VATT-TUTKIMUKSIA 6
VATT- RESEARCH REPORTS

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ON OPEN ECONOMY TAX POLICY

Valtion taloudellinen tutkimuskeskus
Helsinki 1991

ISBN 951-561-014-1
ISSN 0788-5008

Valtion taloudellinen tutkimuskeskus
Hämeentie 3, 00530 Helsinki, Finland

Valtion painatuskeskus
Kampin VALTIMO
Helsinki 1991

Hetemäki, Martti: On Open Economy Tax Policy. Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Institute for Economic Research, 1991, 133 p. (X, ISSN 0788-5008; No 0) ISBN 951-561-014-1.

ABSTRACT: The study analyses open economy tax policies in intertemporal general equilibrium models. It is shown that it is optimal for a single country to reduce its external imbalance when it faces an endogenous interest rate for its external debt. Using this result several propositions about the desirable tax policies given the external balance and the tax tools available are derived. The basic model is extended to a world economy where there are industrialized and less developed countries, the latter being net debtors in the world capital market, and where the terms of trade between these two blocs of countries are also endogenous. The effects of a tax policy which stimulates investment demand within the industrialized countries is examined. The model is then extended by including an oil producing bloc and the effects of a tax on imported oil by the industrialized countries are evaluated. It is shown that some of the results from static international policy coordination models hold in the dynamic context. The desirability of tax policy coordination depends on tax and market distortions and the weight put on equity. It is shown that the tax competition outcome can be improved upon by coordinated tax policies where countries reduce intertemporal tax distortions.

KEY WORDS: open economy tax policy, intertemporal general equilibrium models

Hetemäki, Martti: On Open Economy Tax Policy. Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Institute for Economic Research, 1991, 133 p. (X, ISSN 0788-5008; No 0) ISBN 951-561-014-1.

TIIVISTELMÄ: Tutkimus tarkastelee avoimen talouden veropolitiikkaa intertemporaalisissa yleisen tasapainon malleissa. Osoitetaan, että yksittäisen maan on optimaalista pienentää ulkoista epätasapainoaan, jos sen ulkomaisen velan korko on endogeeninen. Tätä tulosta käyttäen johdetaan useita väittämiä toivottavasta veropolitiikasta riippuen ulkoisesta tasapainotilanteesta. Perusmallia laajennetaan ottamaan huomioon maailmantalous, jossa on teollisuus- ja kehitysmaita, joista jälkimmäiset ovat nettovelallisia. Mallissa tarkastellaan veropolitiikkaa, joka kannustaa investointeja teollisuusmaissa. Tämän jälkeen otetaan huomioon öljyn tuottajamaat ja selvitetään teollistuneiden maiden öljyyn kohistuva vero vaikutuksia. Lopuksi tarkastellaan kansainvälistä verokoordinointia. Veropolitiikan koordinoinnin tavoiteltavuus riippuu mm. markkina- ja verorääristymistä ja maiden väliselle oikeudenmukaisuudelle annettavasta painosta. Ns. verokilpailutasapainoa voidaan parantaa koordinoidulla politiikalla, jossa kukin maa vähentää intertemporaalisia verorääristymiään.

AVAINSANAT: avoimen talouden veropolitiikka, intertemporaaliset yleisen tasapainon mallit

PREFACE

The study owes much to Pertti Haaparanta and Erkki Koskela, who guided it from the beginning. Their suggestions and comments on several drafts influenced the whole approach of the work.

I wrote the study mainly at the Economics Department of the Ministry of Finance while I was on leave from my usual duties. The friendly and encouraging atmosphere at the Department was a big help.

Malcolm Waters not only checked the language but he also made many arguments much clearer.

I am grateful to Nordiska skattevetenskapliga fårsknings-råd and the Yrjö Jahnsson foundation for financial support and to the Government Institute for Economic Research for publishing the study.

Finally, I wish to thank Eeva for her cheerful attitude towards my work.

Helsinki, September 1991

Martti Hetemäki

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1 INTRODUCTION

1.1 Issues in open economy tax policy research

An exhaustive and lucid survey of tax policy in open economies has been presented by Dixit (1985). Below, some of the research that has been carried out since the publication of the Dixit survey is discussed. In particular, tax policy in intertemporal models, which is not covered by Dixit, will be considered.

Traditionally, there are important differences between models used in analyses of open economy optimal taxation and those used in analyses of open economy macropolicy. Optimal taxation questions are usually examined in static general equilibrium models with optimizing households and producers (see, e.g., Diewert et al. (1989) and Keen (1989)). Macroeconomic policies are typically evaluated within some variant of the Mundell-Fleming model with extensions to include, e.g., rational expectations, but not dynamically optimizing agents (see Svensson (1987) for a criticism of this approach). The choice of models also constrains the objectives of the analysis. The macroeconomic policy models have not been able to address welfare issues explicitly while the static optimal taxation models have been unable to consider macroeconomic targets such as the external balance. Recently, e.g., Kimbrough (1988) and Summers (1988) have evaluated the effects of tax reforms on macroeconomic targets in intertemporal open economy models. These studies can be viewed as steps in narrowing the gap between the optimal taxation and the macroeconomic policy literature.

There is a rapidly growing literature on the effects of tax policies in dynamic closed and open economy models with intertemporally optimizing agents. Among the first of these studies were Chamley (1981) and Judd (1985), both of which were based on closed economy models. Open economy tax models based on intertemporally optimizing agents

include Kimbrough (1986) and (1988), Bovenberg (1986), (1988) and (1989) and Frenkel and Razin (1987), (1988a) and (1989). These models represent an improvement in theoretical consistency over those models which do not consider the effects arising from dynamically optimizing agents and binding intertemporal budget constraints.

Usually, the static framework can readily be interpreted as a dynamic one. However, the generalization to the explicitly intertemporal setting extends the tax policy analysis to cope with many interesting phenomena. For example, the distinction between temporary and permanent policy measures and short-run and long-run effects can be made in the dynamic models. Further, trade need not balance at each date. This allows for external imbalances affecting the world capital market and the prevailing interest rate. These effects can be analysed adequately only in an explicitly dynamic framework.

There are, of course, several alternative dynamic open economy frameworks in which the effects of tax policies can be examined. When formulating the model one has to consider at least the following questions: (i) a continuous time or a discrete time model, (ii) a representative agent or a heterogeneous agents model, (iii) a perfect foresight or a stochastic model, (iv) a monetary or non-monetary model, (v) a perfect or non-perfect capital markets model and (vi) a model incorporating or not incorporating an operative bequest motive, i.e. an infinite or finite horizon model.

The remainder of this chapter is organized as follows. First, section 2 addresses each of the above issues in turn and then discusses some modelling questions which are specific to the analysis of tax policy. Next, section 3 gives a brief survey of recent related open economy tax policy research. Finally, section 4 presents the aim and outline of the study.

1.2 Alternative modelling approaches

In the analysis of many issues, the choice between a continuous or a discrete time model is immaterial. However, when the concept of time period is needed in the analysis, the use of a continuous time framework may imply a loss of generality. This study employs discrete time models where the capital stock dynamics can be interpreted as follows. The investment decision is made at the beginning of the period and the new investment becomes part of the productive capital stock at the beginning of, say, the following period. The productive capital stock is constant during the period and depreciation occurs at the end of the period. The choice between discrete and continuous time models in general has been analysed in Buiter (1980).

In the recent intertemporal open economy literature, the dynamics in the continuous time models arise almost invariably from strictly convex adjustment costs of investment (see, e.g., Bovenberg (1988) and (1989), Brock (1989) and Sen and Turnovsky (1989a) and (1989b)). In all of these studies the adjustment cost hypothesis determines the dynamics of the model. Two continuous time open economy tax policy models which do not employ this hypothesis are Giovannini (1988) and Turnovsky (1991). Giovannini (1988) assumes that output not consumed is instantaneously transformed into productive capital. In Turnovsky (1991), the assumption that capital is not tradeable plays the same role as the convex adjustment costs in limiting the rate of capital stock adjustment.

Since at least Rothchild (1968), it has been known that the adjustment cost hypothesis requires assumptions which can be regarded as rather strong. The popularity of this hypothesis is apparently due to the observed slow adjustment of investment to exogenous shocks. In general, sluggish adjustment can be explained in an optimizing framework only by strictly convex adjustment costs. However, recently Lippi (1988) has shown that lagged

behaviour may simply be the result of aggregation over agents. In particular, he shows that static or almost static microbehaviour can give rise to the kind of dynamically complex macroequations which the aggregate time series analysis typically produces. This view is supported by the recent empirical evidence on labour adjustment dynamics by Hamermesh (1989).

When the issues addressed necessitate a discrete time framework, many questions can be addressed without loss of generality in a two-period framework. The two-period model can be interpreted as a model consisting of periods t=1,...,T where the entire future t=2,...,T is represented by the second period as in, e.g., Maskin and Newbery (1990).

Whether a representative agent or a heterogeneous agents model is used depends largely on the questions which the analysis seeks to address. Using a heterogeneous agents setting, one can make interpersonal welfare comparisons. The analysis of these effects in a dynamic framework could be kept relatively simple and tractable by adopting the two representative agents, two-period, perfect foresight framework of Benninga and Talmor (1988). In the recent literature on intertemporal open economy tax policy analysis, there appears to be no published study applying such a framework. However, in an open economy context one may be more interested in the welfare effects between different countries or groups of countries.

The commonly used perfect foresight assumption is, of course, a strong one. However, the alternative to this assumption is not obvious. In incorporating uncertainty, one has to make assumptions about the source and nature of uncertainty as well as about the individual attitude towards risk. As Sinn (1987, pp. 241-242) notes, the perfect foresight assumption provides a useful reference point which is not situated at the extreme of meaningful assumptions.

In order to rationalize the role of money in models based on optimizing agents, one typically requires some arbitrary assumptions. Further, one has to choose from several alternative approaches, each of which seems to have some special implications. For example, the rather implausible implications stemming from the unitary velocity of money in the cash-in-advance approach, which has been used in many recent studies, are considered by Joshua Aizenman in the comments on Kimbrough (1988). Therefore, to avoid strong assumptions, especially when the study focuses on the effects of fiscal policies, it is reasonable to abstract from money.

