with incorporating a capital gains tax is endemic to all models. Although it is relatively easy, at least in a dynamic framework, to model capital gains on an accruals basis, it is more difficult to model them on the basis on which they are taxed - a

14 A forecasting version of ORANI has been developed by Dixon and Parmenter (1987, 1988) which, among other things, adds dynamic equations explaining trend capital accumulation to the standard ORANI framework.

realisation basis. On the latter basis, gains in the value of existing capital are taxed only when the capital asset changes hands.

One way of incorporating a capital gains tax would be to treat it either as a funny sort of property tax, or as a funny sort of direct tax on non-labour income. In the former case, some judgement could be made as to a realistic rate of turnover of existing capital relative to its total value in the face of a capital gains tax, recognising that with a tax now in place the turnover rate is likely to be lower than has historically been the case. With the real increase in turnover value taxed at corporate or personal tax rates, an estimate of the first round revenue raised by the tax could be made, prior to subsequent adjustment in the economy, and the result converted into an equivalent increase in property tax rates on the total value of capital. Some similar conversion could likewise be made if a capital gains tax were to be treated as a kind of direct tax on non-labour income. The issue here, however, is whether a capital gains tax is behaviourally more like a tax on wealth or more like a tax on income flows. The fact that the tax rates are corporate and personal rather than property tax rates could be taken into account in the empirical conversion.

Alternatively, capital gains tax revenue could be modelled explicitly.[15] The method requires a trend rate of appreciation in real capital values between time t (when a shock is injected) and time t + T (when the new equilibrium is reached) to be supplied as a piece of data from external sources. The method then estimates how this trend rate of real apreciation would be affected by the shock itself, using the information generated by the model on how capital values in period t + T will differ from the values they would have had at that time in the absence of the shock.

In level terms, define K_{jt} as the physical capital existing in industry j at period t, π^R_{jt} as the initial real price of capital in period t and $\pi^R_{j(t+T)}$ as the real price of that capital in period t + T. Then the revenue accruing from a real capital gains tax in period t + T, prior to any shock, can be defined as

15 I am indebted to Alan Powell for outlining this approach.

$$R_{j(t+T)} = K_{jt}[\Pi^R_{j(t+T)} - \Pi^R_{jt}]V_j T_j \qquad (2)$$

where V_j is the proportion of existing capital that changes hands between period t and t + T and where T_j is the real capital gains tax rate.

Now take logarithmic differentials of (2) at period t + T to find out how the capital gains tax revenue collected in period t + T will differ as a result of a shock. The important point is that neither the initial quantity of capital K_{jt} nor the initial value Π^R_{jt} will be affected by a shock injected at period t that does not work fully through the system until period t + T. Logarithmic differentiation therefore gives

$$r_{j(t+T)} = \frac{\Pi^R_{j(t+T)}}{[\Pi^R_{j(t+T)} - \Pi^R_{jt}]} \pi^R_{j(t+T)} + v_j + t_j \qquad (3)$$

where lower case letters in (3) represent percentage changes in the corresponding upper case variables in (2).

Equation (3) can be used to explain how capital gains tax revenue will change in response to a shock, once a value for the trend rate of real appreciation $\Pi^R_{j(t+T)}/[\Pi^R_{j(t+T)} - \Pi^R_{jt}]$ is provided as data and once the variable $\pi^R_{j(t+T)}$ representing the percentage change in the real price of existing capital is defined in terms of other variables in FH-ORANI. The variables v_j and t_j would normally be treated as exogenous.

The remaining problem, once again, is that FH-ORANI contains no variable representing the market price of existing capital. In the long term, it would be reasonable to assume that existing capital was valued at replacement cost (i.e., that Tobin's q was equal to unity), in which case $\pi^R_{j(t+T)}$ could be defined as

$$\pi^R_{j(t+T)} = \pi_j - \xi^{(3)} \qquad (4)$$

where π_j is (the percentage change in) the creation price of a unit of capital and $\xi^{(3)}$ is (the percentage change in) the consumer price index, the deflator used by the Australian tax authorities when defining real capital gains. Both these variables are defined in standard ORANI.

In the short term, it may be more reasonable to assume that the market value of existing capital fluctuates with short term profitability (i.e., that Tobin's q is not constrained to equal unity). In this case, $\pi^{R}_{j(t+T)}$ could be approximated by

$$\pi^{R}_{j(t+T)} = p^{(1)}_{(g+1,2)j} - \xi^{(3)} \qquad (5)$$

where $p^{(1)}_{(g+1,2)j}$ is the rental price of capital, again defined in standard ORANI. Either way, a method of treating capital gains taxes remains to be incorporated in future versions of FH-ORANI.

2.3 Other Non-commodity Indirect Taxes (net)

Other non-commodity indirect taxes (net) have been modelled in Table 2.2 as a simple scaling factor - the amount by which working capital costs must be scaled to obtain other costs in total. There are several reasons for this choice. The first is that other indirect taxes (net) comprise those miscellaneous taxes and subsidies which cannot be directly associated with a particular commodity or factor flow. They cover the taxes on the ownership and operation of motor vehicles paid by business, those stamp duties which cannot be associated directly with a financial service flow, even once-off items such as the compensation paid to farmers for losses incurred when sanctions were applied against the USSR and Iran. With such a diverse collection of taxes and subsidies, it is difficult to identify a single tax base in the model to which these indirect taxes (net) could be seen as applying. A scaling factor interpretation sidesteps the question of the tax base.

The second reason for modelling indirect taxes net of subsidies as a scaling factor is that while the indirect taxes (net) may be either positive or negative, corresponding values for the scaling factor would be greater than or less than one, but generally always positive. In general, variables such as an indirect tax rate which can pass through zero should not be modelled in ORANI's percentage change form, but a scaling factor which is always positive can be.

The model sees indirect taxes (net) as the wedge between working capital costs and other costs in total. Indirect tax revenue by industry is

therefore defined in (F26) as the difference between the value of other costs and the value of working capital. Although no tax base has been explicitly identified for indirect taxes (net), the behaviour of this source of government revenue is implicitly determined by the choice made about which pair of variables among working capital, other costs or the tax-related scaling factor is specified as exogenous. Indirect taxes (net) comprise a number of miscellaneous items, but it would be reasonable in most circumstances to suppose that the overall revenue adjusts along with industry activity levels. This would be achieved by designating the scaling factor as exogenous, since indirect taxes (net) would then bear a constant proportionate relationship to working capital costs, which in turn are tied to activity levels.[16]

Aggregate revenue from other indirect taxes is obtained in (F27) by adding across industries. As noted earlier, the unit value relationship between working capital, other costs and the tax-related scaling factor is given in (F28), while (F29) defines the indexing possibilities for the price of working capital.

2.4 Commodity Taxes less Subsidies

The equations in this group simply aggregate across commodities the commodity taxes and customs duties identified in standard ORANI to obtain total commodity tax revenue measures, both for particular taxes and across all taxes. The modelling here follows the tax treatment in DPSV, with the general variables g(.) denoting tax rates. However, the implemented version of standard ORANI now uses tax variables defined as the power (one plus the rate) of an ad valorem tax levied on basic values. The implemented versions of (F30)-(F34) therefore take a form similar to (F26), defining tax revenue as the difference between tax-inclusive and tax-exclusive commodity values. The new tax treatment and its implications for the form of equations (F30)-(F34) is spelt out in Chapter 5.

16 With this closure, the scaling factor in equation (F28) could in fact be interpreted as the "power" (one plus the tax rate) of a tax which applies to working capital costs. Given the diverse nature of these taxes, however, the scaling factor interpretation is preferred. Further, it would remain appropriate when the link between indirect taxes and working capital costs was broken in alternative closures.

2.5 Other Government Revenue

This omnibus revenue category represents all remaining sources of government revenue that are not easily explained by simple extensions to standard ORANI. Conceptually, these sources can be divided into two types.

The first type of revenue is transfers to government not associated with any flow of goods and services. Although direct taxes to government fall into the same category, the sources of direct tax transfers are readily identified within standard ORANI as the owners or users of primary factors. Either the sources of the miscellaneous transfers included in the omnibus category are not readily identified, or the amounts involved are judged too small to be worth modelling separately. These miscellaneous transfer items include estate and gift duties, that portion of the tax on the ownership and operation of motor vehicles paid by households rather than business, and a portion of primary production taxes apparently treated by the Australian Bureau of Statistics as a tax transfer rather than a charge on goods and service flows (see Chapter 6 for details).

The second type of miscellaneous government revenue is the income earned by government through its direct operation of productive enterprises, or through its ownership of stocks, bonds and other financial assets which entitle it to a part of the income stream from capital somewhere in the economy. Included in this revenue category is the income from public enterprises and income from interest, rent, dividends and royalties. Were the income to have been traced back to a particular industry source, then the amounts could have been treated as a type of direct tax on non-labour income in that industry, with implicit tax rates of one hundred per cent for public enterprises and something less than one hundred per cent for industries in which government had a partial stake as shareholder or creditor. It was felt, however, that this approach would have entailed more attention to the personal, or at least institutional distribution of income than was warranted in a model which elsewhere considers only the functional distribution.

The omnibus category "other government revenue" in equation (F36) can either be treated as exogenous or tied to nominal GDP at market prices. The first option allows other revenue to be held constant in nominal terms, while the second allows it to be held constant relative to GDP. In either case, the shift term allows other revenue to be changed exogenously, either in nominal terms or relative to GDP. A measure of nominal GDP at market prices is defined later in the model.

Although no attempt has been made to treat in detail the separate sources of this "other" revenue to government, consistency with macroeconomic identities requires that it be a deduction from the income of some entity elsewhere in the economy. In a spirit of agnosticism, other government revenue is treated later in the model as a deduction from economy-wide disposable income in the process of explaining aggregate consumption.

2.6 Total Government Revenue

Here, the various sources of government revenue from direct taxation on labour and non-labour income, from payroll and property taxes, from other indirect taxes (net), commodity taxes net of subsidies and "other" government revenue are added to form a measure of total government revenue.

2.7 Government Expenditure

This set of equations in Table 2.2 firstly aggregates across commodities in (F38) the government current expenditure on commodities from standard ORANI to obtain a measure of aggregate government current expenditure.[17] It then defines in (F39) government investment expenditure as a simple fraction of the total investment expenditure contained in standard ORANI.

Three kinds of government transfer payments are then introduced. In each case, government is assumed to set the real level of transfer per

17 Conceptually, the commodities should be valued at purchasers' prices, but since standard ORANI currently does not make provision for margins and taxes on government purchases, purchasers' prices are equal to basic values for this final demand category.

recipient. Total expenditure on the transfer is then indexed to the consumer price index to keep the real transfer per recipient constant. Finally, total expenditure on the transfer varies with the number of recipients. The three types of transfer are distinguished according to recipient. Unemployment benefits in (F40) are paid only to the unemployed. Means-tested benefits in (F41) are paid only to those not in the workforce. Non-means-tested benefits in (F42) are payable to anyone in the population. The numbers of people in each employment status category are explained later in the model.

The model then defines an omnibus "other" government expenditure category in (F43) which can be held constant either in nominal terms or relative to nominal GDP. Like the omnibus other revenue category, the expenditure item contains several small miscellaneous transfer items which it is felt are not worth modelling separately. These include grants made to private individuals for capital purposes, government unfunded employee retirement benefits and transfers overseas. In 1978-79, however, almost 80 per cent of this item comprised government interest paid on the government debt instruments used to finance budget deficits (ABS 1981b). At first sight, it might seem possible to endogenise these interest payments within the fiscal extension. However, the extension explains only the government's current deficit, not the total amount of government debt outstanding as the result of current and past deficits.[18] For this reason, "other" expenditure has been treated in the same way as "other" revenue. Other government expenditure must nevertheless become the income of some entity elsewhere in the economy. Later in the model, it is treated as an addition to economy-wide disposable income in the process of explaining aggregate consumption.

Finally, two measures of aggregate government expenditure are defined in equations (F44) and (F45) of Table 2.2. Total expenditure includes investment expenditure as one of its components, while current expenditure excludes investment. Corresponding to these definitions of government expenditure are two broad-based government expenditure price

18 The forecasting version of ORANI documented in Dixon and Parmenter (1987, 1988) contains sufficient dynamics to explain debt levels and debt accumulation.

indices, defined in (F47) and (F48) as appropriately weighted combinations of the prices of the separate items of government outlay.[19] A narrower index, defined in (F46), is the government current expenditure price index over the prices of goods and services in current expenditure.

2.8 Government Budget

Two nominal measures of the government budget deficit are defined in (F49) and (F51) from the two measures of aggregate government expenditure, giving a total nominal borrowing requirement and a nominal deficit on current account. The definition of borrowing requirement used in the model abstracts from any government net lending, and thus differs slightly from the concept used in government finance publications. Since the deficit, on either measurement, could conceptually change sign, the model has defined each nominal measure as an absolute rather than percentage change.

Associated with each nominal measure of the budget deficit is a real measure, defined in (F50) and (F52). Thus when simulating a situation in which the government budget constraint is binding, the model allows the deficit to be set exogenously in either real or nominal terms. The behaviour of the nominal deficit may be of interest to policy-makers in the short term. However, nominal deficit growth need not translate into real deficit growth. Suppose that from an initial position of deficit, both revenue and expenditure grew by the same proportion in nominal terms, in line with an increase in the price of government outlays. Then the deficit would widen in nominal terms, even though it would be unchanged in real terms. The model's real deficit measures correct the growth in both revenue and expenditure for the growth in the price index of government expenditure and would, in the above situation, register zero real deficit growth. A deficit fixed in real terms would be the

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19 The investment goods price index used in (F47) is defined in ORANI as an index over the investment expenditure of endogenous investment industries only. The implemented version of (F47) uses a more general index defined over investment expenditure by all industries. Ideally, the more general index should also use government rather than total investment expenditure weights. This would be possible once data on government investment by industry was obtained.

suitable assumption to make in exercises designed to compare the welfare effects of alternative tax regimes.[20]

2.9 Labour Supplies and Unemployment

The primary purpose of this set of equations is to explain the number of people in each employment status category as an outcome of the interaction between participation, labour supply and labour demand decisions. Since standard ORANI contains well-defined labour demand equations for each occupation in each industry, most of the modelling in this section focuses on participation and labour supply. Because the theoretical structure is taken essentially intact from sources which explain labour supply in a labour-leisure-consumption-saving choice framework, the labour supply modelling also lays the groundwork for explaining aggregate consumption behaviour.