Whether perfect international capital mobility is assumed or not plays an important role in determining the policy effects in an open economy context (see, e.g., Greenwood and Kimbrough (1985)). The assumption of perfect capital mobility is, of course, extreme. However, the case for capital immobility or effective capital controls is not very strong inspite of the rejection of the perfect capital mobility hypothesis in many empirical tests. In comments on Summers (1988), Jeffrey Frankel gives an insightful account of the empirical tests of this hypothesis. He argues that, rather than testing this hypothesis on the basis of saving and investment correlations, one should address directly the question of whether capital is sufficiently mobile to equalize expected real rates of return internationally. Even this hypothesis may be rejected empirically for reasons other than capital immobility. Expected real exchange depreciation, political risk and exchange rate risk are likely to explain some of the international differences between real rates of return. Therefore it is debatable whether one should, on the basis of the existing empirical evidence, replace the perfect capital mobility assumption in a theoretical model.

The properties of a model depend critically on whether agents are assumed to have an operative bequest motive or not. The absence of an operative bequest motive is

probably the single most important reason for the Ricardian equivalence hypothesis failing to hold. In this case, considerations stemming from overlapping generations and finite lives cannot be ignored in an open economy treatment (see Persson (1985)). However, in the presence of an operative bequest motive, the overlapping generations model reduces to the Ramsey model. Incorporating capital market imperfections may or may not violate this result (see Judd (1987)). As, e.g., Judd (1987) and Blanchard and Fischer (1989) argue, the extent to which the Ricardian equivalence hypothesis fails to hold is essentially an empirical issue.[1]

Open economy models also differ in their inclusion or exclusion of a non-traded sector of the economy. Excluding the non-traded sector focuses attention on the saving-investment balance in determining the external balance of the economy. Including the non-traded sector emphasizes the importance of the relative price of non-traded goods in the determination of the current account. Examples of two-sector models are the two-period, perfect foresight, small open economy model with investment of Marion (1984) and the two-period, perfect foresight, two-country model without investment of Durlauf anf Staiger (1990). Both of these models are formulated using duality theory.

A further impcrtant distinguishing feature in open economy models is whether the terms of trade and the interest rate are endogenous or exogenous. If goods market prices are fixed, then world markets are cleared through adjustments in the interest rate. There is empirical evidence in favour of rigid goods market prices and several reasonable hypotheses can be put forward to explain this (see Blanchard and Fischer (1989, pp. 376-388 and pp. 463-478)). Capital markets are presumably less prone to market imperfections, and one may argue that it is realistic to consider a world economy model where equilibrium is attained through interest rate adjustments in the capital market rather than through price adjustments in the goods market. This kind of a model has

been employed by, e.g., Frenkel and Razin, (1988a), (1988b) and (1989); see also Frenkel and Razin (1987). However, in some contexts it may be more realistic to also allow for market-clearing prices and assume endogenous terms of trade between, say, different trading blocs or between industrialized and less developed countries. This kind of a model has been used by, e.g., Marion and Svensson (1986) and van Wijnbergen (1988).

In tax policy analysis it is common to focus on the substitution, as opposed to income, effects of distortionary taxes. This is done, e.g., by assuming balancing lump sum taxes and transfers. As Dixit (1985, p. 346) notes, apparent paradoxes may be derived from the general analysis of tax reforms where lump sum transfers are not available. In particular, Guesnerie (1977) first showed that a Pareto improvement in tax reform may require production inefficiency, contrary to the results established by Diamond and Mirrlees (1971). This issue was also analysed by Diewert (1978) and Weymark (1979). However, it was later shown by Smith (1983) that the production inefficiency result depends on the range of policy instruments available to the government being peculiarly narrow. Assuming an instrument which enables tax revenue to be returned to the consumers in a lump sum form rules out the production inefficiency result.

The assumption of lump sum taxes and transfers has been criticized in the literature. However, it is perhaps not relevant to consider how realistic this assumption is, but rather to view it only as an assumption which enables one to focus on the substitution effects of taxes. As Sinn (1987, p. 6) notes:

> "By using the assumption of lump sum transfers, a particular form of differential tax analysis is carried out. This assumption is solely an analytical tool for isolating the direct substitution effect, it does not imply that such transfers can really be made."

In fact, the assumption of lump sump taxes or transfers or

zero initial tax rates is often unnecessary. It is well known that with a given present value tax revenue requirement in a Ramsey model, i.e. in the overlapping generations model under an operative bequest motive, the income effects from tax policy changes should have no real effects, or as Sinn (1987, p. 286) puts it:

> "If the (overlapping generations) model is generalized in the sense of Barro by incorporating a bequest motive, then all income effects vanish immediately."

Therefore in an overlapping generations model with an operative bequest motive there is no need to eliminate the income effects by assuming zero initial tax rates or lump sum taxes and transfers. Throughout the present study it is assumed that tax rates are initially zero. This assumption serves to make the analysis more tractable. Further, as is shown in Appendix A, it involves no loss of generality in the consumption, income, wage income and input tax cases. However, in the interest income tax case, considered in Chapter 5, the zero initial tax rate assumption has an effect on the analysis. Namely, in the Ramsey model, where income effects are irrelevant, a flat consumption or income tax does not distort the intertemporal saving-consumption decision while an interest income tax does. Consequently, under an initial non-zero interest income tax rate, the initial equilibrium is distorted unlike in the case of a zero initial tax rate.

Another assumption which is maintained throughout the study is that tax rates and tax revenue are positively related. This assumption has sometimes been called the upward-sloping Laffer curve assumption (see, e.g., Koskela (1989)). It rules out the possibility that, say, a current tax cut would not require a future tax increase in that tax or an increase in another tax for the government tax revenue to remain unchanged. In many contexts the upward-sloping Laffer curve assumption helps to abstract from ambiguities which are not likely to arise in reality. For a survey of the relationship between tax rates and

government tax revenue, see Fullerton (1982).

The study examines the effects of marginal changes in tax instruments. Previously, these so-called radial policy analyses have been carried out mainly in static models (see, e.g., Dixit (1985)). In addition to ignoring effects arising from intertemporal optimization, static models do not distinguish between temporary, permanent and anticipated future policies and short- and long-run effects. The extension to the dynamic framework enhances both the theoretical generality and the applicability of the tax policy analysis. In particular, the effects stemming from binding intertemporal budget constraints are taken into account.

An area omitted in the study is problems related to tax administration costs, tax compliance, tax enforcement, tax avoidance and tax evasion under different tax systems. The question of the choice between different tax systems with regard to the above-mentioned issues has been surveyed by Slemrod (1990a) (see also Kay (1990)).

Another topic which is largely omitted in the study is traditional tax incidence analysis. Tax incidence is analysed only in the context of labour input taxation in Chapter 4. The main interest as regards tax incidence in this study is the effects on welfare between countries.

The analysis is carried out using the dual approach, which enables a rigorous and general modelling of household and producer behaviour. Household behaviour is represented by the expenditure function and producer behaviour usually by the profit function. The conditions for and properties of expenditure and profit functions are stated in Varian (1984); fuller treatments of profit and expenditure functions are given in, e.g., Diewert (1974) and Diamond and McFadden (1974), respectively. Good references on the uses of duality theory in an open economy context are Dixit and Norman (1980) and Woodland (1982).

1.3 Related tax policy models

Recent studies evaluating tax policies in dynamic open economy models include Kimbrough (1986), Summers (1988), Krugman and Feldstein (1989), Razin and Sadka (1989b) and Frenkel and Razin (1987), (1988a) and (1989). All of these studies, like the present one, employ a perfect foresight, two-period, non-monetary, representative agent model. Implicitly, these models also assume that the representative agent has an operative bequest motive so that overlapping-generations considerations are irrelevant. There are, of course, numerous other tax policy studies employing a dynamic framework. However, in the following only those studies that are related to the present study are considered.

Kimbrough (1986) uses a two-country, two-period model which is similar to the models used in the present study. The focus in his study is the effects of international transfers.

In the theoretical part of his study, Summers (1988) considers a perfect foresight small open economy model where first-period investment augments the second-period output. The model incorporates traded and non-traded goods sectors. Summers uses graphical analysis to examine the effects of investment and saving incentives on the external balance and international competitiveness, which is defined as the size of the traded goods sector. In Summers's framework, the trade balance effects depend critically on the relative capital intensiveness of the traded and non-traded goods sectors.

Summers (1988) also includes a brief discussion on the important question of the length of the short and long run in two-period models. He cites simulation results according to which households will take periods of up to ten years to adjust their wealth following a change in the rate of return on capital. Accordingly, in tax policy considerations with a time horizon of a decade or less,

emphasis should be put on the first-period effects.

Krugman and Feldstein (1989) use a two-sector small open economy model to examine the effects of value added taxation. In particular, they evaluate the external balance effects of a shift from income taxation towards value added taxation.

Razin and Sadka (1989a) and (1989b) use a small open economy model to examine the effects of interest income taxation. Razin and Sadka (1989a) focus on the desirability of capital income tax harmonization. Razin and Sadka (1989b) analyse the desirability of quantity restrictions on international capital movements in the case where the government cannot effectively tax foreign source income. In Razin and Sadka (1989a) the issue of whether to apply the source or residence principle in the face of possible tax competition is given a fairly full treatment. Also, the question of what should be done when the tax authority has incomplete control over foreign source capital income is largely settled in Razin and Sadka (1989b). Because these important issues, which have become even more relevant as a result of rapid capital market integration, are at least partly resolved in the studies by Razin and Sadka, they will not be addressed in this study.

Chapters 2-5 employ models which are based on similar assumptions as the studies by Frenkel and Razin (1988a), (1988b) and (1989). Hence it is useful to briefly survey the main characteristics and properties of their models. Frenkel and Razin (1989) use an intertemporal two-country perfect foresight model with exogeneous terms of trade and an endogenous world interest rate to analyse revenue neutral conversions between income and consumption taxation. In this framework they show that the equivalence between (corporate and wage) income and consumption taxation breaks down. This result depends, however, on a critical assumption according to which the government's budget must balance in each period rather than in present

value terms. Thus, if trade is not initially balanced in each period, the time profile of tax rates cannot be flat, which, in turn, implies real effects.

In Frenkel and Razin (1988a) the assumption according to which tax revenue is kept intact in each period is replaced by the more general condition which states that the budget must balance only in present value terms. In this study Frenkel and Razin show that budget deficits caused by tax cuts have real effects. Again, it is the non-constancy of tax rates which is responsible for the neutrality proposition failing to hold. The analysis of consumption taxation in the Frenkel and Razin (1988a) study can be summarized by means of the following example.

Assume that a country has a consumption tax system with a tax rate s^t, t=1,2, all other tax parameters being zero. Consider a cut in s^1. This induces a budget deficit and, in order to satisfy the government's solvency condition, this cut must be followed by an increase in the future tax rate s^2. This induces substitution from second-period consumption toward first-period consumption. All other things being equal, this causes a first-period trade balance deficit, which, in turn, increases the endogenous world rate of interest. Through this influence on the world rate of interest, the domestic budget deficit is transmitted internationally. It should be stressed that in Frenkel and Razin (1988a) it is not budget deficits themselves which have real effects, but budget deficits caused by temporary tax cuts which call for future tax increases, implying a non-flat time profile of tax rates, which then distorts the decisions between, e.g., current and future consumption.

The above summary of the Frenkel and Razin (1988a) and (1989) studies also serves as an introduction to Chapter two, which extends the analysis of Frenkel and Razin. By formalizing their framework, one is able to, e.g., evaluate explicitly the welfare effects of tax policies.

1.4 Aim and outline of the study

Among the interesting questions which arise in an open economy context are the following. What is the reason for the observed relatively strong association between domestic saving and investment rates? Why should a welfare- maximizing government try to correct current account imbalances? How do changes in tax rates and tax bases affect external balance and welfare? How are domestic tax polices transmitted to the rest of the world? What happens if each country practices tax policies aimed at maximizing its own welfare? Can welfare be improved by international policy coordination? Is policy coordination between the North and the South, i.e. between the rich and poor countries, desirable and how does this depend on the external debt problem of the South? These are the kind of questions which this study attempts to address. To specify the aim of the study more closely, consider first the findings of the existing literature.

In the literature, several hypotheses have been put forward to explain the finding by Feldstein and Horioka (1980) according to which data from many countries shows high contemporaneous correlation between domestic investment and savings rates. An apparent explanation for the puzzle is international capital immobility. When the assumption of capital immobility is relaxed, perhaps the most satisfactory explanation for the finding appears to be that the external balance is a policy objective, as Summers (1988) notes. By casual observation, the external balance seems indeed to be an important policy target in many countries. However, this target appears to bear no direct relation to welfare or equity objectives. In particular, in international trade theory literature trade imbalances do not themselves give rise to real effects and hence they do not affect welfare either. Consequently, there should be no room for interventionist government policies aiming at external balance.

Static general equilibrium trade models can readily be

interpreted as intertemporal models by distinguishing commodities according to their dates. However, to incorporate, e.g., interest payments on debt, time needs to be introduced explicitly into these models. In fact, as will be shown in Chapter 2, the existence of an endogenous interest rate that can be influenced by domestic borrowing policy gives rise to a result according to which policies aiming towards external balance may be welfare improving. In fact, it turns out that, if a country faces an interest rate which depends on its external borrowing and lending, the welfare and external balance targets coincide.

Another hypothesis which may explain the current account balance objective arises from the country risk argument (see Eaton et al. (1986)). According to this, the determination of the interest rate which the country faces may depend, in addition to the conditions of supply and demand in the world capital market, on the risk of default. This risk, in turn, is likely to be an increasing function of the stock of external debt. Therefore a large external debt may keep the domestic interest rate relatively high and reduce the capital stock below its Golden Rule level. Therefore, discretionary policies aimed at improving the external balance may also be justifiable in this case.

Assuming international capital mobility and that capital controls directly determining the current account are not feasible, how can the external balance be influenced by economic policies? In those general benchmark models where there is no role for money and where individuals have an operative bequest motive, monetary policy and fiscal policies involving lump sum taxes or transfers or other non-distortionary measures have no real effects. In this framework, to influence the intertemporal allocation and the current account, distortionary tax policies or changes in the time path of exchange rates are called for. Permanent changes in exchange rates do not affect the real equilibrium because they do not, in general, distort intertemporal consumption or investment decisions. So far,

the literature has focused to a large extent on how tax rate changes whithin one form of taxation affect the current account or welfare (see, e.g., Frenekel and Razin (1988a) and (1988b), Bovenberg (1988) and Sibert (1990)).

There are relatively few analytical studies on the effects of tax base changes which use an intertemporal open economy framework. A shift from income to consumption taxation is analysed by Krugman and Feldstein (1989). However, their analysis is restricted to the small open economy case and they do not obtain the welfare effects of the tax base change. Frenkel and Razin (1989) consider several tax base changes, but, as was mentioned above, they make the implausible assumption that the goverment budget has to balance in each period, which is critical for their results. There do not appear to be any studies employing a dynamic open economy model which examine the effects of a shift in the financing base of social security, although this been an important policy issue in some countries.

Neither tax policies nor any other policies are transmitted internationaly if the country is small enough to face an exogenous world interest rate and exogenous terms of trade. Recently, a number of studies have considered the case where the country faces given world prices, but an endogenous, world capital market-clearing interest rate. These studies include Frenkel and Razin (1988a), (1988b) and (1989), where domestic tax policies are transmitted to other countries through changes in the current account which affect the prevailing world interest rate. In some contexts, it may be appropriate to relax the exogenous terms of trade assumption as well. In this case, in addition to the interest rate channel, terms of trade changes transmit domestic policies abroad.

So far, there has not been much published research on fiscal policy in intertemporal models with endogenous terms of trade, one exception being Frenkel and Razin (1987, pp. 198-210). However, their analysis is confined

to examining the effects of government expenditure.

It is common in the literature to consider the tax policies of one country assuming unchanged policies on the part of other countries (see, e.g., the studies by Frenkel and Razin (1988a), (1988b) and (1989) and the references cited therein). While this assumption may be a reasonable starting point for the analysis, it may be more realistic to consider a situation where all countries are simultaneously maximizing their own welfare. This is the Nash equilibrium or tax competition equilibrium analysed by, e.g., Razin and Sadka (1989a) and Sorensen (1989). These studies compare the welfare effects of the tax competition outcome to a coordinated outcome in the case of capital income taxation. In an overlapping generations model without a bequest motive, such as the Sorensen model, there may be efficiency gains from tax policy coordination. In the presence of an operative bequest motive, tax policy coordination does not, however, result in efficiency gains, as Razin and Sadka (1989a) show.

The result according to which, in general, no efficiency gains can be attained by tax policy coordination may seem disappointing. However, policy cooridination may still be desirable because, among the efficient equilibria, the coordinated outcome may be preferred from the equity point of view. In fact, the best arguments for consumption tax harmonization appear to be based on equity, rather than on efficiency, grounds (see Sinn (1990)). It is also likely that tax policies are seldom based only on efficiency arguments and that distributional questions are inherent in most tax policy issues. There do not appear to be any previous studies on international tax policy coordination which take the equity objective explicitly into account.

One reasonable way to determine the desirable direction of policy coordination is to use the utilitarian social welfare function with the welfare of the participating countries as arguments so that the objective is the maximization of the sum of welfare changes in the

countries in question. It turns out that, in a general competitive framework, tax policy coordination where each country reduces its intertemporal tax distortions and which does not hold the world interest rate unchanged is Pareto improving. Starting from a competitive non-distorted equilibrium, different policies cause changes only along the world transformation frontier from one Pareto-optimal equilibrium to another. Hence, in this case, there is no welfare gain available from policy coordination and policy coordination is desirable only if marginal utilities of wealth differ across countries. This means in practice that, given identical preferences across countries, welfare-improving tax policies amount to wealth redistribution in which rich countries lose and poor countries gain. Consequently, a natural framework where policy coordination could be beneficial is the so-called North-South framework.

There is a rapidly growing literature analysing diverse issues in intertemporal North-South models (see, e.g., Grossman and Helpman (1989)). So far, North-South tax issues have been analysed only in static models (see Slemrod (1990b)). However, in addition to the lack of theoretical generality, static models cannot take adequately into account the implications stemming from the prevailing situation in which the North is a net creditor and the South is a net debtor in the world capital market.

There are several interesting tax policy issues which arise in a North-South framework. One such issue, and one which is not peculiar to tax policy, arises from policies by the North which increase economic activity exclusively within the North. Such a stimulus could be provided by intensified economic integration within the North or by an investment incentive if investment goods are produced only in the North. A second policy issue which may be of importance in this framework is a tax on oil which is imposed by the North but not by the South. For instance, a tax on fossil fuels in the rich countries has been advocated as a means of enhancing efforts to constrain the

growth of carbon dioxide emissions. There do not appear to be any previous studies on these issues in intertemporal open economy models.

In the following chapters, the above-mentioned issues will be addressed. The study is organized in the following way.

Chapter 2 considers the targets of tax policy in an open economy. In particular, the relation between the commonly accepted welfare objective and the external balance objective is examined.

Chapter 3 reconsiders the tax policy issues analysed by Frenkel and Razin (1988a) and (1988b). In these studies Frenkel and Razin use a two-country model where tax policies are transmitted internationally through a market-clearing world interest rate. The chapter formalizes the Frenkel and Razin framework and extends it to include the analysis of welfare effects.