On the demand side, the fiscal extension defines standard ORANI's demand for person-hours by occupation and industry in (F60) as the product of a demand for persons and a demand for hours per person. With the absence of any further equations explaining an industry's relative preference for persons and hours per person, the model assumes an industry to be indifferent whether additional person-hours are filled by additional persons or by additional hours from existing employees. This clearly abstracts from technological and demand conditions which might constrain industries in their choice of overtime and shiftwork.

On the supply side, labour supply is seen as involving three separate decisions:

(i) There is firstly the decision to participate, i.e., to be a member of the workforce.

(ii) Given the decision to participate, there is the decision of which occupation to pursue.

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20 In the context of a model in which the government budget is always balanced, Shoven and Whalley (1977) advocate making tax comparisons on an equal real yield basis. In the current model this would correspond to the joint assumptions of a fixed real deficit and fixed real government expenditure.

(iii) Given the choice of occupation, then for those who can find employment in that occupation, there is the decision of how many hours of work to offer.

The participation decision is captured in (F53). Empirical studies in Australia and elsewhere show that participation rates depend crucially on demographic characteristics of the population and are related to such decisions as family formation. The fiscal extension abstracts from these influences, assuming the demographic structure to be constant over the time horizon considered in FH-ORANI experiments.

Of the possible economic influences on participation decisions, three have been shown to be important. Kerrison (1986a) discusses more fully the theoretical basis for these influences and reviews some of the empirical studies made for Australia. As a result, equation (F53) models the participation rate (i.e., the size of the labour force relative to the size of the working-age population[21]) as depending firstly on the real wage rate. As the real wage rises, the opportunity cost of being out of the workforce increases. This attracts more people to enter. The sign of the elasticity with respect to the real wage γ_{ℓ}^{1} is therefore positive. A priori, one might expect participation behaviour to depend on some kind of expected or average after-tax wage rather than a before-tax wage. However, the model's elasticity value given in Chapter 6 is based on empirical studies which invariably used a gross wage concept. A before-tax real wage measure is therefore used in the model's participation equation.

The participation rate is also assumed to depend on the unemployment rate. As this rises, unemployed individuals may become discouraged and leave the workforce. Alternatively, new household members may join the workforce to replace the wage income of those unemployed. The former effect appears to dominate and the sign of the elasticity with respect to the unemployment rate γ_{ℓ}^{2} is therefore negative. Finally, the

21 The formulation in (F53) uses the percentage change in the standard ORANI variable q, the number of households, to denote also the percentage change in the number of working-age individuals in the population, on the assumption that average household size and age structure does not change over the model's time horizon.

participation rate depends negatively on real per capita non-labour income. As this increases, individuals can buy leisure by foregoing wage income and leaving the workforce. The sign of the elasticity with respect to real non-labour income γ_{ℓ}^{3} is therefore negative.

Non-labour income in (F54) comprises non-wage factor income and the various types of government transfers, including "other" government expenditure net of "other" government revenue. Non-wage factor income is itself equal to the aggregate disposable non-labour income defined in (F24), but net of disposable non-labour income accruing to foreigners. It is defined fully in the Horridge extension of the next chapter.

Empirical studies have invariably showed that adjustments to participation rates do not occur uniformly across all demographic groups. Kerrison (1986a) suggests that over the time horizon relevant for FH-ORANI, adjustments in Australia's participation rate at the margin have tended to occur primarily through the retirement decisions of older groups. She proves formally that if an economy-wide participation relationship is an aggregate of the behaviour of a responsive and an unresponsive group, the economy-wide relationship will have the form of (F53) and (F54), but with group-specific income shares in (F54). Specific groups could be expected to have shares of the different components of non-labour income which differed from economy-wide shares. In particular, the older age groups could be expected to have higher shares of non-wage factor income (through financial assets accumulated over their lifetime entitling them to a claim on the income streams from capital in the economy) and higher shares of means-tested benefits (old age pensions) in their total non-labour income than for the economy as a whole. The formulation of (F54) allows the income shares to be group-specific rather than economy-wide.

The occupational choice decision is captured in equation (F57). The supply of persons to each occupation, relative to the number of people in the labour force, responds to relative expected occupational wage rates. Occupational wages are defined in (F55), while (F56) multiplies these by occupational employment rates to give an expected wage measure. Occupational employment rates are in turn defined by occupational demand for persons relative to supply of persons through

equations (F61) and (F63). The transformation elasticity in the occupational choice equation measures the ease with which people can change occupations once they have entered the workforce. Empirical estimation for Australia by Powell, Parham, Sams, Hiep and Rimmer (1984) shows the elasticity to be fairly low - around -0.4 (the parameter appearing in equation (F57) is actually the negative of the transformation elasticity and its sign is therefore positive). Note that the choice is assumed to be over occupations but not over industries. The implication is that while it might be difficult, though not impossible, to change occupations, it is perfectly easy to change industries while staying within a single occupational category. The implication seems reasonable where sufficient industry options exist. It would not be reasonable in a one-horse-town, but the appropriate solution would then be to add a regional dimension to FH-ORANI.[22]

Finally, the number of hours offered per employed person in each occupation and industry is described in equation (F58). Hours worked is seen as a result of the labour-leisure-consumption-saving tradeoff, along the lines of Tulpulé and Powell (1978) and Tulpulé (1980). Hours worked in each occupation and industry therefore depend on real after-tax wage rates in that occupation and industry, and real disposable non-labour income per employed person. Once again, the use of group-specific shares of the different components of non-labour income in (F59) will ensure that the resulting measure relates to employed persons. The non-wage factor income component is the measure that is net of non-labour income accruing to foreigners.

The supply of person-hours to each occupation and industry is a combination of these three separate labour supply decisions. While the behavioural elasticity estimates for use in these equations are given in Chapter 6, one aspect of the numbers is worth repeating here. Hours worked respond slightly, and negatively, to real wages - Australia faces a backward bending curve in this dimension of labour supply choice. Nevertheless, the relevant quantity to be matched with labour demand is

22 In its normal long run closure in which aggregate but not occupation-specific employment is fixed, the standard version of ORANI assumes either that it is perfectly easy to change occupations, or that there is a sufficient number of unemployed in each occupation to satisfy any relative demand shifts.

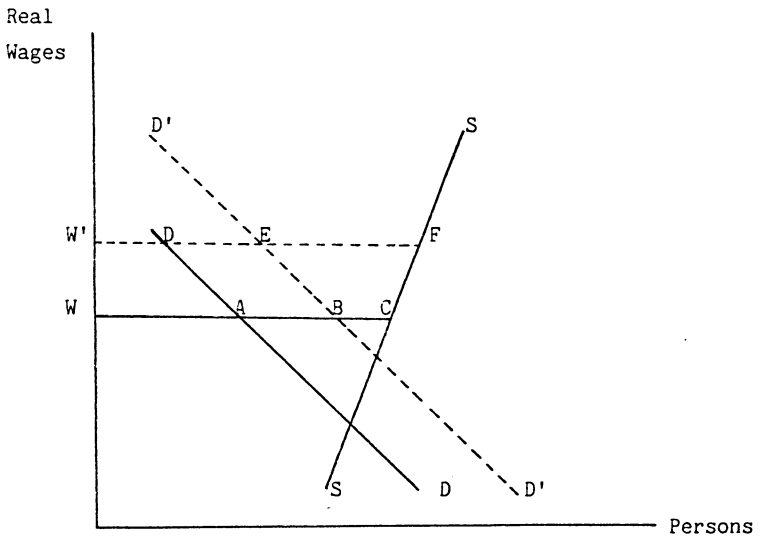
person-hours, not hours per person. A second dimension therefore involves participation, the supply of persons, and this responds slightly but positively to real wage rates. The positive response of persons is roughly as large as the negative response of hours per person so that the economy-wide labour supply curve for person-hours would seem to be almost vertical in real wage space. However, the ability, albeit limited, of people to switch occupations ensures that the supply of persons and person-hours to each occupation will be more elastic than to the economy as a whole, i.e., will be upward sloping and less than vertical.

The remaining equations in this section of the model show how labour supply reacts with labour demand to determine employment and unemployment levels. An important assumption here is embodied in equation (F62). The model assumes market clearing for hours per person employed; the number of hours per person demanded equals the number of hours per person supplied. The model user's choice of closure will influence the mechanisms which ensure this market clearing for hours per person employed.

An important closure choice with respect to the labour market concerns the degree of wage rigidity. If wages are rigid, then labour market adjustments will tend to occur via adjustments to the number of persons unemployed; if wages are more flexible, then labour market adjustments may occur through wage flexibility alone. The polar cases are illustrated, in simplified terms, in Figure 2.1. More detailed discussion of model closures is given shortly, and in Chapter 4.

If the labour market closure allows wage flexibility, then wage adjustments may, among other things, help to ensure that those employed are working their desired number of hours. If the closure instead incorporates a degree of wage rigidity, then adjustments to the number of unemployed may help to ensure that those still employed are on their supply curves for hours worked. In a general equilibrium context, of course, indirect influences will also have a role to play in ensuring market clearing for hours per person employed. For example, the perfect mobility of workers of a given occupation across different industries is likely to be particularly important.

FIGURE 2.1 : A SIMPLIFIED ILLUSTRATION OF ALTERNATIVE LABOUR MARKET CLOSURES



This diagram simplifies the labour market by ignoring variations in hours per employed worker. In real wage-persons space, labour demand is initially DD and labour supply is SS. At an initial real wage of W, employment is given by the point A and unemployment is given by the distance AC.

Consider a shock to the economy which shifts the labour demand curve to D'D'. The new equilibrium depends on whether real wages or unemployment are treated as exogenous.

(i) With real wages exogenous and unemployment endogenous, the real wage stays at W, unemployment shifts to BC and employment shifts to the point B.

(ii) With real wages endogenous and unemployment exogenous (say, because the distance AC represents some natural level of unemployment), the real wage shifts to W' so that unemployment EF equals the initial level AC, and employment shifts to the point E.

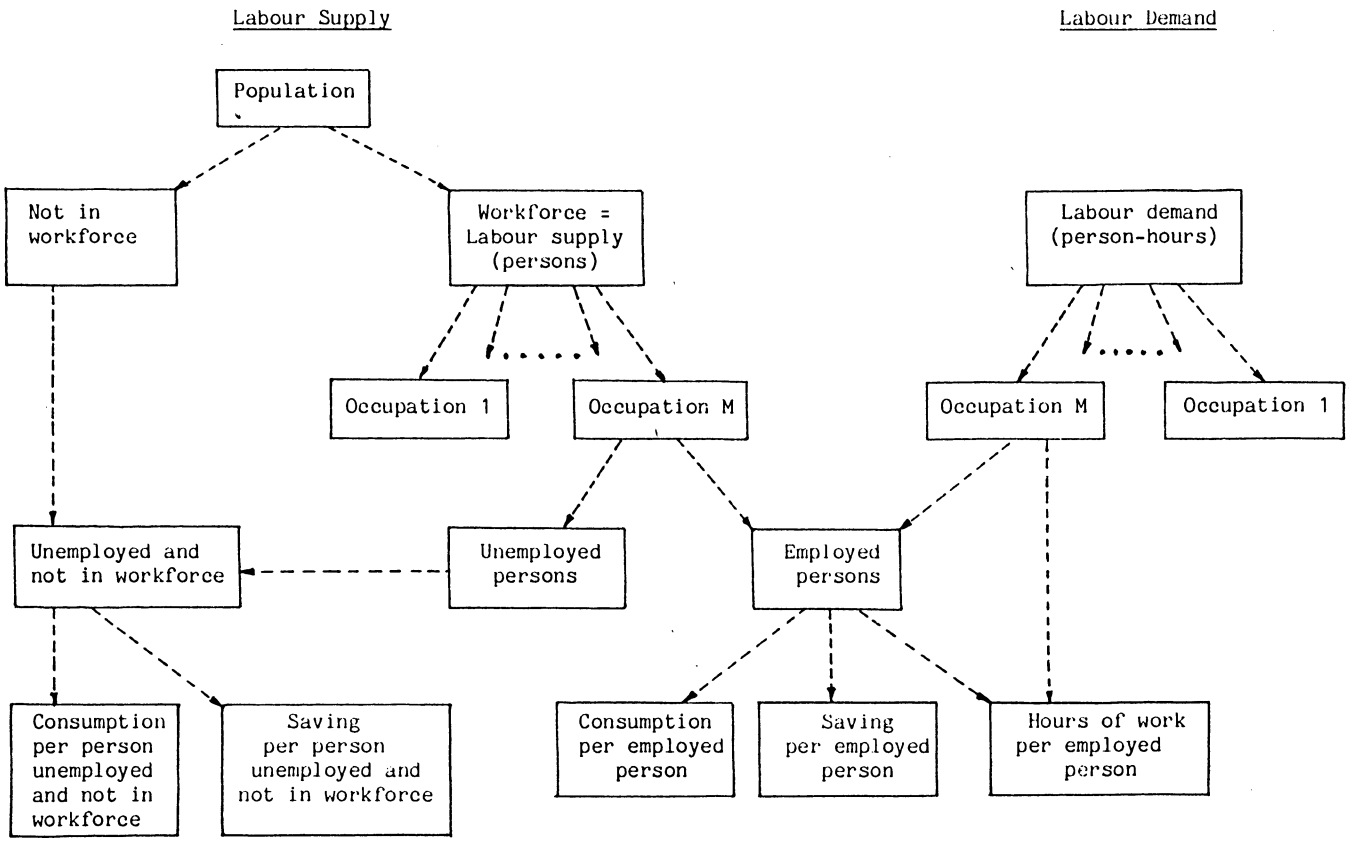
The assumption of market clearing for hours per person employed has the modelling advantage that those employed are always on their hours supplied curves, and thus always remain on their consumption, saving and other curves that are determined jointly with hours supplied in a labour-leisure-consumption-saving framework. Consumption and savings functions for the employed are introduced later in the model, as are separate consumption and savings functions for the unemployed and those not in the workforce. The assumption of hours market clearing simply means that the model abstracts from issues of unfilled overtime or underutilisation of existing employees (Powell 1983).

Similarly, the model specification ensures that industries are always on their demand curves for person-hours by occupation, and thus remain on the other factor demand curves that are determined jointly with labour demand in the cost-minimising factor choice framework of standard ORANI. This is implicit in equation (F60) where levels of persons employed, which need not equal the levels of persons supplied, can adjust residually to ensure that persons and hours per person together meet industry demand levels.