Chapter 4 employs a model where, instead of a fixed or a supply-determined labour input, labour input is demand-determined. The chapter examines the effects of indirect labour costs or taxes on labour input. Further, the effects of a shift from a wage tax to a consumption tax in social security financing are evaluated. Finally, the chapter considers the incidence of labour taxes employing a competitive labour market model with market-clearing wages.

Chapter 5 focuses on the effects of a tax on international borrowing or lending. This tax can also be called a tax on net national borrowing in the former case and a tax on net national saving in the latter case. These taxes are, under fairly general conditions, equivalent to constraints on capital imports and exports. A similar type of tax has been analysed in Frenkel and Razin (1988a) and (1988b). The chapter extends the framework of Frenkel and Razin by allowing for endogenous labour supply. Further, using a formal model rather than a graphical framework as in

Frenkel and Razin allows one to again derive the welfare effects of tax policy changes.

Chapter 6 relaxes the exogenous terms of trade assumption and analyses the effects of tax policies in a North-South framework. The analysis is based on two intertemporal models of the world economy. The first of these models describes a two-country world economy where there are two blocs called the OECD bloc and the LDC bloc. The model is used to examine how increased demand within the OECD bloc affects the world economy. This effect can be obtained by an investment tax incentive in the OECD bloc or it could also be acheived through intensified economic integration within the OECD bloc. The second of the models extends the first one by introducing a raw material producing country called the OPEC bloc. This model is employed to evaluate the effects of a tax imposed by the OECD bloc on the raw material which the OPEC bloc produces.

Chapter 7 examines first under what conditions international tax policy coordination can yield Pareto improvements. Secondly, it extends the international tax policy coordination analysis to take equity issues explicitly into account.

Chapter 8 summarizes and concludes the study.

Notes:

[1] It may have been more the implausibility of the implications of the Ricardian equivalence hypothesis than the implausibility of the operative bequest motive and the plausibility of the non-operative bequest motive which has often influenced the choice of the framework in the literature. The empirical work in this area has mostly tested the implications of the models statisfying the Ricardian equivalence hypothesis rather than the assumptions of these models (see, e.g., the references cited in Smith (1990)). Recently, Abel et al. (1989) have tested the relevance of the dynamic inefficiency hypothesis, which arises in models assuming a non-operative bequest motive. The data used by Abel et al. suggest that their criteria for dynamic efficiency are satisfied comfortably in the U.K., the U.S., France, West Germany, Italy, Canada and Japan in all years for the observation period 1960-1984.

2 OPEN ECONOMY TAX POLICY TARGETS

2.1 Introduction

The two commonly accepted targets of economic policy are the efficiency and equity targets. Although the external balance or current account target also seems to be an important policy goal in practice, a general theoretical argument for this policy objective appears to be lacking. Assuming a binding intertemporal budget constraint, an external balance deficit today will be met by an off-setting surplus in the future and there is no case for interventionist policies.

In an open economy context, distributional issues are of importance within a country and between countries. The representative agent framework adopted in this study does not allow for interpersonal comparison of the welfare effects. On the other hand, the framework does enable an interesting analysis of distributional questions between countries. Partly due to the increased integration of world financial markets, the effects of economic policies by one country or a group of countries on other countries are stronger than before. This raises the question as to whether the welfare of countries can be increased via international tax policy coordination, an issue which will be considered in Chapter 7.

The availability of capital controls affects the choice of desirable policies. Analogously to the optimum tariff criterion, welfare maximization calls for capital controls. As is shown by Greenwood and Kimbrough (1985), in the optimum the implicit tax on foreign borrowing which is imposed by capital controls is equal to the reciprocal of the elasticity of the foreign offer curve. Hence capital controls drive a wedge between domestic and world interest rates. Given that this wedge is kept constant, irrespective of tax polices, the effects of tax policies will be the same as in the absence of capital controls. However, if capital controls take a form such that the

current account is kept constant, the intertemporal distortions induced by tax policies are offset by changes in capital controls. In addition, of course, domestic policies will have no effect on foreign countries because the world capital market will be unaffected owing to the constancy of the current account, as Greenwood and Kimbrough (1985) also note.

In general, capital controls and tax instruments can be used to achieve exactly the same economic effect. A difference in effects arises only when the equivalence between tariffs and quotas breaks down. As is noted in van Wijnbergen (1990), this may occur in the presence of uncertainty or if the rents created by quantity controls are distributed differently from the rents arising from price intervention. In general, capital controls can be represented by a tax on foreign borrowing, as in, e.g., Marion and Svensson (1984b) and van Wijnbergen (1990). Using consumption and income tax policies, the same allocation can be attained as by taxing foreign borrowing because these taxes are linked by an equivalence relation (see Frenkel and Razin (1989)).

Aizenman (1986) considers the optimal way of raising a given revenue requirement on condition that lump sum taxes are not available. In particular, Aizenman compares the welfare costs of tariffs, capital controls and an inflation tax. The general conclusion from his analysis is that the absence of lump sum taxes gives rise to complementarity between distortive policies for raising the required revenue. This complementarity does not, however, hold, in general, when the objective is to attain a given allocation, as Aizenman notes.

The main purpose of this chapter is to examine the relation between the external balance and the welfare targets, the latter being the objective in the standard tax reform analysis. It turns out that the two objectives coincide when the country faces an endogenous interest rate for its debt. This finding provides a case for

policies improving the external balance and it also offers a positive explanation for the observed high correlation between national investment and saving.[1] Although changes in taxation will not be considered in this chapter, taxation is included in the following model for the purposes of Chapter 3.

2.2 The model

The following assumptions, which are essentially the same as in Frenkel and Razin (1988a) and (1989), are made to set up the model: (i) there are two countries each of which faces exogenous terms of trade, (ii) there is one good which is internationally tradeable and which can be consumed or invested, (iii) both countries face the same endogenous world rate of interest, (iv) the production possibilities are given by a continuous, quasi-concave, weakly increasing production function, $X^t=f(K^t,L^t)$ relating output in period t, X^t, to capital stock, K^t, and and a fixed labour input, L^t, (v) the present capital stock is predetermined and the future capital stock is endogenous and defined as $K^2=I^1+(1-d)K^1$, (vi) the rate of capital stock depreciation is d=1, i.e. $K^2=I^1$, and there is no investment in the second period so that at the end of period two the capital stock of the economy has been used up, (vii) welfare and consumption demand are represented by a continuous, quasi-concave, weakly increasing utility function $U(C^1,C^2)$, where C^1 and C^2 denote present and future period consumption of the final good, the final good being assumed to be a normal good at both dates, (viii) labour supply is inelastic and flexible wages ensure full employment of labour, (ix) there is an income tax at a rate v^t and a value added consumption tax at a rate s^t. Most of these assumptions will be maintained throughout the study. The exceptions include section 4 of Chapter 3, which considers the case of elastic labour supply, and Chapters 3-7, which employ the additional assumption of homothetic preferences.[2] Further, the fixed labour input assumption will also be relaxed in Chapter 4 and Chapter 6 introduces a variable raw material input.

For a discussion of the above assumptions, except the capital stock adjustment assumption, see Woodland (1982). Woodland (1982) also provides a thorough treatment of the dual approach - which is applied extensively in this study - to the modelling of firm and household behaviour.

In the following, partial derivatives will be denoted by subscripts. The final goods will be used as the numeraire so that the output price at both dates, p^t, is set to unity.

The production side of the economy is represented by a domestic product function, $Y^t(1,K^t,L^t)$, which is a function of the normalized output price, the capital stock and the fixed labour input. In this chapter the domestic product function takes a trivial form because the first-period domestic product is predetermined and only the second-period capital stock is variable. Hence the optimization problem of the firm reduces to the choice of investment.[3] Tne domestic product is a concave function of the capital stock, i.e. $Y^2_K>0$, $Y^2_{KK}<0$. In the absence of income taxation, optimal investment is the solution to the problem (see also Svensson (1984, p. 655 footnote 14)):

$$\max\{Y^1(K^1,L^1)-I+RY^2(K^2,L^2)\},$$
$$\{I\}$$
subject to K^1, L^t, $t=1,2$ fixed,

where $R=1/(1+r)$ is the discount factor and r is the rate of interest. The first order condition for investment is

$$(1)\quad RY^2_K-1=0.$$

Investment demand is given by $I=I(R)$; $I_R=-Y^2_K/Y^2_{KK}>0$. Income taxation is introduced in the model by assuming a cash-flow income tax as in Frenkel and Razin (1989). Incorporating, e.g., non-immediate expensing or other non-neutralities, is not interesting for the purposes of the present analysis. In the presence of corporate income taxation, optimal investment is the solution to the

following problem:

$$\max_{\{I\}}\{(1-v^1)[Y^1(K^1,L^1)-I]+R(1-v^2)Y^2(K^2,L^2)\},$$
subject to K^1, L^t, $t=1,2$ fixed,

where v^t is the income tax rate in period t. From this the first order condition for investment is

$$(2)\quad RY^2_K=(1-v^1)/(1-v^2).$$

The investment function can be written as $I=I(v^1,v^2,R)$; $I_{v^1}>0$, $I_{v^2}<0$, $I_R>0$.

The demand side of the economy is represented by a present value expenditure function which is defined as

$$(3)\quad E[(1+s^1),R(1+s^2),u]=$$

$$\min\{(1+s^1)C^1+(1+s^2)RC^2 : u(C^1,C^2)\geq u\},$$

where u is the level of utility.

The private sector budget constraint can be written as

$$(4)\quad C^1+RC^2=(1-v^1)(Y^1-I)+R(1-v^2)Y^2-s^1C^1-Rs^2C^2.$$

The government budget constraint is written as

$$(5)\quad G^1+RG^2=v^1(Y^1-I)+Rv^2Y^2+s^1C^1+Rs^2C^2,$$

where G^t is government purchases of the final good.

Substituting the government budget constraint into equation (4), the economy's intertemporal budget constraint can be written as

$$(6)\quad C^1+RC^2+I+G^1+RG^2=Y^1+RY^2.$$

Adding to both sides of (6) $s^1C^1+Rs^2C^2$ and using (3), (6)

can be written as

(7) $E[(1+s^1),R(1+s^2),u]+I+G^1+RG^2=Y^1+RY^2+s^1C^1+Rs^2C^2$.

The left hand side of (7) is the present value of consumption, investment and government expenditure. The right hand side of (7) is the present value of profit-maximizing output and taxes. Denoting the foreign country variables by an asterisk, the intertemporal budget constraint of the foreign country is written as

(8) $E^*(1,R,u^*)+I^*=Y^{*1}+RY^{*2}$.

It is assumed that in the foreign country tax rates and government expenditure are zero. This assumption implies no loss of generality because the analysis will focus only on the effects of the tax policies of the home country.

The first-period external balance of the home country is defined as

(9) $b^1=Y^1-I-C^1-G^1$.

Assuming that the country has no initial debt, equation (8) is its first period current account balance. The second-period trade balance takes the form

(10) $b^2=Y^2-C^2-G^2$.

According to the budget constraint, the present value of the home country external balance equals zero

(11) $b^1+Rb^2=0$.

The foreign country has analogous conditions corresponding to equations (9), (10) and (11). In addition, there are the market-clearing conditions for first- and second-period world output. These conditions can be written as

(12) $b^1=-b^{*1}$,

(13) $b^2=-b^{*2}$.

2.3 External balance as a policy target

The reason why a welfare-maximizing government should pursue policies aimed at external balance is not clear. Related to this question is the puzzle revealed by the empirical evidence of Feldstein and Horioka (1980) according to which domestic saving and investment are strongly correlated, implying that current account deficits or surpluses tend to be balanced by some mechanism.

One explanation for the external balance objective may be provided in a framework which incorporates the risk of default (see, e.g., Eaton et al. (1986)). Edwards (1986) provides empirical evidence showing that the risk premium on foreign borrowing is positively related to the debt output ratio. This finding is, however, not undisputed in the literature (see the references in Edwards (1986)).

In the following, another possible explanation for why a welfare-maximizing country should try to reduce its external deficit or surplus is put forward. The explanation is simple; assume that the country faces an endogenous interest rate and that it is currently a net debtor in the world capital market. Then a welfare improvement can be attained by a fall in the interest rate, which, under an endogenous interest rate, requires reduced borrowing by the country. That a fall in the interest rate is welfare improving given an initial external balance deficit is also noted by Svensson (1984, p. 660). However, he does not pursue this issue further.

For the time being, abstract from government policies and consider the desirable response to an initial external balance deficit or surplus given an endogenous world interest rate. As is shown later, the world interest rate can be influenced by altering national saving. In general,

the following proposition can be put forward.

PROPOSITION 1: Policies improving (worsening) the current account are welfare improving for a country with an initial external balance defict (surplus).

PROOF: Differentiating the home country's intertemporal budget constraint, equation (7), keeping policy variables constant and allowing for a variable interest rate, yields

(14) $E_u du=-C^2 dR-I_R dR-G^2 dR+Y^2 dR+RY^2_K I_R dR.$

Noting that $b^2=Y^2-C^2-G^2$, (14) can be written as

(15) $E_u du=b^2 dR+(RY^2_K-1)I_R dR.$

The term inside the brackets in (15) is zero by the first order condition for investment, equation (1). Hence the second term is also zero. Consider first the interest rate reducing case, where $dr<0$ and $dR>0$. Given an initial external balance deficit, i.e. $b^1<0$, then by equation (11), $b^2>0$. Hence the first term is positive. Therefore, given that $E_u>0$, the change in welfare, du, is positive. Consider next the interest rate increasing case, where $dr>0$ and $dR<0$. Given an initial external balance surplus, i.e. $b^1>0$, $b^2<0$, the first term in (15) is also positive in this case, implying $du>0$. Q.E.D.

The intuition behind Proposition 1 becomes more apparent when equation (15) is written, using equation (11), as

(15) $E_u du=b^2 dR=-(1+r)b^1 R_r dr=-(1+r)b^1[-(1+r)^{-2}]dr=Rb^1 dr.$

In other words, the change in welfare, du, is proportional to the present value of the change in the interest yield on net foreign credit. If the country is, say, a net creditor, i.e. $b^1>0$, it benefits from the increase in the world interest rate.

An implication of the above result is that if an economy

maximizes its welfare over time, i.e. if it is dynamically efficient, and given an inital external deficit, it should pursue pro-lending policies so as to bring about a fall in the interest rate.[4] Similarly, given an initial surplus, the country should practice pro-borrowing policies so as to induce an increase in the world interest rate. Consequently, and in principle, one should then observe in dynamically efficient economies a tendency to equate saving and investment in each period. The terminology is due to Frenkel and Razin (1989), who distinguish between pro-lending and pro-borrowing policies. The former stimulate current external lending (national saving) while the latter stimulate current external borrowing (national dissaving). Pro-borrowing policies increase the world interest rate and pro-lending policies decrease it.

A similar result to Proposition 1 above is obtained in Buiter and Kletzer (1991, p. 234). Using an overlapping generations model without an operative bequest motive, they show that for a utilitarian planner welfare improving policy calls for a tax which raises the interest rate if the home country is a net creditor, or a tax which lowers the interest rate if the home country is a net debtor.

Note that the welfare implications of Proposition 1 would be the same for small open economies provided that they face an interest rate which is a decreasing function of their external balance. In general, the above framework is applicable only for those countries or blocs of countries whose borrowing and lending have an effect on the world capital market. By casual observation these countries or blocs of countries could currently include, e.g., the United States, Japan and the EC. Hence the welfare effects of economic policies, which will be derived in the following chapters, may be relevant only for these, sufficiently large, countries or blocs. However, the external balance effects of the policy measures in Chapters 3-5 are equivalent for small open economies.

Notes:

[1]Summers (1988) argues that the close link between saving and investment is due to government policies, but as Roger Gordon notes in commenting on Summers (1988): "Several questions remain, however, even if we accept Summers's argument. First, why have governments chosen so consistently to restrict any current account deficit or surplus? Since, given the normal vagaries of policy making, it seems difficult to attribute the close association between savings and investment across many countries and over an extended period of time entirely to the use of policy, what else may be going on?"

[2] A homothetic utility function has a constant rate of time preference and hence constant marginal propensity to consume out of wealth. For a discussion of this and related issues, see Svensson and Razin (1983).

[3] Apart from section 4 of Chapter 3, the study employs the profit function, which in the present context may be called the domestic product function, to model the production side of the economy. Depending on the context and the author, the domestic product function is also called the revenue, the restricted profit, the variable profit, the value added or the GNP function, as Svensson (1984) also notes. In Chapters 2, 3, 5 and sections 2 and 3 of Chapter 6, the domestic product function takes a trivial form because the first-period domestic product is predetermined and the second-period domestic product is endogenous only through the first-period investment.

[4] It is interesting that given an initial current account surplus, competitive equilibrium welfare can be improved by interventionist policies leading to increased current consumption. It is well known, since Diamond (1965), that in a closed economy overlapping generations model with finite lives, the competitive economy can cumulate too much capital and that welfare can be improved by increasing current consumption; for an open economy treatment, see Persson (1985). However, empirical evidence by Abel et al. (1989) suggests that this kind of dynamic inefficiency is not of practical relevance.

3 CONSUMPTION AND INCOME TAXATION

3.1 Introduction

The purpose of this chapter is to consider the effects of income and consumption taxation in the framework which was presented in Chapter 2. In the analysis the tax policy issues addressed in Frenkel and Razin (1988a) are reconsidered. Slightly different versions of Frenkel and Razin (1988a) are provided in Frenkel and Razin (1987, Chapter 8) and in Frenkel and Razin (1988b).

The chapter is organized in a similar way as Frenkel and Razin (1987), (1988a) and (1988b). First, in section 2, the effects of changes in consumption taxation are considered. Section 3 considers the effects of income taxation under fixed labour supply. Finally, section 4 sets up first the endogeous labour supply version of the model and then analyses the effects of wage income taxation. In this section it is instructive to first work out the general case where consumption and leisure are not separable and then proceed to employ a more restrictive model which is capable of producing unambiguous results.

3.2 Effects of consumption taxation

Frenkel and Razin (1988a) consider first the effects of a cut in the current tax rate under the consumption tax system. In fact, the consumption tax case has also been analysed by van Wijnbergen (1986, p. 1019) in the same framework, i.e. in a two-country, fixed labour input and exogenous terms of trade framework. Section 2 below extends the analysis of these studies by deriving the welfare effects of the consumption tax changes.

This chapter employs the framework of Chapter 2. Further, for the purposes of the subsequent analysis it is assumed that preferences are homothetic so that the marginal propesity to consume out of wealth is constant in time. Denote the marginal propensity to consume out of wealth,

$W=Y^1+RY^2$, in the first and second periods by c^1_W and c^2_W, respectively, and in a similar fashion for the foreign country. Hence constant marginal propensity to consume out of wealth means $c^1_W=c^2_W$, $c^{*1}_W{}^*=c^{*2}_W{}^*$. The intertemporal budget constraints imply that all wealth is consumed within the two periods. Hence $c^1_W+Rc^2_W=1$, $c^{*1}_W{}^*+Rc^{*2}_W{}^*=1$, which can be written as $(1+R)c^1_W=1$, $(1+R)c^{*1}_W{}^*=1$, which is equivalent to $c^1_W=c^{*1}_W{}^*$.

The effects of a change in the current consumption tax under an initial external imbalance are summarized by the following proposition.

PROPOSITION 2: In the presence of an initial external deficit (surplus), a current tax increase (cut) under a consumption tax improves home country and reduces foreign country welfare.

PROOF: Differentiating the home and foreign country trade balances, allowing for changes in the discount factor, R, and the consumption tax rates, s^t, yields

(1) $db^1=-C^1_{s^1}ds^1-C^1_{s^2}ds^2-C^1_u du-C^1_R dR-I_R dR$,

(2) $db^{*1}=C^{*1}_u{}^* du^*-C^{*1}_R dR-I^*_R dR$.