Finally, aggregate employment of persons is defined in (F64). Note that this measure differs from standard ORANI's existing measure of aggregate employment of person-hours. The number of unemployed is then defined in (F65) as the difference between aggregate supply of and demand for persons, while the number of people not in the workforce is defined in (F66) as the difference between the population and the number of persons in the workforce. The number of unemployed has been expressed in percentage rather than absolute change terms. This assumes that the variable will never change sign, i.e., that the labour market for persons will clear or be slack, but there will never emerge an excess demand for persons.

Figure 2.2 provides a diagrammatic summary of the complete structure of the labour market module of the fiscal extension. Suppose the real wage in each occupation and industry is fixed exogenously. Given the structure shown in Figure 2.2, fiscal ORANI's labour market can operate in the following way. Any shock which affects the demand for

FIGURE 2.2: LABOUR MARKET MODULE OF FISCAL EXTENSION



person-hours is likely also to affect the number of hours existing employees are willing to supply. After they adjust their hours worked, the number of persons employed can then respond residually to ensure that the new demand for person-hours is fulfilled. This and any adjustment to labour force participation and occupational choice will then determine aggregate unemployment and the way this is divided among occupations.

As is usual within an ORANI framework, however, variations on this story can be obtained with alternative closures in the same model framework. Though closures for the entire model are discussed in more detail in Chapter 4, several labour market alternatives are mentioned here. For industries where it is judged infeasible to marginally adjust hours per worker (industries which require continuous 24 hour operation in three shifts would be one example), hours per person could be set exogenously and the appropriate industry and occupational wage shift variables could be made endogenous (to measure required changes in shift work premiums).

Similarly, a move to full employment, i.e., to market clearing for persons, could be modelled by exogenously shifting occupational employment rates while providing for flexibility in relative occupational wage rates. The appropriate shocks to occupational employment rates would be whatever was required to move them from their initial levels to 100-x per cent, where x represents some irreducible minimum level of frictional unemployment for each occupation. Calculation of these shocks would firstly require data on current employment rates by occupation or, equivalently, on current unemployment rates by occupation. Unemployment statistics are now available by occupation of previous job, although the occupational classification does not exactly match the IMPACT classification outlined in DPSV.[23] Work is also under way to obtain an indirect association between the unemployed and the occupation in which they are currently seeking work, via the Income and Housing Surveys published by the Australian Bureau of Statistics. Calculation of full employment shocks would also require

23 However, the Australian Standard Classification of Occupations (ASCO) has been gradually introduced in the presentation of ABS statistics since September 1986 and, at its finest level of disaggregation, maps relatively easily into the IMPACT classification.

estimates of x, measures of the irreducible or "natural" level of unemployment in each occupation. No known attempts have been made to estimate these by occupation, although for many purposes it may be sufficient to assume x = 0.

Another possible closure would be to allow aggregate (but not relative) real wage flexibility so as to hold fixed the aggregate number of unemployed. This would represent the maximum degree of labour market flexibility possible in an economy in which relative wage adjustment was difficult to achieve. In closures such as this, the endogenous adjustments produced in occupation-specific employment rates could possibly be unrealistic, implying for example that the available supply of a particular occupational skill was more than exhausted. Estimates of current unemployment rates by occupation could be used to run an independent check for such unrealistic results.

2.10 Aggregate Consumption

Aggregate nominal consumption of employed persons is written in equation (F67) of Table 2.2 as the product of real consumption per employed person, the number employed and the consumer price index. Real per capita consumption depends on the same variables as does hours offered per employed person, and has been derived and estimated in the same choice framework. In particular, it depends on real per capita non-labour income of the employed, itself comprising non-wage factor income (net of income accruing to foreigners) and the various types of government transfers, including "other" government expenditure and net of "other" government revenue. The addition of a shift term to this consumption function allows the aggregate consumption story introduced in this section to be overridden, should the user want to retain the story and macro closure options of the standard ORANI model core. Its role will be discussed in more detail in Chapter 4.

In order to explain aggregate consumption of the entire economy, an explanation is required of aggregate consumption by the unemployed and those not in the workforce. In the absence of theoretical or empirical work for Australia on this score, the model assumes in (F68) that those who are not among the employed consume all their income, i.e., that only

the employed save.[24] Consumption of the unemployed and those not in the workforce changes in strict proportion to their total disposable income, which in turn comprises both disposable non-wage factor income (net of income accruing to foreigners) and government transfers, but by definition excludes any wage income. The income shares in this equation again are group-specific.

Economy-wide aggregate nominal consumption expenditure is then defined in (F69) as the sum of consumption by the employed and by the remainder, the unemployed and those not in the workforce. Finally, aggregate saving is defined in (F70) as the product of real per capita saving of the employed, the only group to save, the number of employed and the consumer price index, where real per capita saving of the employed depends on the same variables as their consumption and hours worked. Its inclusion is simply for completeness.

2.11 Income Tax Regime

As explained in Chapter 1, the model recognises progressivity in the tax rates on labour income. Under a progressive regime, average tax rates are not constant, but increase as taxable labour income increases. Note that average tax rate changes will occur continuously (though with jumps) even if marginal tax rates vary only in several discrete steps.

The average tax rates on labour income in (F71) are modelled explicitly as functions of gross labour earnings per employed person by occupation and industry. Of course, in reality the average rate of tax collected for a given occupation and industry would itself be a composite of rates for many individuals distributed at different points in the tax scale. At its present stage of development, the fiscal extension has nothing to

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24 McAleer et al. (1979) make a similar but slightly weaker assumption, namely, that the unemployed have a marginal propensity to consume of unity. Williams (1980) instead assumes that the average propensity to consume of pensioners is about half-way between unity and the national average, an assumption consistent with a range of different values for the marginal propensity to consume. The different assumptions reflect paucity of information, but are consistent in assuming that those not working will save "less" than those working. Apart from this distinction, FH-ORANI simplifies by ignoring the possibility of distinct behaviour by different types of households.

say about how the size distribution of labour earnings among the employed within a given occupation and industry may change in response to a shock. Hence, the coefficients σ_{mj}^{YL} in (F71), which relate the average tax rate on gross labour earnings by occupation and industry to annual nominal (if the indexing parameter $h^{YL} = 0$) or real (if $h^{YL} = 1$) labour earnings per employed person, are treated as invariant parameters.

Chapter 6 shows how these tax elasticities can be calculated from the characteristics of the 1978-79 personal income tax schedule and the 1978-79 industry and occupational wage rates per worker, to obtain values which will capture the characteristics of the actual tax schedule in Australia at that time. As just seen, a tax indexing parameter is also included in the formulation of (F71) to determine whether average tax rates by occupation and industry respond to changes in real or nominal labour earnings.

Alternative tax regimes could be simulated using a combination of exogenous changes in the tax rate shift variables and alternative settings of the elasticity parameters. For example, a move to a proportional income tax regime, the so-called flat tax, could be simulated by calculating and feeding into the model through the tax shift terms the changes in average tax rates in each occupation and industry required to bring these average tax rates into equality, and by setting the elasticity parameters to zero to ensure that average tax rates then remained unchanged in the face of second, third and subsequent round adjustments throughout the economy. The calculations could be undertaken to bring average tax rates together at some predetermined level. Alternatively, they could bring rates together at an arbitrary level, while the economy-wide labour tax shift variable could be designated endogenous and allowed to adjust to measure the final level required to achieve some target elsewhere. Finally, an economy-wide shock of the same proportionate size to all average tax rates under a progressive regime would, among other things, preserve the progressivity of that regime.

The average tax rates on non-labour income in (F72) are proportional in the sense that they do not depend on the size of the non-labour income tax base. But as with the tax rates on labour income, a number of tax

shift variables have been appended to allow various tax policy changes to be modelled.

2.12 Miscellaneous Equations

Nominal GDP at market prices, to which "other" government revenue and expenditure can be tied, is not defined in standard ORANI so it is defined here in equation (F75). Nominal GDP is the product (sum in percentage change terms) of real GDP in (F73) and a GDP deflator in (F74), both of which are useful measures in their own right. Note that exports and imports in the real GDP equation (F73) are measured in pure volume terms, unlike the aggregate export, import and trade balance variables of standard ORANI that are valued at foreign prices. The real GDP measure therefore captures the effects of terms of trade changes, to the extent that these affect the volumes of imports and exports purchased. It does not capture the changed worth of a given volume of exports in terms of its ability to purchase imports (the valuation effect).

Finally, two measures of aggregate real disposable income are defined, one for those employed and another for those unemployed and not in the workforce. The motivation for defining these variables explicitly is that they are of potential policy concern, and could be targeted in policy analysis experiments. While the aggregate consumption of each group was introduced earlier and could also be targeted, the aggregate consumption of the employed is deficient as an indicator of welfare because it excludes the saving of the employed. Since saving is undertaken to expand future consumption possibilities, and since the prospect of future consumption yields utility today, a suitable welfare proxy should count that saving. The real disposable income of the employed by definition counts both their current consumption and their saving for future consumption.[25]

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25 The consumption framework adopted in the fiscal extension is not explicitly intertemporal but as Clements (1976) notes, Hadar (1971) has demonstrated that intertemporal consumption problems under assumptions of continual replanning collapse into equivalent "as if" one period problems.

TABLE 2.2 : EQUATIONS OF THE FISCAL EXTENSION

Identifier	Equation
(a)	Income and Factor Taxes - Labour
(F1)	$y^{t}_{(g+1,1,m)j} = p^{(1)}_{(g+1,1,m)j} + x^{(1)}_{(g+1,1,m)j}$
(F2)	$y^{g}_{(g+1,1,m)j} = p^{g}_{(g+1,1,m)j} + x^{(1)}_{(g+1,1,m)j}$
(F3)	$y^{d}_{(g+1,1,m)j} = p^{d}_{(g+1,1,m)j} + x^{(1)}_{(g+1,1,m)j}$
(F4)	$r^{YL}_{mj} = t^{YL}_{mj} + y^{g}_{(g+1,1,m)j}$
(F5)	$y^{d}_{(g+1,1,m)j} = B^{YL}_{mj}\, y^{g}_{(g+1,1,m)j} + (1-B^{YL}_{mj})\, r^{YL}_{mj}$
(F6)	$r^{PL}_{mj} = t^{PL}_{mj} + y^{t}_{(g+1,1,m)j}$
(F7)	$y^{t}_{(g+1,1,m)j} = H^{dL}_{mj}\, y^{d}_{(g+1,1,m)j} + H^{YL}_{mj}\, r^{YL}_{mj} + H^{PL}_{mj}\, r^{PL}_{mj}$
(F8)	$r^{YL} = \sum_{m=1}^{M} \sum_{j=1}^{h} S^{YL}_{mj}\, r^{YL}_{mj}$
(F9)	$r^{PL} = \sum_{m=1}^{M} \sum_{j=1}^{h} S^{PL}_{mj}\, r^{PL}_{mj}$
(F10)	$p^{d}_{g+1,1} = \sum_{m=1}^{M} \sum_{j=1}^{h} S^{d}_{(g+1,1,m)j}\, p^{d}_{(g+1,1,m)j}$
(F11)	$p^{g}_{g+1,1} = \sum_{m=1}^{M} \sum_{j=1}^{h} S^{g}_{(g+1,1,m)j}\, p^{g}_{(g+1,1,m)j}$
(b)	Income and Factor Taxes - Non-Labour
(F12)	$y^{t}_{(g+1,2)j} = p^{(1)}_{(g+1,2)j} + x^{(1)}_{(g+1,2)j}$

Subscript range*	Number	Description
j=1-h m=1-M	Mh	Nominal gross labour costs by industry and occupation
j=1-h m=1-M	Mh	Nominal gross labour earnings by industry and occupation
j=1-h m=1-M	Mh	Nominal disposable labour income by industry and occupation
j=1-h m=1-M	Mh	Nominal direct tax revenue on labour by industry and occupation
j=1-h m=1-M	Mh	Nominal gross labour earnings as sum of disposable income and direct tax on labour by industry and occupation
j=1-h m=1-M	Mh	Nominal payroll tax revenue by industry and occupation
j=1-h m=1-M	Mh	Nominal gross labour costs as sum of disposable income, payroll taxes and direct tax on labour by industry and occupation
	1	Aggregate nominal direct tax revenue on labour
	1	Aggregate nominal payroll tax revenue
	1	Average nominal wage rate after tax
	1	Average nominal wage rate before tax
j=1-h	h	Nominal gross factor cost for fixed capital by industry

TABLE 2.2 : EQUATIONS OF THE FISCAL EXTENSION (Cont'd)

Identifier	Equation
(F13)	$y^{t}_{(g+1,3)j} = p^{(1)}_{(g+1,3)j} + x^{(1)}_{(g+1,3)j}$
(F14)	$y^{t}_{(g+2)j} = p^{(1)}_{wj} + x^{(1)}_{g+2,j}$
(F15)	$r^{PK}_{2j} = t^{PK}_{2j} + h^{P}_{j}\,\pi_{j} + x^{(1)}_{(g+1,2)j}$
(F16)	$r^{PK}_{3j} = t^{PK}_{3j} + h^{P}_{j}\,p^{(1)}_{(g+1,3)j} + x^{(1)}_{(g+1,3)j}$
(F17)	$y^{g}_{(g+1,2)j} = B^{PK}_{2j}\,y^{t}_{(g+1,2)j} + (1-B^{PK}_{2j})\,r^{PK}_{2j}$
(F18)	$y^{g}_{(g+1,3)j} = B^{PK}_{3j}\,y^{t}_{(g+1,3)j} + (1-B^{PK}_{3j})\,r^{PK}_{3j}$
(F19)	$y^{g}_{(g+1)j} = H^{K}_{2j}\,y^{g}_{(g+1,2)j} + H^{K}_{3j}\,y^{g}_{(g+1,3)j} + H^{K}_{4j}\,y^{t}_{(g+2)j}$
(F20)	$r^{YK}_{j} = t^{YK}_{j} + G^{YK}_{j}\,y^{g}_{(g+1)j} + (1-G^{YK}_{j})\,\pi_{j} - D^{YK}_{j}\delta_{j} - D^{YK}_{j}\,x^{(1)}_{(g+1,2)j} - A^{YK}_{j}\alpha_{j} - A^{YK}_{j}y_{j}$
(F21)	$y^{d}_{(g+1)j} = B^{YK}_{j}\,y^{g}_{(g+1)j} + (1-B^{YK}_{j})\,r^{YK}_{j}$
(F22)	$r^{PK} = S^{PK}_{2}\sum_{j=1}^{h} S^{PK}_{2j}\,r^{PK}_{2j} + S^{PK}_{3}\sum_{j=1}^{h} S^{PK}_{3j}\,r^{PK}_{3j}$
(F23)	$r^{YK} = \sum_{j=1}^{h} S^{YK}_{j}\,r^{YK}_{j}$
(F24)	$y^{d}_{g+1} = \sum_{j=1}^{h} S^{d}_{(g+1)j}\,y^{d}_{(g+1)j}$
(F25)	$y^{g}_{g+1} = \sum_{j=1}^{h} S^{g}_{(g+1)j}\,y^{g}_{(g+1)j}$