Differentiating the home country budget constraint, equation (7) in Chapter 2, yields

(3) $C^1ds^1+C^2d[(1+s^2)R]+E_u du+G^2dR=$

$$Y^2+(RY^2_K-1)I_R dR+C^1ds^1+RC^2ds^2.$$

Noting that $C^2d[(1+s^2)R]=C^2[(1+s^2)dR+Rds^2]$, $s^2=0$, $b^2=Y^2-C^2-G^2$, $RY^2_K-1=0$ and solving for $E_u du$, yields

(4) $E_u du=b^2dR$,

Differentiating the foreign country budget constraint, equation (8) in Chapter 2, yields

(5) $E^*_u * du^* = b^{*2} dR$.

The marginal propensity to consume out of wealth, $W=Y^1+RY^2$, in the first period can be written as $c^1_W = C^1_u / E_u$ and in a similar fashion for the foreign country. Note that c^1 is the uncompensated (Marshallian) first-period demand function while C^1 is the compensated (Hicksian) first-period demand function (see also Svensson (1984, p. 658)). Using $C^1_u = c^1_W E_u$ and $C^*_u = c^{*1}_W * E^*_u$ to substitute (4) and (5) into (1) and (2), yields

(6) $db^1 = -C^1_{s1} ds^1 - C^1_{s2} ds^2 - c^1_W b^2 dR - C^1_R dR - I_R dR$,

(7) $db^{*1} = c^{*1}_W * b^{*2} dR - C^{*1}_R dR - I^*_R dR$.

According to the first-period market-clearing condition, $db^1 = -db^{*1}$.

Using this and solving for dR yields

(8) $dR = -(C^1_{s1} ds^1 + C^1_{s2} ds^2) /$

$$(C^{*1}_R + I^*_R + C^1_R + I_R + c^{*1}_W * b^{*2} + c^1_W b^2).$$

Differentiating next the government budget constraint, equation (5) in Chapter 2, assuming zero initial tax rates and allowing for changes in the consumption tax rates yields

(9) $C^1 ds^1 + RC^2 ds^2 = 0$.

Given that $C^1 > 0$, $R > 0$, $C^2 > 0$, ds^1 and ds^2 have opposite signs. Given that there is a first-period consumption tax increase, i.e. $ds^1 > 0$, then by (9) $ds^2 < 0$. In this case the denominator of (8) is positive because $C^1_{s1} ds^1 < 0$ and $C^1_{s2} ds^2 < 0$ given that $C^1_{s1} < 0$ and $C^1_{s2} > 0$.

Utilizing the fact that in the numerator of (8) $c^1_W = c^{*1}_W *$

and $b^2=-b^{*2}$, $c^1_W b^2+c^{*1}_W b^{*2}=0$. Further, given that $C^{*1}_R>0$, $I^*_R>0$, $C^1_R>0$, $I_R>0$, the numerator is also positive. Hence $s^1>0$ implies $dR>0$. Analogously, $ds^1<0$ implies $dR<0$. Consider next the case of $b^1<0$, $ds^1>0$, implying $dR>0$, which implies $du>0$ in (4). Similarly, in the case of $b^1>0$, $ds^1<0$, implying $dR<0$, which implies $du>0$ in (4). In both cases, on the basis of equation (5) the change in the foreign country welfare, du^*, is negative. Q.E.D.

Proposition 2 confirms the result by Frenkel and Razin (1988a). Further, the formal framework also enables one to derive the welfare effects of the policy.

The intuition behind Proposition 2 is the following. A current consumption tax rise and the required future tax cut induces an intertemporal substitution from current consumption towards future consumption. This increases current domestic saving and is hence a pro-lending policy, inducing a fall in the world interest rate. Given that the country has an initial current account deficit, it benefits from the fall in the interest rate. Note that the fall in the interest rate is smaller, and hence the welfare gain is smaller, the greater is the numerator in (8), i.e. the higher are the elasticities of home and foreign investment and current consumption with respect to the interest rate.

3.3 Effects of corporate income taxation

The effects of capital income taxation in a dynamic open economy context are considered by Bovenberg (1986), (1988) and Sibert (1990). The analysis of Bovenberg (1986) is confined to the small open economy case. Bovenberg (1988) focuses on the effects of a corporate income tax in a two-sector model where adjustment costs give rise to imperfect sectoral capital mobility. Sibert (1990) employs a large country model to evaluate the effects of capital income taxation. However, her model is based on the assumption of overlapping-generations without an operative bequest motive. In this context, e.g., distortionary taxes also

give rise to income effects, unlike in the models employed in the present study.

The following analysis uses a framework which is based on the same assumptions as Frenkel and Razin (1988a) and (1988b). The income tax base includes a tax on both capital and labour income. Because labour supply is, for the time being, assumed to be fixed, the allocative effect of the income tax will be equivalent to a tax on capital or corporate income only. There is full expensing of investment, hence the system is a cash flow income tax system. Frenkel and Razin demonstrate that a current-period tax cut under the income tax system is a pro-lending policy. In the following this result is established formally. Further, the welfare effects arising from the tax changes are obtained.

PROPOSITION 3: In the presence of an initial external deficit (surplus), a current tax cut (increase) under an corporate income tax improves home country and reduces foreign country welfare.

PROOF: Differentiating the home and foreign country first-period external balances yields

(10) $db^1=-I_{v^1}dv^1-I_{v^2}dv^2-C^1_R dR-I_R dR,$

(11) $db^{*1}=-C^{*1}_R dR-I^*_R dR.$

Use $c^1_W=C^1_U/E_U$ and $c^{*1}_W{}^*=C^{*1}_U{}^*/E^*_U{}^*$ to substitute equation (4) and (5) into (10) and (11). As is verified below, equation (4) also holds under corporate income taxation. Using $db^1=-db^{*1}$ to solve dR from (10) and (11) yields

(12) $dR=-(I_{v^1}dv^1+I_{v^2}dv^2)/(C^{*1}_R+I^*_R+C^1_R+I_R+c^1_W b^2+c^{*1}_W{}^* b^{*2}),$

Differentiating the government budget constraint, assuming that tax rates are initially zero and allowing for changes in the corporate profit tax rates, yields

(13) $(Y^1-I)dv^1+RY^2dv^2=0$.

Assuming that $Y^1-I>0$, the term inside the brackets in (13) is positive. Hence, given that $Y^2>0$, dv^1 and dv^2 have opposite signs. Consider first the case with $dv^1<0$, implying, by the above government budget constraint condition, $dv^2>0$. With $dv^1<0$, $dv^2>0$, $I_{v^1}>0$, $I_{v^2}<0$, the denominator of (12) is positive. Since, as in Proposition 2, the numerator is also positive, $dR>0$. Similarly, in the case with $dv^1>0$, implying $dv^2<0$, $dR<0$.

To determine the welfare effects, differentiating the home country intertemporal budget constraint yields

(14) $E_u du=b^2dR+(RY^2_K-1)[I_R dR+I_{v^1}dv^1+I_{v^2}dv^2]$.

Given that $v^1=v^2=0$ initially, $RY^2_K=1$ by equation (2) in Chapter 2 and the second term in (14) is zero. Hence (14) reduces to equation (4). Consider the case with $b^1<0$, implying $b^2>0$. Then $dv^1<0$, implying $dv^2>0$ and $dR>0$, induces a change in welfare which is positive given that $E_u>0$. Consider next the case with $b^1>0$, implying $b^2<0$. Then $dv^1>0$, implying $dv^2<0$ and $dR<0$, results in $du>0$. It can readily be verified, using equation (5), that in both of these cases the foreign country welfare deteriorates.

Q.E.D.

Proposition 3 confirms the result by Frenkel and Razin (1988a) that a current tax cut (increase) under corporate income taxation is pro-lending (pro-borrowing). In addition, Proposition 3 indicates when the pro-lending and pro-borrowing policies are desirable.

The intuition behind Proposition 3 is the following. An increase in, say, the current corporate income tax means that tax deductions from current investment increase, which has a positive effect on investment. A future tax increase decreases the future marginal productivity of capital, inducing a fall in current investment demand.

On the other hand, a policy consisting of $dv^1>0$, $dv^2<0$, increases investment and worsens the current external balance, which induces an increase in the world interest rate. Given that the country initially runs an external surplus, i.e. the country is a net creditor country, it will benefit from the increase in the interest rate.

3.4 Effects of wage income tax

This section examines the effects of a tax cut under wage income taxation and under supply-determined employment. To set up the elastic labour supply version of the model, the approach used by Greenwood and Kimbrough (1985) and Kimbrough (1986) is applied. The production side of the economy is represented by a production function of the form

$$(15)\quad Y^t=f(L^t,K^t)=w^tL^t+h^t(K^t),$$

where the marginal productivity of labour, w^t, is independent of the capital stock. Output is a concave function of the capital stock, i.e., $h_K>0$, $h_{KK}<0$. Noting that $I=K^2$, the first order condition for investment is $h_K(I)=1/R$ and investment demand can be written as $I=I(R)$; $I_R=-h_K/h_{KK}>0$.

The demand side is represented by a present value expenditure function, which is defined as

$$(16)\quad E(1,R,(1-m^1)w^1,R(1-m^2)w^2,u)=$$

$$\min\{C^1+RC^2-(1-m^1)w^1L^1-R(1-m^2)w^2L^2:u(C^1,L^1,C^2,L^2)\geq u\},$$

where m^t is the marginal and average wage income tax rate. In what follows, the net after-tax wage rate, $(1-m^t)w^t$, will be denoted as n^t.

According to the derivative properties of the expenditure function, compensated consumption demands and labour supplies are obtained using the derivative properties of

the expenditure function $E_1=C^1$, $E_2=C^2$, $E_3=-L^1$ and $E_4=-L^2$. Assuming that the final goods are normal goods at both dates and that the quantities of leisure consumed in the two periods are net substitutes, the arguments of these functions can be signed as follows (see also Greenwood and Kimbrough (1985, p. 748))

$$(17)\quad C^1=C^1(1,R,n^1,Rn^2,u), \qquad - + + \; + \quad +$$

$$(18)\quad C^2=C^2(1,R,n^1,Rn^2,u), \qquad + - + \; + \quad +$$

$$(19)\quad L^1=L^1(1,R,n^1,Rn^2,u), \qquad - - + \; - \quad -$$

$$(20)\quad L^2=L^2(1,R,n^1,Rn^2,u). \qquad - - - \; + \quad -$$

The private sector budget constraint can be written as

$$(21)\quad C^1+RC^2+I=Y^1+RY^2-m^1L^1-Rm^2L^2.$$

The government budget constraint is of the form

$$(22)\quad G^1+RG^2=m^1w^1L^1+Rm^2w^2L^2.$$

Substituting (22) into (21), the intertemporal budget constraint of the economy can be written without the tax revenue terms as

$$(23)\quad C^1+RC^2+G^1+RG^2+I=Y^1+RY^2.$$

Using a tax-exclusive version of the expenditure function (16) and the definition of the production function, equation (15), (23) can be written as

$$(24)\quad E(1,R,w^1,Rw^2,u)+G^1+RG^2+I=h(K^1)+Rh(I).$$

Assuming that the foreign country labour input is also

supply-determined, that the marginal product of labour is constant and that no taxes are imposed, the corresponding foreign country budget constraint can be written as

(25) $E^*(1,R,w^{*1},Rw^{*2},u^*)+I^*=h^*(K^{*1})+Rh^*(I^*)$.

The first-period trade balance for the home country can be written as

(26) $b^1=Y^1-C^1-I-G^1$.

Consider now the effects of a current-period tax change by the home country under the wage income tax.

Differentiating the government budget constraint, equation (22), given that tax rates are initially zero and that government output is constant, yields

(27) $w^1L^1dm^1+Rw^2L^2dm^2=0$.

Given that $L^t>0$, $R>0$, dm^1 and dm^2 are of opposite signs.

Differentiating the home country first-period trade balance, equation (26), yields

(28) $db^1=w^1L^1_R dR+w^1L^1_{n1}dn^1+w^1L^1_{n2}dn^2+w^1L^1_u du$

$-C^1_R dR-C^1_{n1}dn^1-C^1_{n2}dn^2-C^1_u du-I_R$.

The change in the trade balance of the foreign country is

(29) $db^{*1}=w^{*1}L^{*1}_R dR+w^{*1}L^{*1}_u{}^* du^*$

$-C^{*1}_R dR-C^{*1}_u{}^* du^*-I^*_R dR$.

It can readily be verified that the home country welfare response also reduces in the present case to the one given by equation (4).

Using $c^1_W E_u=C^1_u$ and $c^{*1}_W{}^* E^*_u{}^*=C^{*1}_u{}^*$ to substitute (4) and

(5) into (28) and (29) and using $db^1=-db^{*1}$ to solve dR from (28) and (29), yields

$$(30)\quad dR=(w^1L^1_{n1}dn^1+w^1L^1_{n2}dn^2-C^1_{n1}dn^1-C^1_{n2}dn^2)/$$

$$(C^1_wb^2+C^{*1}_w*b^{*2}+C^{*1}_R+I^*_R-w^{*1}L^{*1}_R-w^1L^1_R+C^1_R+I_R).$$

Consider the case of a current-period tax cut followed by a future increase, i.e. $dm^1<0$ and $dm^2>0$. This implies that the changes in net after-tax wages are $dn^1>0$ and $dn^2<0$. The first two terms and the fourth term in the denominator of (30) are positive, but the third term, $-C^1_{n1}dn^1$, is negative and all the terms in the numerator are positive. Given the ambiguity of the sign of the denominator, dR cannot be signed, i.e. the world interest response is ambiguous. It is obvious that a current-period tax increase followed by a future tax cut also has an ambiguous interest rate effect. By Proposition 1, the ambiguity of the interest rate response implies that the welfare effect cannot be signed.

In the above, the world interest rate response to the domestic wage income tax cut is ambiguous because an increase in the current net wage has a positive effect on current domestic consumption. This positive consumption effect induces a negative trade balance effect, which, in turn, results in a positive world interest rate effect.

The above analysis does not confirm the result by Frenkel and Razin (1988a), according to which a current wage tax cut is a pro-lending policy leading to a fall in the world interest rate. This result is attained by the additional assumption (which Frenkel and Razin (1988a) also make explicitly) that the utility function is weakly separable between consumption and leisure, implying that the intertemporal consumption choice depends only on the relative price of current and future final goods and not on wage structure. In this case the compensated consumption demand and labour supply functions reduce to

the following, as compared to the more general equations (17)-(20) above

$$(31)\quad C^1=C^1(1,R,u),\qquad \underset{}{-\ +\ +}$$

$$(32)\quad C^2=C^2(1,R,u),\qquad \underset{}{+\ -\ +}$$

$$(33)\quad L^1=L^1(n^1,Rn^2,u),\qquad \underset{}{+\quad -\ +}$$

$$(34)\quad L^2=L^2(n^1,Rn^2,u).\qquad \underset{}{-\quad +\ +}$$

Using the above functions, the interest rate and welfare effects of wage income taxation can be signed. Now, the following proposition can be put forward.

PROPOSITION 4: In the presence of an initial external deficit (surplus) and weakly separable consumption and leisure, a current tax cut (increase) under wage income taxation improves home country and reduces foreign country welfare.

PROOF: Repeating the steps from equation (28) to (30) using the consumption demand and labour supply functions (31)-(34), equation (30) reduces to

$$(35)\quad dR=(w^1L^1_{n1}dn^1+w^1L^1_{n2}dn^2)/$$

$$(c^1_W b^2+c^{*1}_W b^{*2}+C^{*1}_R+I^*_R-w^{*1}L^{*1}_R-w^1L^1_R+C^1_R+I_R).$$

As in Propositions 2 and 3, the numerator is positive. Consider first an increase in the current income tax, i.e. $dm^1>0$, implying $dm^2<0$. In this case the denominator of (35) is negative. Hence $dR<0$, i.e. the world interest rate increases. Similarly, $dm^1<0$, implying $dm^2>0$, leads to $dR>0$, i.e. to a fall in the world interest rate. To obtain the welfare responses, differentiate the home country intertemporal budget constraint, equation (24), to yield

(36) $E_u du=-C^2 dR+w^2L^2 dR+h(I)dR-G^2 dR$.

Noting that $b^2=h(I)+w^2L^2-C^2-G^2$, (36) reduces to

(4) $E_u du=b^2 dR$.

Consider first the case with $b^1<0$, implying $b^2>0$, and $dm^1<0$, implying $dm^2>0$ and $dR>0$. In this case $du>0$, given $E_u>0$. Consider next the case with $b^1>0$, implying $b^2<0$ and the policy with $dm^1>0$, implying $dm^2<0$ and $dR<0$. The welfare response, du, is also in this case positive. From $E^*_u{}^* du^*=b^{*2} dR$ and $b^{*2}=-b^2$, it follows that in both of these cases $du^*<0$. Q.E.D.

The intuition behind the improvement in welfare resulting from, say, the current wage income tax cut under an initial external deficit is the following. An increase in the current net after-tax wage increases current labour supply and output. Given that the intertemporal consumption decision is not distorted, the external balance improves, bringing about a fall in the interest rate faced by the country and implying a benefit to this country, which is currently a net debtor.

The above propositions have shown how different forms of taxation can be employed to reduce external imbalance, in the case of a small economy, and to reduce external imbalance and to improve welfare, in the case of a large country. The difference between the small and large country being that the former faces an exogenous interest rate for its external debt while for the latter it is endogenous. Nothing was said, however, about the relative efficiency of different tax tools in acheiving the improvement in external balance or welfare.

It is apparent that the relative efficiency question cannot be resolved without quantitative information about the structure of the economy and about the behaviourial and technological parameters. Note that all policy

packages can, in principle, be designed so that they bring the external balance into equilibrium. In this case, of course, all packages are equally efficient in the sense that they all produce the same maximum welfare gain which is potentially available. In reality each tax parameter is likely to have a range within which it can vary.

The analysis in this chapter has served the following purposes. First, it formalized the graphical analysis by Frenkel and Razin (1988a) (which is also presented in Frenkel and Razin (1987, Chapter 8) and Frenkel and Razin (1988b)). Second, the formal analysis enabled the derivation of the welfare effects of tax policies. Third, the desirable tax policies were established given the external balance situtation and the tax instruments. Finally, it was noted that the relative efficiency of the different policy packages is an empirical issue.

The analysis did not consider what happens if both countries try to maximize their welfare given the decisions of the other. It is clear that these Nash strategies would have an ambiguous world interest rate effect because one country is pursuing pro-lending and the other pro-borrowing policies. Hence the welfare effects would also be ambiguous. However, as is shown in Chapter 7, given that the countries are initially pursuing Nash strategies so that their tax systems imply intertemporal distortions, a coordinated reduction of these distortions will improve welfare in both countries.

4 LABOUR INPUT TAXATION

4.1 Introduction

Labour input or payroll taxes, such as employers' social security contributions, induce distortions in the economy. This chapter considers the effects of changes in the time path of labour input taxes. Further, the question of whether it would be beneficial to shift the financing of social security from a system based on wage tax towards one based on a consumption tax is addressed.

This chapter differs from the previous ones by introducing elastic labour demand. There is much uncertainty about how the labour markets operate in reality. While a model where flexible wages bring the demand for and supply of labour into equilibrium may serve as a useful benchmark, there is empirical evidence supporting the view that wage contracts and wage indexation play an important role. Hence the assumption of perfectly competitive labour markets is perhaps not a very good approximation of reality.[1] Apart from the section 2 and 3, this chapter employs a two-country model where labour input is demand-determined and the labour tax-exclusive wage is assumed to be either fixed or indexed to the consumer price.