Subscript range*	Number	Description
j=1-h	h	Nominal gross factor cost for agricultural land by industry
j=1-h	h	Nominal gross factor cost for working capital by industry
j=1-h	h	Property tax revenue from fixed capital by industry
j=1-h	h	Property tax revenue from agricultural land by industry
j=1-h	h	Nominal gross factor cost for fixed capital by industry as sum of gross earnings plus property taxes
j=1-h	h	Nominal gross factor cost for agricultural land by industry as sum of gross earnings plus property taxes for agricultural
j=1-h	h	Nominal gross operating surplus by industry
j=1-h	h	Nominal revenue from taxes on non-labour inputs by industry
j=1-h	h	Nominal gross operating surplus as sum of disposable non-labour income and taxes on non-labour inputs by industry
	1	Aggregate nominal property tax revenue
	1	Aggregate nominal revenue from taxes on non-labour inputs
	1	Aggregate disposable non-labour income
	1	Aggregate gross non-labour earnings

TABLE 2.2 : EQUATIONS OF THE FISCAL EXTENSION (Cont'd)

Identifier	Equation

(c) Other Non-Commodity Indirect Taxes (net)

(F26) $$r_j^{NI} = S_j^I [p_{g+2,j}^{(1)} + x_{g+2,j}^{(1)}] + (1-S_j^I)[p_{wj}^{(1)} + x_{g+2,j}^{(1)}]$$

(F27) $$r^{NI} = \sum_{j=1}^{h} S_j^{NI} r_j^{NI}$$

(F28) $$p_{g+2,j}^{(1)} = p_{wj}^{(1)} + t_j^I$$

(F29) $$p_{wj}^{(1)} = h_j^w \xi^{(3)} + f_j^w$$

(d) Commodity Taxes Less Subsidies

(F30) $$r_{(1)}^c = \sum_{s=1}^{2} \sum_{i=1}^{g} \sum_{j=1}^{h} S_{(is,j1)} [g(is,j1) + x_{(is)j}^{(1)}]$$

(F31) $$r_{(2)}^c = \sum_{s=1}^{2} \sum_{i=1}^{g} \sum_{j=1}^{h} S_{(is,j2)} [g(is,j2) + x_{(is)j}^{(2)}]$$

(F32) $$r_{(3)}^c = \sum_{s=1}^{2} \sum_{i=1}^{g} S_{(is,3)} [g(is,3) + x_{is}^{(3)}]$$

(F33) $$r_{(4)}^c = \sum_{i=1}^{g} S_{(i,4)} [g(i1,4) + x_{i1}^{(4)}]$$

(F34) $$r_{(0)}^c = \sum_{i=1}^{g} S_{i2}^{(0)} [g(i2,0) + x_{i2}^{(0)}]$$

(F35) $$r^c = S_{(1)}^c r_{(1)}^c + S_{(2)}^c r_{(2)}^c + S_{(3)}^c r_{(3)}^c + S_{(4)}^c r_{(4)}^c + S_{(0)}^c r_{(0)}^c$$

(e) Other Government Revenue

(F36) $$r^o = h_r^o \text{ gdpe} + f_r^o$$

Subscript range*	Number	Description
j=1-h	h	Other indirect tax revenue by industry
	1	Aggregate nominal revenue from other indirect taxes (net)
j=1-h	h	Other costs as sum of working capital and other indirect taxes
j=1-h	h	Indexing of price of working capital
	1	Aggregate nominal revenue from commodity taxes on intermediate inputs
	1	Aggregate nominal revenue from taxes on inputs to capital creation
	1	Aggregate nominal revenue from taxes on household consumption
	1	Aggregate nominal revenue from taxes on exports
	1	Aggregate nominal tariff revenue
	1	Aggregate revenue from commodity taxes less subsidies
	1	Aggregate nominal revenue from other sources

TABLE 2.2 : EQUATIONS OF THE FISCAL EXTENSION (Cont'd)

Identifier	Equation

(f) Total Government Revenue

(F37) $$r = S_r^{YL}\, r^{YL} + S_r^{PL}\, r^{PL} + S_r^{YK}\, r^{YK} + S_r^{PK}\, r^{PK} + S_r^{I}\, r^{NI} + S_r^{c}\, r^{c} + S_r^{o}\, r^{o}$$

(g) Government Expenditure

(F38) $$g^c = \sum_{s=1}^{2} \sum_{i=1}^{g} S_{(is)}^{(5)} \left[p_{is}^{(0)} + x_{is}^{(5)}\right]$$

(F39) $$g^i = \alpha^i + i$$

(F40) $$g^u = b_R^u + \xi^{(3)} + \ell^u$$

(F41) $$g^m = b_R^m + \xi^{(3)} + \ell^n$$

(F42) $$g^n = b_R^n + \xi^{(3)} + q$$

(F43) $$g^o = h_g^o\, gdpe + f_g^o$$

(F44) $$g = S_g^c\, g^c + S_g^i\, g^i + S_g^u\, g^u + S_g^m\, g^m + S_g^n\, g^n + S_g^o\, g^o$$

(F45) $$g' = S_g^{c'}\, g^c + S_g^{u'}\, g^u + S_g^{m'}\, g^m + S_g^{n'}\, g^n + S_g^{o'}\, g^o$$

(F46) $$\xi^{(5)} = \sum_{s=1}^{2} \sum_{i=1}^{g} S_{(is)}^{(5)}\, p_{is}^{(0)}$$

(F47) $$\xi^{(g)} = S_g^c\, \xi^{(5)} + S_g^i\, \xi^{(2)} + (S_g^u + S_g^m + S_g^n)\xi^{(3)} + S_g^o\, gdppd$$

(F48) $$\xi^{(g)'} = S_g^{c'}\, \xi^{(5)} + (S_g^{u'} + S_g^{m'} + S_g^{n'})\xi^{(3)} + S_g^{o'}\, gdppd$$

Subscript range*	Number	Description
	1	Aggregate nominal government revenue
	1	Aggregate government final consumption expenditure
	1	Aggregate government investment expenditure
	1	Aggregate nominal unemployment benefits
	1	Aggregate nominal means-tested transfers to persons
	1	Aggregate nominal non-means-tested transfers to persons
	1	Aggregate nominal other outlays
	1	Aggregate government expenditure
	1	Aggregate government current expenditure
	1	Government consumption expenditure price index
	1	Government total expenditure price index
	1	Government current expenditure price index

TABLE 2.2 : EQUATIONS OF THE FISCAL EXTENSION (Cont'd)

Identifier	Equation
(h)	Government Budget
(F49)	$100\ \Delta GB = Gg - Rr$
(F50)	$100\ \Delta GBR = G[g - \xi^{(g)}] - R[r - \xi^{(g)}]$
(F51)	$100\ \Delta GC = G'g' - Rr$
(F52)	$100\ \Delta GCR = G'[g' - \xi^{(g)'}] - R[r - \xi^{(g)'}]$
(i)	Labour Supplies and Unemployment
(F53)	$\ell^s = q + \gamma^1_\ell [p^g_{g+1,1} - \xi^{(3)}] + \gamma^2_\ell [\ell^u - \ell^s] + \gamma^3_\ell [y^g_n - \xi^{(3)} - q]$
(F54)	$y^g_n = S^g_{yn} yad + S^u_{yn} g^u + S^m_{yn} g^m + S^n_{yn} (S^n_o g^n + S^g_o g^o - S^t_o r^o)$
(F55)	$p^g_m = \sum_{j=1}^{h} S^m_{(g+1,1,m)j}\ p^g_{(g+1,1,m)j}$
(F56)	$p^c_m = p^g_m + e_m$
(F57)	$\ell^s_m = \ell^s + \sigma^s_m [p^c_m - \sum_{m=1}^{M} S_m\ p^c_m]$
(F58)	$m^s_{mj} = \gamma^1_m [y^d_m - \xi^{(3)} - \ell^{(1)}] + \gamma^2_m [p^d_{(g+1,1,m)j} - \xi^{(3)}]$
(F59)	$y^d_m = S^g_{ym} yad + S^u_{ym} g^u + S^m_{ym} g^m + S^n_{ym} (S^n_o g^n + S^g_o g^o - S^t_o r^o)$
(F60)	$x^{(1)}_{(g+1,1,m)j} = \ell^{(1)}_{(g+1,1,m)j} + m^{(1)}_{(g+1,1,m)j}$

Subscript range*	Number	Description
	1	Nominal government borrowing requirement
	1	Real government borrowing requirement
	1	Nominal government deficit on current account
	1	Real government deficit on current account
	1	Labour force participation
	1	Aggregate nominal non-labour income including transfer payments
m=1-M	M	Gross wage in each occupation
m=1-M	M	Expected wage in each occupation
m=1-M	M	Supply of persons to each occupation
j=1-h m=1-M	Mh	Supply of hours per person by occupation to each industry
	1	Aggregate nominal disposable non-labour income including transfer payments of employed
j=1-h m=1-M	Mh	Demand for person-hours as the product of demand for persons and hours per person (by industry and occupation)

TABLE 2.2 : EQUATIONS OF THE FISCAL EXTENSION (Cont'd)

Identifier	Equation
(F61)	$\ell_m^{(1)} = \sum_{j=1}^{h} \psi_{(g+1,1,m)j}\, \ell_{(g+1,1,m)j}^{(1)}$
(F62)	$m_{mj}^{s} = m_{(g+1,1,m)j}^{(1)}$
(F63)	$e_m = \ell_m^{(1)} - \ell_m^{s}$
(F64)	$\ell^{(1)} = \sum_{m=1}^{M} \psi_{1m} \ell_m^{(1)}$
(F65)	$S_\ell^u\, \ell^u = \ell^s - (1 - S_\ell^u)\ell^{(1)}$
(F66)	$S_\ell^n\, \ell^n = q - (1 - S_\ell^n)\, \ell^s$

(j) Aggregate Consumption

(F67)	$c^e = \xi^{(3)} + \ell^{(1)} + \gamma_c^1 [y_m^d - \xi^{(3)} - \ell^{(1)}] + \gamma_c^2 [p_{g+1,1}^d - \xi^{(3)}] + f_c$
(F68)	$c^o = S_{yo}^g yad + S_{yo}^u g^u + S_{yo}^m g^m + S_{yo}^n (S_o^n g^n + S_o^g g^o - S_o^t r^o)$
(F69)	$c = S^e c^e + (1 - S^e)\, c^o$
(F70)	$s = \xi^{(3)} + \ell^{(1)} + \gamma_s^1 [y_m^d - \xi^{(3)} - \ell^{(1)}] + \gamma_s^2 [p_{g+1,1}^d - \xi^{(3)}]$

(k) Income Tax Regime

(F71)	$t_{mj}^{YL} = \sigma_{mj}^{YL} [y_{(g+1,1,m)j}^{g} - \ell_{(g+1,1,m)j}^{(1)} - h^{YL}\xi^{(3)}] + f_{mj}^{YL} + f^{YL} + f^{Y}$

Subscript range*	Number	Description
m=1-M	M	Demand for persons of each skill
j=1-h m=1-M	Mh	Supply equals demand for hours per employed person
m=1-M	M	Employment rate for each occupation
	1	Number of persons employed
	1	Number of persons unemployed
	1	Number of persons not in workforce
	1	Aggregate nominal consumption of employed persons
	1	Aggregate nominal consumption of unemployed and those not in workforce
	1	Aggregate nominal consumption
	1	Aggregate nominal private saving
j=1-h m=1-M	Mh	Average direct tax rates on labour inputs

TABLE 2.2 : EQUATIONS OF THE FISCAL EXTENSION (Cont'd)

Identifier	Equation

(F72) $$t_j^{YK} = f_j^{YK} + f^{YK} + f^{Y}$$

(ℓ) Miscellaneous Equations

(F73) $$gdp = S^{G1} \sum_{s=1}^{2} \sum_{i=1}^{g} S_{is}^{G1} x_{is}^{(3)} + S^{G2} \sum_{j=1}^{h} S_j^{G2} y_j + S^{G3} \sum_{s=1}^{2} \sum_{i=1}^{g} x_{is}^{(5)} + S^{G4} \sum_{i=1}^{g} S_i^{G4} x_{i1}^{(4)} - S^{G5} \sum_{i=1}^{g} S_i^{G5} x_{i2}^{(0)}$$

(F74) $$gdppd = S^{G1} \sum_{s=1}^{2} \sum_{i=1}^{g} S_{is}^{G1} p_{is}^{(3)} + S^{G2} \sum_{j=1}^{h} S_j^{G2} \pi_j + S^{G3} \sum_{s=1}^{2} \sum_{i=1}^{g} p_{is}^{(0)} + S^{G4} \sum_{i=1}^{g} S_i^{G4} [p_{i1}^{e} + \phi] - S^{G5} \sum_{i=1}^{g} S_i^{G5} [p_{i2}^{m} + \phi]$$

(F75) $$gdpe = gdp + gdppd$$

(F76) $$y_R^e = S_\ell^e p_{g+1,1}^d + S_\ell^e \ell + (1 - S_\ell^e) y_m^d - \xi^{(3)}$$

(F77) $$y_R^o = c^o - \xi^{(3)}$$

Number of equations in fiscal extension = 11Mh + 14h + 5M + 47

* In this column the notation "j=1-h", for example, indicates that the suffix j ranges over all integers from 1 to h inclusive. h is the number of industries and M is the number of occupations distinguished. In the FH-ORANI database outlined in Chapter 6, h = 112 and M = 10.

Subscript range*	Number	Description
j=1-h	h	Average direct tax rates on non-labour inputs
	1	Real GDP at market prices
	1	GDP deflator
	1	Nominal GDP at market prices
	1	Aggregate real disposal income of employed
	1	Aggregate real disposal income of unemployed and those not in workforce

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
α^i		1	Share of government investment in total investment expenditure
α_j	j=1-h	h	Rate of investment allowances by industry
b_R^m		1	Real means-tested transfers per recipient
b_R^n		1	Real non-means-tested transfers per recipient
b_R^u		1	Real unemployment benefit per unemployed person
c^e		1	Aggregate nominal consumption expenditure of employed persons
c^o		1	Aggregate nominal consumption expenditure of unemployed and those not in workforce
δ_j	j=1-h	h	Rate of depreciation allowances by industry
ΔGB		1	Nominal government borrowing requirement (absolute change in millions of base period dollars)
ΔGBR		1	Real government borrowing requirement (absolute change in millions of base period dollars)
ΔGC		1	Nominal government deficit on current account (absolute change in millions of base period dollars)

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
ΔGCR		1	Real government deficit on current account (absolute change in millions of base period dollars)
e_m	m=1-M	M	Employment rate in each occupation
f_c		1	Shift to allow aggregate consumption function to be "deactivated"
f_g^O		1	Shift term in nominal other government outlays
f_r^O		1	Shift term in nominal government revenue from other sources
f_j^W	j=1-h	h	Shift term in price of working capital by industry
f_j^{YK}	j=1-h	h	Specific shift in average tax rates on non-labour inputs
f^{YK}		1	General shift in average tax rates on non-labour inputs
f_{mj}^{YL}	j=1-h m=1-M	Mh	Specific shift in average tax rates on labour income
f^{YL}		1	General shift in average tax rates on labour income
f^Y		1	Economy-wide shift in direct tax rates
g		1	Aggregate nominal government expenditure

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
g'		1	Aggregate nominal government current expenditure
g^c		1	Aggregate government final consumption expenditure
gdp		1	Real GDP at market prices
gdpe		1	Nominal GDP at market prices
gdppd		1	GDP price deflator
g^i		1	Aggregate government investment expenditure
g^m		1	Aggregate nominal means-tested transfers to persons
g^n		1	Aggregate nominal non-means-tested transfers to persons
g^o		1#	Nominal other government outlays
g^u		1	Aggregate nominal unemployment benefits
$\ell^{(1)}_{(g+1,1,m)j}$	j=1-h m=1-M	Mh#	Demand for persons by occupation in each industry
$\ell^{(1)}_m$	m=1-M	M	Aggregate demand for persons of each occupation
$\ell^{(1)}$		1	Aggregate number of persons employed

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
ℓ^n		1	Number of persons not in workforce
ℓ^s_m	m=1-M	M	Supply of persons to each occupation
ℓ^s		1	Number of persons in labour force
ℓ^u		1	Number of unemployed persons
$m^{(1)}_{(g+1,1,m)j}$	j=1-h m=1-M	Mh#	Demand for hours per person by occupation in each industry
m^s_{mj}	j=1-h m=1-M	Mh#	Supply of hours per person by occupation to each industry
p^c_m	m=1-M	M#	Expected wage in each occupation
$p^d_{(g+1,1,m)j}$	j=1-h m=1-M	Mh	Post-tax nominal wage rate by industry and occupation
$p^d_{g+1,1}$		1	Average nominal wage rate after tax
$p^g_{(g+1,1,m)j}$	j=1-h m=1-M	Mh#	Pre-tax nominal wage rate by industry and occupation
$p^g_{g+1,1}$		1	Average nominal wage rate before tax
p^g_m	m=1-M	M#	Average nominal pre-tax wage in each occupation
$p^{(1)}_{wj}$	j=1-h	h#	Price of working capital by industry
r		1	Aggregate nominal government revenue

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
$r^{c}_{(1)}$		1	Aggregate nominal revenue from commodity taxes on intermediate inputs
$r^{c}_{(2)}$		1	Aggregate nominal revenue from commodity taxes on inputs to capital creation
$r^{c}_{(3)}$		1	Aggregate nominal revenue from commodity taxes on household consumption
$r^{c}_{(4)}$		1	Aggregate nominal revenue from commodity taxes on exports
$r^{c}_{(0)}$		1	Aggregate nominal tariff revenue
r^{c}		1	Aggregate nominal revenue from commodity taxes less subsidies
r^{NI}_{j}	j=1-h	h#	Other non-commodity indirect tax revenue (net) by industry
r^{NI}		1	Aggregate nominal revenue from other non-commodity indirect taxes (net)
r^{o}		1#	Nominal government revenue from other sources
r^{PK}_{2j}	j=1-h	h#	Revenue from property taxes on fixed capital by industry
r^{PK}_{3j}	j=1-h	h#	Revenue from property taxes on agricultural land by industry
r^{PK}		1	Aggregate nominal property tax revenue

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
r^{PL}_{mj}	j=1-h m=1-M	Mh#	Nominal payroll tax revenue by industry and occupation
r^{PL}		1	Aggregate nominal payroll tax revenue
r^{YK}_{j}	j=1-h	h#	Revenue from taxes on non-labour inputs by industry
r^{YK}		1	Aggregate nominal revenue from taxes on non-labour inputs
r^{YL}_{mj}	j=1-h m=1-M	Mh#	Nominal direct tax revenue on labour by industry and occupation
r^{YL}		1	Aggregate nominal direct tax revenue on labour
s		1	Aggregate nominal private saving
t^{I}_{j}	j=1-h	h	Scaling factor for other indirect non-commodity taxes (net) by industry
t^{PK}_{2j}	j=1-h	h	Property tax rate on fixed capital by industry
t^{PK}_{3j}	j=1-h	h	Property tax rate on agricultural land by industry
t^{PL}_{mj}	j=1-h m=1-M	Mh	Nominal payroll tax rate by industry and occupation
t^{YK}_{j}	j=1-h	h#	Tax rate on non-labour inputs by industry

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
t^{YL}_{mj}	j=1-h m=1-M	Mh	Nominal direct tax rate on labour by industry and occupation
$\xi^{(5)}$		1	Government consumption expenditure price index
$\xi^{(g)}$		1	Government total expenditure price index
$\xi^{(g)'}$		1	Government current expenditure price index
$y^{d}_{(g+1,1,m)j}$	j=1-h m=1-M	Mh#	Nominal disposable labour income by industry and occupation
$y^{d}_{(g+1)j}$	j=1-h	h	Nominal disposable non-labour income by industry
y^{d}_{g+1}		1	Aggregate nominal disposable non-labour income
y^{d}_{m}		1#	Aggregate nominal disposable non-labour income including transfer payments of employed
y^{e}_{R}		1	Aggregate real disposable income of employed
$y^{g}_{(g+1,1,m)j}$	j=1-h m=1-M	Mh#	Nominal gross labour earnings by industry and occupation
$y^{g}_{(g+1,2)j}$	j=1-h	h#	Nominal gross earnings to fixed capital by industry
$y^{g}_{(g+1,3)j}$	j=1-h	h#	Nominal gross earnings to agricultural land by industry

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Unique to Fiscal Extension (in alphabetical order)			
$y^{g}_{(g+1)j}$	j=1-h	h[#]	Gross operating surplus by industry
y^{g}_{g+1}		1	Aggregate gross non-labour earnings
y^{g}_{n}		1[#]	Aggregate nominal non-labour income including transfer payments
y^{o}_{R}		1	Aggregate real disposable income of unemployed and those not in workforce
$y^{t}_{(g+1,1,m)j}$	j=1-h m=1-M	Mh[#]	Nominal gross labour costs by industry and occupation
$y^{t}_{(g+1,2)j}$	j=1-h	h[#]	Nominal gross factor cost for fixed capital by industry
$y^{t}_{(g+1,3)j}$	j=1-h	h[#]	Nominal gross factor cost for agricultural land by industry
$y^{t}_{(g+2)j}$	j=1-h	h[#]	Nominal gross factor cost for working capital by industry
Number of variables unique to fiscal extension = 13Mh + 20h + 5M + 56			
Variables Shared with Standard ORANI (in alphabetical order)			
c		1	Aggregate household consumption expenditure
$f^{(1)}_{g+2,j}$	j=1-h	h	Shift term in price of other cost tickets
g(is,j1)	i=1-g j=1-h s=1,2	2gh[†]	Tax rate on sales of commodity i from source s to industry j for current production

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Shared with Standard ORANI (in alphabetical order)			
$g(is,j2)$	i=1-g j=1-h s=1,2	$2gh^{\dagger}$	Tax rate on sales of commodity i from source s to industry j for capital creation
$g(is,3)$	i=1-g s=1,2	$2g^{\dagger}$	Tax rate on sales of commodity i from source s to households
$g(i1,4)$	i=1-g	$g^{\dagger}$	Tax rate on sales of domestic good i for export
$g(i2,0)$	i=1-g	$g^{\dagger}$	Rate of customs duty on imported good i
i		1	Aggregate nominal private investment expenditure
ℓ		1	Aggregate employment (in person-hours)
$p^{(1)}_{(g+1,1,m)j}$	j=1-h m=1-M	Mh	Price paid for labour of each occupation by each industry
$p^{(1)}_{(g+1,2)j}$	j=1-h	h	Rental price of fixed capital by industry
$p^{(1)}_{(g+1,3)j}$	j=1-h	h	Rental price of agricultural land by industry
$p^{(1)}_{g+2,j}$	j=1-h	$h^{\#}$	Price of other cost tickets to each industry
$p^{(3)}_{is}$	i=1-g s=1,2	$2g^{\#}$	Purchasers' price paid for commodities by households
p^{e}_{i1}	i=1-g	g	F.o.b. foreign currency export prices

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Shared with Standard ORANI (in alphabetical order)			
p^{m}_{i2}	i=1-g	g	C.i.f. foreign currency import prices
$p^{(0)}_{is}$	i=1-g s=1,2	2g	Basic price of commodity i from source s
π_j	j=1-h	h	Replacement cost of fixed capital in each industry
ϕ		1	Exchange rate (price of foreign currency)
q		1	Number of households
$x^{(1)}_{(g+1,1,m)j}$	j=1-h	Mh#	Demand for person-hours by industry and occuptation
$x^{(1)}_{(g+1,2)j}$	j=1-h	h#	Demand for fixed capital in each industry
$x^{(1)}_{(g+1,3)j}$	j=1-h	h#	Demand for agricultural land in each industry
$x^{(1)}_{g+2,j}$	j=1-h	h#	Demand for other costs tickets by industry
$x^{(1)}_{(is)j}$	i=1-g j=1-h s=1,2	2gh#	Demand for commodity i from source s by industry j for current production
$x^{(2)}_{(is)j}$	i=1-g j=1-h s=1,2	2gh#	Demand for commodity i from source s by industry j for capital creation
$x^{(3)}_{is}$	i=1-g s=1,2	2g	Household demand for commodity i from source s

TABLE 2.3: VARIABLES OF THE FISCAL EXTENSION (Cont'd)

Variable	Subscript range*	Number	Description
Variables Shared with Standard ORANI (in alphabetical order)			
$x^{(4)}_{(i1)}$	i=1-g	g	Export demands for domestic good i
$x^{(0)}_{i2}$	i=1-g	g	Aggregate imports of commodity i
$x^{(5)}_{is}$	i=1-g s=1,2	$2g^{\#}$	Other (mainly government) demand for commodity i from source s
$\xi^{(3)}$		1	Consumer price index
$\xi^{(2)}$		1	Investment goods price index
y_j	j=1-h	h	Capital creation by using industry
Variables Shared with Modified Horridge Extension			
yad		1	Aggregate disposable non-labour income of Australians

* In this column the notation"j=1-h", for example, indicates that the suffix j ranges over all integers from 1 to h inclusive. h is the number of industries, g is the number of commodities and M is the number of occupations distinguished. In the FH-ORANI database outlined in Chapter 6, h = 112, g = 114 and M = 10.

\# These variables are eliminated in the condensed system.

† These variables are replaced in the condensed system by composite variables - see Chapter 5.

Notes to Table 2.4

Tables 2.2 and 2.3 gave the equations and variables of the fiscal extension, while Table 2.4 describes the coefficients and parameters of those equations. It also outlines sources for those coefficients and parameters. Some need to be obtained directly from external sources. These are usually described in Table 2.4 as being "user specified" (in the case of the indexing parameters), as coming from "econometric" sources (in the case of the behavioural parameters mentioned in Chapter 2), or as being "calculated directly" from external data (in the case of some of the aggregate government revenue and expenditure shares). The 1978-79 values for all but the indexing parameters are given directly in Chapter 6.

However, most of the entities in Table 2.4 are coefficients described as coming from the standard ORANI database (ODB) and/or the fiscal database (FDB). In these instances, a description is given of how the coefficient is calculated from database matrices or vectors (denoted by tildes). The matrices from the standard ORANI database most commonly used in Table 2.4 are:

$\tilde{U}$: a (Mxh) matrix of gross factor costs for labour
$\tilde{V}$: a (1xh) vector of gross factor costs for fixed capital
$\tilde{W}$: a (1xh) vector of gross factor costs for land
$\tilde{X}$: a (1xh) vector of "other" costs

where M = number of occupations
h = number of industries

The full set of data matrices in the standard ORANI database is given in DPSV (p. 151). The reader is referred there for a description of the other ORANI data matrices used in Table 2.4.

In addition to standard ORANI data, the following fiscal data matrices are referred to in Table 2.4:

$\tilde{U}_P$: a (Mxh) matrix of payroll taxes

$\tilde{U}_T$: a (Mxh) matrix of direct taxes on labour income

$\tilde{V}_P$: a (1xh) vector of property taxes on fixed capital

$\tilde{V}_D$: a (1xh) vector of depreciation allowances

$\tilde{V}_A$: a (1xh) vector of investment allowances

$\tilde{W}_P$: a (1xh) vector of property taxes on land

$\tilde{X}_W$: a (1xh) vector of working capital

$\tilde{X}_O$: a (1xh) vector of other indirect taxes (net)

$\tilde{V}_T$: a (1xh) vector of direct taxes on non-labour income

The 1978-79 values for these fiscal data matrices are provided in Chapter 6. The 1978-79 values for the standard ORANI data matrices are available in the standard 1978-79 ORANI database.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION

Equation/Parameter		Description	Source (ODB = ORANI database, FDB = fiscal database)
(F5)	B^{YL}_{mj}	Ratio of gross labour earnings to disposable labour income for occupation m in industry j.	FDB and ODB. mjth element of $\tilde{U} - \tilde{U}_P$ divided by mjth element of $\tilde{U} - \tilde{U}_P - \tilde{U}_T$.
(F7)	H^{dL}_{mj}	Share of disposable labour income in gross labour costs for occupation m in industry j.	FDB and ODB. mjth element of $\tilde{U} - \tilde{U}_P - \tilde{U}_T$ divided by mjth element of $\tilde{U}$.
(F7)	H^{YL}_{mj}	Share of direct taxes in gross labour costs for occupation m in industry j.	FDB and ODB. mjth element of $\tilde{U}_T$ divided by mjth element of $\tilde{U}$.
(F7)	H^{PL}_{mj}	Share of payroll tax in gross labour costs for occupation m in industry j.	FDB and ODB. mjth element of $\tilde{U}_P$ divided by mjth element of $\tilde{U}$.
(F8)	S^{YL}_{mj}	Share of aggregate nominal direct tax revenue on labour accounted for by direct tax on occupation m in industry j.	FDB. mjth element of $\tilde{U}_T$ divided by sum of all elements in $\tilde{U}_T$.
(F9)	S^{PL}_{mj}	Share of aggregate nominal payroll tax revenue accounted for by payroll tax paid on occupation m in industry j.	FDB. mjth element of $\tilde{U}_P$ divided by sum of all elements in $\tilde{U}_P$.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F10) $S^{d}_{(g+1,1,m)j}$	Share of aggregate disposable labour income accounted for by disposable income to occupation m in industry j.	FDB and ODB. mjth element of $\tilde{U} - \tilde{U}_P - \tilde{U}_T$ divided by sum of all elements in $\tilde{U} - \tilde{U}_P - \tilde{U}_T$.
(F11) $S^{g}_{(g+1,1,m)j}$	Share of aggregate labour earnings accounted for by gross earnings to occupation m in industry j.	FDB and ODB. mjth element of $\tilde{U} - \tilde{U}_P$ divided by sum of all elements in $\tilde{U} - \tilde{U}_P$.
(F15), (F16) h^{P}_{j}	Parameter to allow indexing of property tax rates.	User specified.
(F17) B^{PK}_{2j}	Ratio of factor costs to gross earnings for fixed capital in industry j.	FDB and ODB. jth element of $\tilde{V}$ divided by jth element of $\tilde{V} - \tilde{V}_P$.
(F18) B^{PK}_{3j}	Ratio of factor costs to gross earnings for agricultural land in industry j.	FDB and ODB. jth element of $\tilde{W}$ divided by jth element of $\tilde{W} - \tilde{W}_P$.
(F19) H^{K}_{2j}	Share of gross operating surplus in industry j accounted for by gross earnings to fixed capital.	FDB and ODB. jth element of $\tilde{V} - \tilde{V}_P$ divided by jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W$.

(F19)	H^K_{3j}	Share of gross operating surplus in industry j accounted for by gross earnings to agricultural land.	FDB and ODB. jth element of $\tilde{W} - \tilde{W}_P$ divided by jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W$.
(F19)	H^K_{4j}	Share of gross operating surplus in industry j accounted for by gross factor cost of working capital.	FDB and ODB. jth element of $\tilde{X}_W$ divided by jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W$.
(F20)	G^{YK}_j	Ratio of gross operating surplus to GOS net of depreciation and investment allowances in industry j.	FDB and ODB. jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W$ divided by jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W - \tilde{V}_D - \tilde{V}_A$.
(F20)	D^{YK}_j	Ratio of depreciation allowances to GOS net of depreciation and investment allowances in industry j.	FDB and ODB. jth element of $\tilde{V}_D$ divided by jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W - \tilde{V}_D - \tilde{V}_A$.
(F20)	A^{YK}_j	Ratio of investment allowances to GOS net of depreciation and investment allowances in industry j.	FDB and ODB. jth element of $\tilde{V}_A$ divided by jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W - \tilde{V}_D - \tilde{V}_A$.
(F21)	B^{YK}_j	Ratio of gross operating surplus to nominal disposable non-labour income in industry j.	FDB and ODB. jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W$ divided by jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W - \tilde{V}_T$.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F22) S_2^{PK}	Share of aggregate property tax revenue accounted for by aggregate property taxes on fixed capital.	FDB. Sum of all elements in $\tilde{V}_P$ divided by sum of all elements in $\tilde{V}_P + \tilde{W}_P$.
(F22) S_3^{PK}	Share of aggregate property tax revenue accounted for by aggregate property taxes on agricultural land.	FDB. Sum of all elements in $\tilde{W}_P$ divided by the sum of all elements in $\tilde{V}_P + \tilde{W}_P$.
(F22) S_{2j}^{PK}	Share of aggregate property taxes on fixed capital accounted for by property taxes on fixed capital in industry j.	FDB. jth element of $\tilde{V}_P$ divided by sum of all elements in $\tilde{V}_P$.
(F22) S_{3j}^{PK}	Share of aggregate property taxes on fixed capital accounted for by property taxes on fixed capital in industry j.	FDB. jth element of $\tilde{W}_P$ divided by sum of all elements in $\tilde{W}_P$.
(F23) S_j^{YK}	Share of aggregate revenue from direct taxes on non-labour inputs accounted for by taxes on non-labour inputs in industry j.	FDB. jth element of $\tilde{V}_T$ divided by sum of all elements in $\tilde{V}_T$.

(F24)	$S^{d}_{(g+1)j}$	Share of aggregate disposable non-labour income accounted for by disposable non-labour income from industry j.	FDB and ODB. jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W - \tilde{V}_T$ divided by sum of all elements in $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W - \tilde{V}_T$.
(F25)	$S^{g}_{(g+1)j}$	Share of aggregate gross operating surplus accounted for by gross operating surplus in industry j.	FDB and ODB. jth element of $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W$ divided by sum of all elements in $\tilde{V} - \tilde{V}_P + \tilde{W} - \tilde{W}_P + \tilde{X}_W$.
(F26)	S^{I}_{j}	Ratio of other costs to other indirect non-commodity taxes (net) in industry j.	FDB and ODB. jth element of $\tilde{X}$ divided by the jth element of $\tilde{X}_0$.
(F27)	S^{NI}_{j}	Share of aggregate other non-commodity indirect taxes (net) accounted for by indirect taxes (net) in industry j.	FDB. jth element of $\tilde{X}_0$ divided by sum of all elements in $\tilde{X}_0$.
(F29)	h^{w}_{j}	Parameter to allow indexing of price of working capital.	User specified.
(F30)	$S_{(is,j1)}$	Share of aggregate taxes on inputs to current production accounted for by taxes on commodity i from source s to industry j.	ODB. ijth element of $\tilde{K}_{g+1}$ (if s=1) or $\tilde{P}_{g+1}$ (if s=2) divided by sum of all elements in $\tilde{K}_{g+1} + \tilde{P}_{g+1}$.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F30)‡ $S^T_{(is,j1)}$	Ratio of tax plus basic value to tax alone for good i from source s sold to industry j for current production.	ODB. ijth element of $\tilde{A} + \tilde{K}_{g+1}$ divided by ijth element of $\tilde{K}_{g+1}$ (if s=1) or ijth element of $\tilde{F} + \tilde{P}_{g+1}$ divided by ijth element of $\tilde{P}_{g+1}$ (if s=2).
(F31) $S_{(is,j2)}$	Share of aggregate taxes on inputs to capital creation accounted for by taxes on commodity i from source s to industry j.	ODB. ijth element of $\tilde{L}_{g+1}$ (if s=1) or $\tilde{Q}_{g+1}$ (if s=2) divided by sum of all elements in $\tilde{L}_{g+1} + \tilde{Q}_{g+1}$.
(F31)‡ $S^T_{(is,j2)}$	Ratio of tax plus basic value to tax alone for good i from source s sold to industry j for capital creation.	ODB. ijth element of $\tilde{B} + \tilde{L}_{g+1}$ divided by ijth element if $\tilde{L}_{g+1}$ (if s=1) or ijth element of $\tilde{G} + \tilde{Q}_{g+1}$ divided by ijth element of $\tilde{Q}_{g+1}$ (if s=2).
(F32) $S_{(is,3)}$	Share of aggregate taxes on household consumption accounted for by taxes on commodity i from source s.	ODB. ith element of $\tilde{M}_{g+1}$ (if s=1) or $\tilde{R}_{g+1}$ (if s=2) divided by sum of all elements in $\tilde{M}_{g+1} + \tilde{R}_{g+1}$.

(F32)‡ $S^{T}_{(is,3)}$	Ratio of tax plus basic value to tax alone for good i from source s sold to household consumption.	ODB. ith element of $\tilde{C} + \tilde{M}_{g+1}$ divided by ith element of $\tilde{M}_{g+1}$ (if s=1) or ith element of $\tilde{H} + \tilde{R}_{g+1}$ divided by ith element of $\tilde{R}_{g+1}$ (if s=2).
(F33) $S_{(i,4)}$	Share of aggregate taxes on exports accounted for by taxes on domestic commodity i.	ODB. ith element of $\tilde{N}_{g+1}$ divided by sum of all elements in $\tilde{N}_{g+1}$.
(F33)‡ $S^{T}_{(i1,4)}$	Ratio of tax plus basic value to tax alone for domestic good i sold to exports.	ODB. ith element of $\tilde{D} + \tilde{N}_{g+1}$ divided by ith element of $\tilde{N}_{g+1}$.
(F34) $S^{(0)}_{i2}$	Share of aggregate tariff revenue accounted for by tariff on imported commodity i.	ODB. ith element of $-\tilde{Z}$ divided by sum of all elements in $-\tilde{Z}$.
(F34)‡ $S^{T}_{(i2,0)}$	Ratio of tariff plus foreign currency value to tariff alone for imported good i.	ODB. Sum of elements in ith row of $\tilde{F} + \tilde{G} + \tilde{H} + \tilde{J}$ divided by ith element of $-\tilde{Z}$.
(F35) $S^{c}_{(1)}$	Share of aggregate (net) commodity tax revenue accounted for by commodity taxes on inputs to current production.	ODB. Sum of all elements in $\tilde{K}_{g+1} + \tilde{P}_{g+1}$ divided by sum of all elements in $\tilde{K}_{g+1} + \tilde{P}_{g+1} + \tilde{L}_{g+1} + \tilde{Q}_{g+1} + \tilde{M}_{g+1} + \tilde{R}_{g+1} + \tilde{N}_{g+1} - (-\tilde{Z})$.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F35) $S^c_{(2)}$	Share of aggregate (net) commodity tax revenue accounted for commodity taxes on inputs to capital creation.	ODB. Sum of all elements in $\tilde{L}_{g+1} + \tilde{Q}_{g+1}$ divided by sum of all elements in $\tilde{K}_{g+1} + \tilde{P}_{g+1} + \tilde{L}_{g+1} + \tilde{Q}_{g+1} + \tilde{M}_{g+1} + \tilde{R}_{g+1} + \tilde{N}_{g+1} - (-\tilde{Z})$.
(F35) $S^c_{(3)}$	Share of aggregate (net) commodity tax revenue accounted for by commodity taxes on household consumption.	ODB. Sum of all elements in $\tilde{M}_{g+1} + \tilde{R}_{g+1}$ divided by sum of all elements in $\tilde{K}_{g+1} + \tilde{P}_{g+1} + \tilde{L}_{g+1} + \tilde{Q}_{g+1} + \tilde{M}_{g+1} + \tilde{R}_{g+1} + \tilde{N}_{g+1} - (-\tilde{Z})$.
(F35) $S^c_{(4)}$	Share of aggregate (net) commodity tax revenue accounted for by commodity taxes on exports.	ODB. Sum of all elements in $\tilde{N}_{g+1}$ divided by sum of all elements in $\tilde{K}_{g+1} + \tilde{P}_{g+1} + \tilde{L}_{g+1} + \tilde{Q}_{g+1} + \tilde{M}_{g+1} + \tilde{R}_{g+1} + \tilde{N}_{g+1} - (-Z)$.
(F35) $S^c_{(0)}$	Share of aggregate (net) commodity tax revenue accounted for by tariff revenue.	ODB. Sum of all elements in $-(-\tilde{Z})$ divided by sum of all elements in $\tilde{K}_{g+1} + \tilde{P}_{g+1} + \tilde{L}_{g+1} + \tilde{Q}_{g+1} + \tilde{M}_{g+1} + \tilde{R}_{g+1} + \tilde{N}_{g+1} - (-\tilde{Z})$.
(F36) h^o_r	Parameter to allow nominal government revenue from other sources to be tied to nominal GDP at market prices.	User specified.

(F37)	S_r^{YL}	Share of total government revenue accounted for by direct taxes on labour.	FDB. Calculated directly from government revenue and expenditure account.
(F37)	S_r^{PL}	Share of total government revenue accounted for by payroll tax revenue.	FDB. Calculated directly from government revenue and expenditure account.
(F37)	S_r^{YK}	Share of total government revenue accounted for by direct taxes on non-labour inputs.	FDB. Calculated directly from government revenue and expenditure account.
(F37)	S_r^{PK}	Share of total government revenue accounted for by property taxes.	FDB. Calculated directly from government revenue and expenditure account.
(F37)	S_r^{I}	Share of total government revenue accounted for by other indirect non-commodity taxes (net).	FDB. Calculated directly from government revenue and expenditure account.
(F37)	S_r^{C}	Share of total government revenue accounted for by commodity taxes less subsidies.	FDB. Calculated directly from government revenue and expenditure account.
(F37)	S_r^{O}	Share of total government revenue accounted for by other government revenue.	FDB. Calculated directly from government revenue and expenditure account.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F38), $S_{is}^{(5)}$ (F46)	Share of aggregate government final consumption expenditure accounted for by expenditure on commodity i from source s.	ODB. ith element of $\tilde{E}$ (if s=1) or $\tilde{J}$ (if s=2) divided by sum of all elements in $\tilde{E} + \tilde{J}$.
(F43) h_g^o	Parameter to allow nominal other government outlays to be tied to nominal GDP at market prices.	User specified.
(F44), S_g^c (F47)	Share of aggregate government expenditure accounted for by government final consumption expenditure.	FDB. Calculated directly from government revenue and expenditure account.
(F44), S_g^i (F47)	Share of aggregate government expenditure accounted for by government investment expenditure.	FDB. Calculated directly from government revenue and expenditure account.
(F44), S_g^u (F47)	Share of aggregate government expenditure accounted for by unemployment benefits.	FDB. Calculated directly from government revenue and expenditure account.

(F44), (F47) S_g^m	Share of aggregate government expenditure accounted for by means-tested transfers to persons.	FDB. Calculated directly from government revenue and expenditure account.
(F44), (F47) S_g^n	Share of aggregate government expenditure accounted for by non-means-tested transfers to persons.	FDB. Calculated directly from government revenue and expenditure account.
(F44), (F47) S_g^o	Share of aggregate government expenditure accounted for by "other" outlays.	FDB. Calculated directly from government revenue and expenditure account.
(F45), (F48) $S_g^{c'}$	Share of aggregate government current expenditure accounted for by government final consumption expenditure.	FDB. Calculated directly from government income and expenditure account.
(F45), (F48) $S_g^{u'}$	Share of aggregate government current expenditure accounted for by unemployment benefits.	FDB. Calculated directly from government income and expenditure account.
(F45), (F48) $S_g^{m'}$	Share of aggregate government current expenditure accounted for by means-tested transfers to persons.	FDB. Calculated directly from government income and expenditure account.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F45), $S_g^{n'}$ (F48)	Share of aggregate government current expenditure accounted for by non-means-tested transfers to persons.	FDB. Calculated directly from government income and expenduture account.
(F45), $S_g^{o'}$ (F48)	Share of aggregate government current expenditure accounted for by "other" outlays.	FDB. Calculated directly from government income and expenditure account.
(F49), G (F50)	Aggregate government expenditure.	FDB. Calculated directly from government income and expenditure account.
(F49), R (F50), (F51), (F52)	Aggregate government revenue.	FDB. Calculated directly from government income and expenditure account.
(F51), G' (F52)	Aggregate government current expenditure.	FDB. Calculated directly from government income and expenditure account.

(F53)	γ_{ℓ}^{1} γ_{ℓ}^{2} γ_{ℓ}^{3}	)Respectively, the elasticities of the)participation rate with respect to the real)pre-tax nominal wage rate, the aggregate)unemployment rate, and real non-labour income)per person including transfers.	Econometric. (Kerrison 1986).
(F54)	s_{yn}^{g}	Share of total non-labour income including transfers accounted for by factor non-labour income. This parameter may either be economy-wide or specific to the group (n) judged to adjust its participation at the margin.	FDB. Calculated directly from the miscellaneous data section.
(F54)	s_{yn}^{u}	Share of total non-labour income including transfers accounted for by unemployment benefits. This parameter may either be economy-wide or specific to the group (n) judged to adjust its participation at the margin.	FDB. Calculated directly from the miscellaneous data section.
(F54)	s_{yn}^{m}	Share of total non-labour income including transfers accounted for by other means-tested benefits. This parameter may either be economy-wide or specific to the group (n) judged to adjust its participation at the margin.	FDB. Calculated directly from the miscellaneous data section.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F54) S^n_{yn}	Share of total non-labour income including transfers accounted for by non-means-tested benefits and other transfers. This parameter may either be economy-wide or specific to the group (n) judged to adjust its participation at the margin.	FDB. Calculated directly from the miscellaneous data section.
(F54), (F59), (F68) S^n_o	Ratio of non-means-tested benefits to non-means-tested benefits plus other government outlays minus government revenue from other sources.	FDB. Calculated directly from government revenue and expenditure account.
(F54), (F59), (F68) S^g_o	Ratio of other government outlays to non-means-tested benefits plus other government outlays minus government revenue from other sources.	FDB. Calculated directly from government revenue and expenditure account.
(F54), (F59), (F68) S^t_o	Ratio of government revenue from other sources to non-means-tested benefits plus other government outlays minus government revenue from other sources.	FDB. Calculated directly from government revenue and expenditure account.

(F55)	$S^{m}_{(g+1,1,m)j}$	Share of aggregate gross labour earnings in occupation m accounted for by gross earnings of occupation m in industry j.	FDB and ODB. mjth element of $\tilde{U} - \tilde{U}_P$ divided by sum of elements in mth row of $\tilde{U} - \tilde{U}_P$.
(F57)	σ^{s}_{m}	The (negative of the) elasticity of transformation in labour supply between occupations.	Econometric. (IMPACT Paper B-33).
(F57)	S_m	Share of aggregate gross labour earnings accounted for by gross earnings of occupation m.	FDB and ODB. Sum of elements in mth row of $\tilde{U} - \tilde{U}_p$ divided by sum of all elements in $\tilde{U} - \tilde{U}_p$.
(F58)	γ^{1}_{m} γ^{2}_{m}	)Respectively, the elasticities of supply of)hours per employed person with respect to real)disposable non-labour income and real after-tax)nominal wage.	Econometric. (IMPACT paper B-12).
(F59)	$S^{g}_{\underset{\sim}{ym}}$	Share of total disposable non-labour income plus transfers of employed persons accounted for by disposable factor non-labour income of employed persons.	FDB. Calculated directly from miscellaneous data section.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F59) S^{u}_{ym}	Share of total disposable non-labour income plus transfers of employed persons accounted for by unemployment benefits to employed persons.	FDB. Calculated directly from miscellaneous data section.
(F59) S^{m}_{ym}	Share of total disposable non-labour income plus transfers of employed persons accounted for by other means-tested benefits to employed persons.	FDB. Calculated directly from miscellaneous data section.
(F59) S^{n}_{ym}	Share of total disposable non-labour income plus transfers of employed persons accounted for by non-means-tested benefits and other transfers to employed persons.	FDB. Calculated directly from miscellaneous data section.
(F61) $\psi_{(g+1,1,m)j}$	Share of number of persons employed in occupation m accounted for by persons employed in occupation m in industry j.	ODB. mjth element of persons matrix divided by sum of elements in mth row of persons matrix.
(F64) ψ_{1m}	Share of aggregate persons employed accounted for by persons employed in occupation m.	ODB. Sum of elements in mth row of persons matrix divided by sum of all elements in persons matrix.

(F65)	S_{ℓ}^{u}	Share of persons in labour force accounted for by unemployed persons.	FDB. Calculated directly from the miscellaneous data section.
(F66)	S_{ℓ}^{n}	Share of population accounted for by number of persons not in workforce.	FDB. Calculated directly from the miscellaneous data section.
(F67)	γ_{c}^{1} γ_{c}^{2}	)Respectively, the elasticities of real)consumption per employed person with respect to)real disposable non-labour income and real)after-tax wage.	Econometric (IMPACT paper B-12).
(F68)	S_{yo}^{g}	Share of total disposable non-labour income plus transfers of unemployed and those not in the workforce accounted for by disposable factor non-labour income of unemployed and those not in the workforce.	FDB. Calculated directly from miscellaneous data section.
(F68)	S_{yo}^{u}	Share of total disposable non-labour income plus transfers of unemployed and those not in the workforce accounted for by unemployment benefits to unemployed and those not in the workforce.	FDB. Calculated directly from miscellaneous data section.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F68) S^m_{yo}	Share of total disposable non-labour income plus transfers of unemployed and those not in the workforce accounted for by other means-tested benefits to unemployed and those not in the workforce.	FDB. Calculated directly from miscellaneous data section.
(F68) S^n_{yo}	Share of total disposable non-labour income plus transfers of unemployed and those not in the workforce accounted for by non-means-tested benefits and other transfers to unemployed and those not in the workforce.	FDB. Calculated directly from miscellaneous data section.
(F69) S^e	Share of aggregate nominal consumption accounted for by consumption of employed persons.	FDB. Calculated directly from miscellaneous data section.
(F70) γ^1_s	)Respectively, the elasticities of nominal	Econometric (IMPACT paper B-12).
γ^2_s	)saving per employed person with respect to)real disposable non-labour income and real)after-tax wage.	

(F71) σ^{YL}_{mj}	Elasticities of average tax rate on labour income for each occupation and industry with respect to tax base.	User specified.
(F71) h^{YL}	Parameter to allow indexing of tax rates on labour income.	User specified.
(F73), (F74) S^{G1}	Share of aggregate household consumption in nominal GDP at market prices.	ODB. Sum of all elements in $\tilde{C} + \tilde{H} + \tilde{M}_1 + \tilde{R}_1 + \ldots \tilde{M}_{g+1} + \tilde{R}_{g+1}$ divided by GDP where GDP = sum of all elements in $\tilde{C} + \tilde{H} + \tilde{M}_1 + \tilde{R}_1 + \ldots \tilde{M}_{g+1} + \tilde{R}_{g+1}$ $+ \tilde{B} + \tilde{G} + \tilde{L}_1 + \tilde{Q}_1 + \ldots \tilde{L}_{g+1} + \tilde{Q}_{g+1}$ $+ \tilde{E} + \tilde{J} + \tilde{O}_1 + \tilde{T}_1 + \ldots + \tilde{O}_{g+1} + \tilde{T}_{g+1}$ $+ \tilde{D} + \tilde{N}_1 + \ldots + \tilde{N}_{g+1}$ $- [\ \tilde{F} + \tilde{G} + \tilde{H} + \tilde{J} - \tilde{Z}\ ]$.
(F73), (F74) S^{G1}_{is}	Share of aggregate household consumption accounted for by consumption of good i from source s.	ODB. ith element of $\tilde{C} + \tilde{M}_1 + \ldots + \tilde{M}_{g+1}$ (if s=1) or $\tilde{H} + \tilde{R}_1 + \ldots \tilde{R}_{g+1}$ (if s=2) divided by sum of all elements in $\tilde{C} + \tilde{H} + \tilde{M}_1 + \tilde{R}_1 + \ldots \tilde{M}_{g+1} + \tilde{R}_{g+1}$.

TABLE 2.4: COEFFICIENTS AND PARAMETERS OF THE FISCAL EXTENSION (Cont'd)

Equation/Parameter	Description	Source (ODB = ORANI database, FDB = fiscal database)
(F73), s^{G2} (F74)	Share of aggregate investment in nominal GDP at market prices.	ODB. Sum of all elements in $\tilde{B} + \tilde{G} + \tilde{L}_1 + \tilde{Q}_1 + \ldots + \tilde{L}_{g+1} + \tilde{Q}_{g+1}$ divided by GDP.
(F73), s^{G2}_j (F74)	Share of aggregate investment accounted for by investment in industry j.	ODB. jth column sum of $\tilde{B} + \tilde{G} + \tilde{L}_1 + \tilde{Q}_1 + \ldots \tilde{L}_{g+1} + \tilde{Q}_{g+1}$ divided by sum of all elements in $\tilde{B} + \tilde{G} + \tilde{L}_1 + \tilde{Q}_1 + \ldots + \tilde{L}_{g+1} + \tilde{Q}_{g+1}$.
(F73), s^{G3} (F74)	Share of aggregate other demands in nominal GDP at market prices.	ODB. Sum of all elements in $\tilde{E} + \tilde{J} + \tilde{O}_1 + \tilde{T}_1 + \ldots + \tilde{O}_{g+1} + \tilde{T}_{g+1}$ divided by GDP.
(F73), s^{G3}_{is} (F74)	Share of aggregate other demands accounted for by other demands for good i from source s.	ODB. ith element of $\tilde{E} + \tilde{O}_1 + \ldots + \tilde{O}_{g+1}$ (if s=1) or $\tilde{J} + \tilde{T}_1 + \ldots + \tilde{T}_{g+1}$ (if s=2) divided by sum of all elements in $\tilde{E} + \tilde{J} + \tilde{O}_1 + \tilde{T}_1 + \ldots + \tilde{O}_{g+1} + \tilde{T}_{g+1}$.
(F73), s^{G4} (F74)	Share of aggregate exports in nominal GDP at market prices.	ODB. Sum of all elements in $\tilde{D} + \tilde{N}_1 + \ldots + \tilde{N}_{g+1}$ divided by GDP.

(F73), s_i^{G4} (F74)	Share of aggregate exports accounted for by exports of good i.	ODB. ith element of $\tilde{D} + \tilde{N}_1 + \ldots + \tilde{N}_{g+1}$ divided by sum of all elements in $\tilde{D} + \tilde{N}_1 + \ldots + \tilde{N}_{g+1}$.
(F73), s^{G5} (F74)	Share of aggregate imports in nominal GDP at market prices.	ODB. Sum of elements in $\tilde{F} + \tilde{G} + \tilde{H} + \tilde{J} - \tilde{Z}$ divided by GDP.
(F73), s_i^{G5} (F74)	Share of aggregate imports accounted for by imports of good i.	ODB. ith row sum of $\tilde{F} + \tilde{G} + \tilde{H} + \tilde{J} - \tilde{Z}$ divided by sum of all elements in $\tilde{F} + \tilde{G} + \tilde{H} + \tilde{J} - \tilde{Z}$.
(F76) s_ℓ^e	Share of aggregate disposable income of employed persons accounted for by disposable labour income.	User specified.

‡ This parameter is not required when the treatment of commodity taxes follows DPSV. It is required when tax variables are instead defined as the power (one plus the rate) of an ad valorem tax levied on basic values.

3 THE THEORETICAL STRUCTURE OF THE MODIFIED HORRIDGE EXTENSION

The fiscal extension of the previous chapter recognised that the disposable income relevant for domestic consumption and saving decisions should be net of non-labour income accruing to foreigners. As yet, the non-labour income accruing to foreigners has not been properly defined. In general, however, the foreign share of non-labour income would depend on the extent of foreign ownership or control of Australian capital.

One of the features of the extension to ORANI developed by Horridge[26] is that it recognises foreign ownership of domestic capital. It models the way in which the foreign ownership share of domestic capital depends on the difference between investment and national saving. Therefore, one of its main contributions is that it explains the way in which long run additions to ORANI's capital stocks are financed domestically or by foreigners.

However, the additional equations which Horridge appends to standard ORANI do not distinguish between the household and government components of national saving. This chapter presents a slightly modified version which introduces the concept of foreign ownership into FH-ORANI while maintaining the distinction between government and household behaviour.

The modified Horridge extension also introduces a small but significant change to the theoretical structure of standard ORANI. The real rates of return on fixed capital, relevant for the behaviour of investment and capital stocks, are redefined as being net of taxation as well as depreciation. The idea that investment decisions are made in response to after-tax returns is in keeping with modern theories of investment. The amended definition provides an important channel by which fiscal policy can affect industry activity levels through the effect on productive capacity in the longer term.

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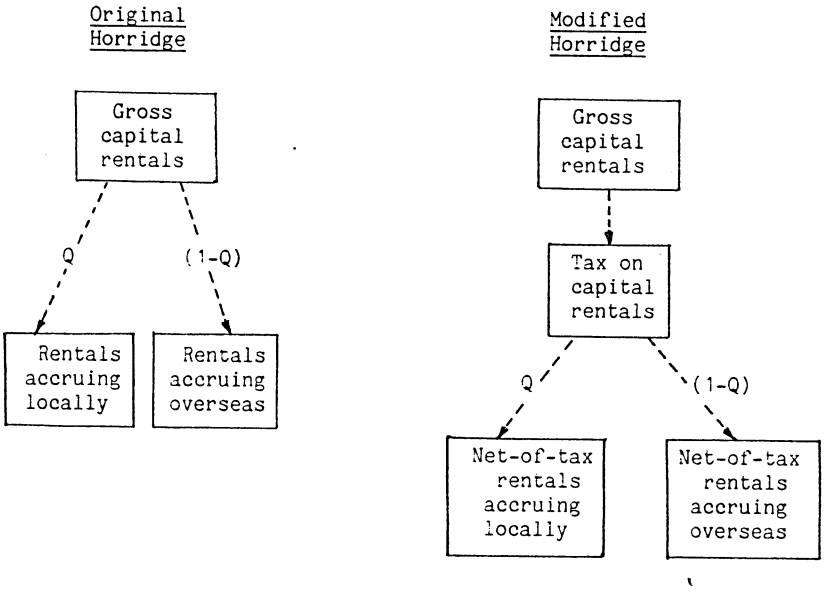
26 This is documented in Horridge and Powell (1984) and Horridge (1985a), (1985b), (1987).

3.1 The Need for Modification

The original Horridge extension added new equations and new variables to the standard ORANI model. Some of the new equations simply defined a number of macroeconomic aggregates, including the components of nominal GDP from both the income and the expenditure sides. Since the fiscal extension also contains equations to compute nominal GDP, the overlapping equations can be dropped from the Horridge extension. What remains is the core of the Horridge extension which explains how additions to the capital stock are financed, and how foreign financing and the evolution of foreign ownership depend on the gap between total investment and domestic saving by households and government.

The fundamental difference between the original and modified versions of the Horridge extension can be illustrated using the following diagram:



Horridge developed his extension as an adjunct to standard ORANI which had no treatment of direct taxation. Consequently, he abstracted from the taxation of capital rentals. The rentals accruing to foreigners from their ownership of local capital was just a simple fraction (1-Q) of all gross capital rentals, and the fraction equalled the foreign ownership share of the local capital stock (Q being the local ownership share).

In reality, the Australian government levies direct taxes on foreigners' rentals. Multinationals operating in Australia pay Australian corporate income tax while the dividends accruing to foreign portfolio investors are subject to an Australian dividends withholding tax. The flow of rentals which actually crosses the Australian border is a flow net of these taxes. The fiscal extension already recognises direct taxation of capital rentals. It models a direct tax on non-labour income which is paid by all industries operating on Australian soil, irrespective of ownership.

The modified Horridge extension should therefore recognise that the rentals accruing overseas are the foreign share of after-tax rentals. The share will equal the foreign ownership share of the capital stock (1-Q) if:

(a) foreign-owned capital earns neither more nor less in gross per unit terms than locally-owned capital in the same industry (this assumption was implicit in the original Horridge closure); and

(b) foreign rentals are taxed at the same rate as local rentals in the same industry.

Whether or not the first assumption is satisfied, the second is likely to be violated when the withholding tax rates applied to dividends accruing overseas are less than the personal rates of income taxation applying to dividends accruing locally. However, the modified Horridge

extension abstracts from this complication because the fiscal extension does not distinguish different tax rates according to ownership.[27]

The modification of the Horridge extension has the following modelling implications.

(i) Nominal GNP, measuring the income accruing to Australians rather than the income generated in Australia, can no longer be defined by adding labour and other income to a measure of gross capital rentals multiplied by a local ownership share (cf. Horridge 1985a, p. 16). This measure omits from national income the direct taxes levied on foreign rentals before they are repatriated overseas. GNP includes taxes on all capital rentals, since these accrue to the Australian government, plus the local share of after-tax rentals, since these accrue to Australian households. To take account of this, GNP can be defined more directly as GDP less rentals accruing overseas (net of tax) plus rentals accruing from overseas.

(ii) Where rentals accruing overseas are modelled directly, they should now be modelled as a foreign ownership share multiplied by total after-tax capital rentals.

(iii) GNP and rentals paid to overseas owners of capital are both income concepts which should recognise that taxes on foreigners' income accrue locally as Australian government income. The government's claim to these taxes does not arise through

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27 The annual reports to Parliament by the Commissioner of Taxation provide separate data on tax paid by resident and non-resident companies. This would provide a partial view of differences in tax treatment but would be deficient in that (i) "non-resident" does not correspond exactly to foreign ownership; and (ii) the data do not cover non-incorporated businesses or partnerships - these also generate capital rentals and need not be totally locally-owned. Nevertheless, the tax data by industry contained in the fiscal database and explained in Chapter 6 measure taxes paid to the Australian authorities, by either Australian or foreign owners. The database therefore reflects any different tax treatment of foreigners by industry. This influences the starting point from which the model's adjustments take place, even though the extent of the initial difference in treatment is not known in explicit detail nor taken into account in the adjustments themselves.

ownership, however. Where the local or foreign shares of capital rentals are computed to serve as measures of the local or foreign ownership shares in the local capital stock, it should be recognised that the government's tax claim does not constitute an ownership claim. The local share of rentals which reflects ownership should therefore exclude these taxes on foreigners' income.

3.2 The Theoretical Structure

The equations of the modified Horridge extension are presented in Table 3.1 at the end of this chapter, with variables, coefficients and parameters explained in Tables 3.2 and 3.3. The equations can now be examined more closely with the above implications in mind.

The first two equations (H1) and (H2) reproduce from the original extension two useful price indices, for exports and imports respectively, that are not already defined in standard ORANI or the fiscal extension.

The next two equations (H3) and (H4) write down nominal GNP from the expenditure and the income sides. The definition from the expenditure side is the same as in the original Horridge extension. It essentially defines national saving - the saving by both households and government - as the difference between national income or GNP and spending by households and government, with allowance made for a balancing item. The definition of GNP from the income side differs from the original; GNP is defined as GDP less rentals to foreigners (net of tax) plus rentals from foreigners.

The next eight equations (H5) to (H12) in the modified Horridge extension reproduce exactly the remaining core of the original. Here the important behavioural equations are (H7) and (H8), which recognise that final outcomes for the local ownership shares of local and foreign capital stocks depend on the evolution over time of national savings. The nature of the adjustment path of savings in this dynamic relationship is subsumed, for the purposes of a comparative static model, into the parameter λ . Horridge (1985a) and (1987) give a more detailed explanation of this point.

The remaining equations up to (H12) are straightforward, defining a simple relationship between household consumption and national savings and showing how national savings is in turn divided between that invested locally and that invested abroad.

However, the relationship between household consumption and national (government plus household) saving in (H5) can also serve as an aggregate consumption function if the shift variable f is treated as exogenous. In this case, aggregate household consumption is constrained to move in the same proportion as national (government plus household) saving. This is an alternative view of aggregate consumption to that provided by the fiscal extension in the previous chapter.

One advantage of the Horridge consumption function is that it allows some direct crowding out, by allowing government saving to substitute for private saving in the household's consumption decision. However, it is not of a form that is necessarily derivable from a utility maximisation problem over the full consumption-leisure-savings choice in the same way as the consumption function of the fiscal extension.

The alternative consumption function in equations (F67) to (F69) of the fiscal extension does not allow direct crowding out, but this can still occur indirectly as households and government compete for available resources. This alternative also ties the households' consumption, savings and hours worked decisions directly to the disposable wages and non-labour income available to households, rather than to some broader measure of aggregate income as the Horridge function would seem to do (e.g., Horridge 1985a, p. 18).

The Horridge consumption function can be overwritten by the consumption function in the fiscal extension by ensuring, among other things, that the shift term f in equation (H5) is designated endogenous. This is explained in more detail in Chapter 4 when closures for FH-ORANI are discussed in full.

Equation (H13) appears to be a simple definition of a capital price index. This is an instance, however, where a parameter calculated as a local share of local rentals is used to "proxy" the local ownership

share of the local capital stock. The description in Table 3.3 of the way this parameter is calculated makes it clear that government taxes on foreigners' incomes are excluded from the local share of local rentals.

Thereafter, equations (H14), (H15), (H19) and (H20) reproduce additional definitions from the original Horridge extension. The definition of total investment in (H20) differs from that in standard ORANI because it aggregates investment spending over all industries, not just over the endogenous investment industries. It therefore defines total investment rather than private investment. In (H15), net foreign investment is defined as the difference between total investment and national saving. Gross income from overseas is defined in (H19), while in (H14) it is subtracted from gross income flowing to foreigners to define net income flowing to foreigners.

Equations (H16) to (H18) in turn define gross capital rentals accruing overseas and differ from the original definition. The income flowing to foreigners is here computed as the foreign share of after-tax capital rentals. This definition draws on tax measures defined in the fiscal extension.

Going through these three equations in detail, equation (H16) aggregates the gross rentals accruing overseas across all industries to produce an economy-wide measure. Equation (H17) is the equivalent, in percentage changes, of a level form equation which sets the gross rentals accruing overseas from industry j equal to all after-tax rentals multiplied by a foreign ownership share (1-Q). Because the local ownership variable q is not industry-subscripted, the Horridge extension assumes that all local ownership shares change in the same proportion in the face of some shock. However, the calculation of the parameters of the equation use industry-specific ownership shares to recognise that each industry's ownership adjustment may start from a different base.

Equation (H18) then defines total after-tax capital rentals in each industry as gross fixed capital earnings (total fixed capital costs net of property taxes) less some portion of all the direct taxes paid on non-labour earnings. As described in Table 3.3, the coefficient calculations assume that the fraction of these taxes imputed to fixed capital is equal to the share of gross fixed capital earnings in gross

operating surplus.

In practice, company accounting procedures would start with the gross operating surplus generated by all assets, then deduct all direct tax liabilities and (ignoring debt finance for the moment) distribute the remainder between domestic residents and foreigners according to equity shares. This practice means that for the purpose of modelling the amounts distributed to foreigners, gross operating surplus and tax liabilities should be apportioned between both the different kinds of assets and the domestic and foreign shares of a particular asset according to capital value shares rather than earnings shares. However, the apportionment of tax liabilities between fixed capital, working capital and agricultural land according to capital values would be difficult in general because standard ORANI does not include, in either its theoretical structure or its database, capital values for working capital or agricultural land. Further, different types of capital asset can earn different rates of return even in the long run - Gordon (1986), in an international context, outlines some of the reasons for this. It need not therefore be reasonable to assume that capital values would be proportional to earnings across assets in the long term, even though capital values may be proportional to earnings across industries for a given asset.

The above method of apportioning tax liability across different assets in proportion to earnings may therefore be suspect, even in long term applications. Nevertheless, improvements on this score should await the further development of financial asset modelling along the lines of Adams (1986, 1987a), to the point where both the assets and liabilities in an industry's balance sheet are fully specified and valued.[28]

Returning to Table 3.1, equation (H21) defines the aggregate disposable non-labour income accruing to Australian households. This is defined as total disposable non-labour income generated in Australia minus the net after-tax rentals accruing to foreigners. Notice that this definition assumes that all rentals flowing into and out of Australia flow to or

28 The approach proposed in Adams (1987a) would have the added advantage, at least in short run applications, of giving a more satisfactory and explicit treatment of dynamic identities which in the Horridge extension are subsumed into a single parameter value.

from the Australian household sector rather than the Australian government. This distinction did not matter in the original Horridge extension which modelled only the combined saving behaviour of households and government. The distinction does matter when the modified Horridge extension is added to a model which contains separate explanations for household consumption and saving behaviour and the government deficit (or government dissaving). The assumption that all inter-country rental flows flow through the household sector must be made if the resulting measure in (H21) is to be the disposable non-labour income of Australian households.

Whether this assumption is reasonable depends in part on how the resulting combined model is to be used. If the extension is seen primarily as explaining foreign ownership, in the strict sense of an equity stake, then the resulting international rental flows would include only profits and dividends. The Australian government is unlikely to have much involvement in these types of flows. However, the model could not then be seen to fully explain the current account deficit since it would not explain debt interest payments or transfers, the remaining components of invisibles flows.

On the other hand, the requirement might be that the combined model should explain the current account deficit. Unless an explicit distinction is drawn on behavioural grounds between debt and equity financing, there is no problem in simply reinterpreting the model's international rental flows as including interest payments along with dividends. In this case, however, the concept of foreign "ownership" should be broadened to include any foreign claim on Australian capital rentals, whether arising from equity ownership or creditor status.[29] Some provision should then be made for those overseas interest payments to and from the government sector that result from its foreign borrowing or lending. Some provision should also be made for government transfers overseas, which are not trivial. However, until the current model is expanded by equations which explain the dynamics of debt accumulation and the government's role in foreign borrowing, then the current

29 Similarly, the database's industry-specific local ownership shares reported in Chapter 6 should be recomputed to reflect each industry's debt as well as equity position.

treatment of disposable income, which assumes that most net rentals accruing overseas flow from the household rather than the government sector, is probably good enough.

The measure in (H21) of aggregate disposable non-labour income accruing to Australian households was used in those equations of the fiscal extension which explained labour force participation, hours worked, consumption and saving behaviour by households.[30] The details of these equations were given in the previous chapter.[31]

The final equation (H22) of the modified Horridge extension defines an alternative measure of industry rates of return - one that is net of both depreciation and taxation. On the labour side, the fiscal extension made explicit the role of payroll taxes and direct taxes on labour income as the wedges between tax-inclusive labour costs, on which labour demand depends, and after-tax wages and non-labour income, on which labour supply depends. On the non-labour side, factor demands similarly depended on tax-inclusive factor costs. However, as the literature on the user cost of capital suggests (e.g., Auerbach 1983, Mayer 1986, Brunker 1984), the tax-inclusive rental price has a counterpart in an after-tax return to factor owners or managers. It is these groups which make investment decisions, decisions which are based on returns net of tax.

Standard ORANI's theory of investment allocation was based on returns net of true economic depreciation, but not net of taxation. In level terms, the new definition of the rate of return $R_j(0)$ is:

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30 Each of these behavioural equations also included some wage or labour income measure as an argument, but since all labour income is assumed to accrue to Australians, no adjustment for overseas transfers is made to these variables.

31 The participation equation is based on modelling and empirical work which generally included a pre- rather than post-tax measure of non-labour income as an argument. However, a post-tax measure is more intuitively appealing and in any event the econometric estimates for this equation were among the more unreliable of those in the fiscal extension. The use of the above measure of non-labour income in the participation equation not only corrects for net rentals to overseas, but also involves a switch from a pre- to a post-tax measure of income.