The chapter is organized as follows. Section 2 sets up a general model where flexible wages bring the demand for and supply of labour into equilibrium. In section 3, this model is used to examine the incidence of labour taxation. Section 4 sets up a more restrictive, but perhaps a reasonably realistic, model where labour input is demand-determined. This model is used in section 5 to evaluate the effects of an anticipated future shift between labour tax- and consumption tax-based social security financing. Section 6 employs the same model to evaluate a policy package consisting of a permanent shift from wage-based towards consumption tax-based financing and a temporary wage freeze with full future wage compensation for the permanent consumer price increase.

4.2 The model

Taking into account labour input taxes, the production side of the economy is represented by a restricted profit, or domestic product, function, defined as

(1) $Y^t[1,(1+a^t)w^t,K^t]=$

$$\max\{X^t-(1+a^t)w^tL^t:X^t=f^t(L^t,K^t)\},$$

where Y^t is the restricted profit function, which is a function of the price of the final good, here the numeraire good, the labour tax rate, a^t, the wage rate in terms of the final good, w^t, and the capital stock, K^t.

As in the previous chapters, the current capital stock is fixed and current investment augments the future capital stock, which depreciates within the second period so that the capital stock is used up by the end of the second period. To rule out the indeterminacy of future output, the future production function is assumed to be a strictly concave function of labour and capital. Capital and labour are assumed to be gross substitutes so that the cross partial of the production function is positive, i.e. $f^2_{LI}>0$. This implies that $I_{(1+a^2)w^2}<0$, $L^2_R>0$. By the strict concavity of the future production, $f^2_{LL}<0$, $f^2_{II}<0$, $f^2_{LL}f^2_{II}-(f^2_{LI})^2>0$.

In the absence of corporate income taxation, the first order condition for investment is $Rf^2_I=1$. Given that capital and labour are gross substitutes, investment is given by the function $I=I((1+a^2)w^2,R)$, $I_{(1+a^2)w^2}<0$, $I_R>0$, where R is the discount factor $R=1/(1+r)$, r being the world interest rate. To keep the analysis reasonably tractable, the world interest rate is kept constant in the tax incidence analysis. As will become apparent in section 3, allowing for an endogenous interest rate would not resolve the ambiguity of the labour tax incidence.

To incorporate elastic labour supply, define the expenditure function as in section 4 of Chapter 3 as

(2) $E(1,R,w^1,Rw^2,u)=$

$$\min\{C^1+RC^2-w^1L^1-Rw^2L^2 : u(C^1,L^1,C^2,L^2)\geq u\},$$

The compensated consumption demand and labour supply functions which are implied by this expenditure function have the same properties as in Chapter 3 and the arguments of these functions can be signed as in equations (17)-(20) in that chapter.

The intertemporal budget constraint of the private sector can be written as

(3) $E(1,R,w^1,Rw^2,u)+I(R,w^2)=$

$$Y^1[1,(1+a^1)w^1,K^1]+RY^2[1,(1+a^2)w^1,K^2]+F^1+RF^2,$$

where F^1 and F^2 are the predetermined social security transfers. The government collects the labour taxes and distributes the transfers, and the government budget constraint can be written as

(4) $F^1+RF^2=a^1w^1L^1+Ra^2w^2L^2.$

Assuming an exogenous interest rate, the first- and second-period world market clearing conditions are not relevant for this small country. However there are also the equilibrium conditions according to which the labour market has to clear at both dates, so

(5) $L^{d1}=L^{s1},$

(6) $L^{d2}=L^{s2},$

where L^{dt}, $t=1,2$ denotes labour demand and L^{st}, $t=1,2$ denotes labour supply. Assuming normality and substitutability across periods, the compensated labour

supply function L^{s1} is increasing in w^1 and decreasing in w^2 and L^2 is increasing in w^2 and decreasing in w^1. The labour demand function L^{d1} is decreasing in w^1 and L^{d2} is decreasing in w^2 (because labour is a variable input in both periods, current labour demand is independent of the future wage and vice versa).

4.3 The incidence of labour input taxation

Although, in the light of empirical evidence, models with demand-determined labour input appear to often roughly capture observed developments, the incidence of labour taxes in such models is simplistic because the burden of labour taxes falls entirely on capital. In general, the larger (smaller) is the labour supply elasticity and the smaller (larger) is the labour demand elasticity, the more (less) labour bears the burden of the labour input tax. The aim of this section is to analyse the issue of labour tax incidence in an intertemporal open economy context. A comprehensive survey of tax incidence in general, and which also covers some open economy questions, is presented in Kotlikoff and Summers (1987). To what extent labour taxes are shifted also depends on the nature of labour and product markets. For example, in the presence of unionized labour markets and imperfect product markets, the possibility of overshifting of taxes arises.[1]

Often tax incidence analyses concentrate on the changes in net incomes induced by taxation. However, as Sinn (1987, p. 290) notes:

> "This procedure may seem plausible at first sight, but it has the disadvantage that the change in net income is not necessarily a good indicator for the change in utility which the taxation causes. If, as in this book, proportional taxes are assumed, then a net income after tax can be seen as a product on a net factor price and a factor supply. Only that part of the change in net income that results from a change in the net factor price is a clear indicator of a change in utility."

Following the line of approach advocated by Sinn, the tax

incidence analysis will be carried out here by deriving the tax-induced changes in endogenous factor prices. In the present context these prices include only the current- and future-period wages, the price of investment being the exogenous world market output price, which is also the consumer price.

In the following, the labour tax incidence issue is addressed by employing a competitive labour market model, with elastic labour demand and supply and market-clearing wages. To anticipate the results, consider the effects of a current increase and a future cut in the labour input tax on the equilibrium wage. In a static model a labour tax increase would result in an increase in the real product wage faced by the firm and in a fall in the real consumption wage faced by the worker. In a dynamic framework, however, the qualitative incidence is not so clear cut. This is because in an intertemporal model the initial wage response also depends on what happens, or rather what is expected to happen, in the future. Assuming that the future fall in the labour tax is anticipated, the current cut and future increase in the consumption wage leads to intertemporal substitution from current towards future labour supply.

The intertemporal substitution effect is increased by the increase in current investment which is induced by the fall in the future product wage because the implied increase in future output and labour demand also bids up the future consumption wage. If the resulting cut in the current labour supply is large enough, the fall in the current consumption wage may not materialize. The ambiguity of the consumption wage response is shown formally below.

It is apparent that the ambiguity of the wage response would not hold in the case of, e.g., a permanent increase in the labour tax. Those cases where the qualitative effects correspond to the ones in the static case are not treated here and the analysis below is confined to the

cases where the time profile of labour tax changes is not flat.

To keep the analysis reasonably tractable, a framework is employed where the world interest rate is kept constant. This assumption has no effect on the qualitative results obtained.

Consider now the incidence of labour tax changes. Differentiate first the private sector intertemporal budget constraint, equation (3), and solve for $E_u du$ to yield

$$(7)\quad E_u du = L^{s1}dw^1 + RL^{s2}dw^2 - L^{d1}dw^1 - w^1L^{d1}da^1 - RL^{d2}dw^2 - RL^{d2}da^2$$

$$+ (RY^2_I - 1)\, I_{w^2} dw^2 + (RY^2_I - 1)\, I_{a^2} da^2 .$$

In (7), the terms involving investment responses to changes in a^2 and w^2 are zero by the first order condition for investment. Differentiating the government budget constraint, keeping the present value of tax revenue constant, yields

$$(8)\quad Rw^2L^2da^2 = -w^1L^1da^1 .$$

Substituting (8) into (7), and setting $L^{dt}=L^{st}$, t=1,2, (8) reduces to

$$(9)\quad E_u du = 0 .$$

Hence the changes in the labour tax rates leave the aggregate welfare unchanged. This follows from the exogenous interest rate assumption. Recall from the results of the previous chapters that, in these competitive models with constant initial tax rates, welfare is affected only through the changes in the world interest rate. Following Sinn (1987), one may question whether it is reasonable to consider tax incidence in a representative agent framework.

In fact, as Sinn (1987, pp. 289-290) notes, the economy may be assumed to consist of a large number of households with identical homothetic preferences. In particular, they may be endowed with different amounts of capital and labour. In this case, tax changes which affect capital and labour income differently also change the distribution of wealth between individuals although the aggregate wealth is left unchanged.

Differentiating the first- and second-period labour market-clearing equations, equations (5) and (6), yields

$$(10)\quad w^1 L^{d1}{}_{a1} da^1 + L^{d1}{}_{w1} dw^1 = L^{s1}{}_{w1} dw^1 + RL^{s1}{}_{w2} dw^2 + L^{s1}{}_{u} du.$$

$$(11)\quad Rw^2 L^{d2}{}_{a2} da^2 + RL^{d2}{}_{w2} dw^2 + RL^{d2}{}_{I} I_{w2} dw^2 + Rw^2 L^{d2}{}_{I} I_{a2} da^2 =$$

$$L^{s2}{}_{w1} dw^1 + RL^{s2}{}_{w2} dw^2 + L^{s2}{}_{u} du.$$

Noting that $du=0$ and solving for dw^1 from (10) and (11) yields

$$(12)\quad dw^1 = [fR^2 w^2 L^{s1}{}_{w2} da^2 (L^{d2}{}_{a2} + L^{d2}{}_{I} I_{a2}) - w^1 L^{d1}{}_{w1} da^1]/$$

$$(L^{d1}{}_{w1} - L^{s1}{}_{w1} + fRL^{s1}{}_{w2} L^{s2}{}_{w1}),$$

where $f=-1/R(L^{d2}{}_{w2} + L^{d2}{}_{I} I_{w2} - L^{s2}{}_{w2}) > 0$.

The denominator of (12) can be signed if da^1 and da^2 are of the same sign. In particular, if $da^t<0$, $t=1,2$, the denominator is negative. However, by equation (8), da^t $t=1,2$ cannot be of the same sign. Further, in the numerator, the first two terms are negative and the third term is positive. Hence, in general, the sign of the consumption wage response is ambiguous, as it was sought to show. Note also that, e.g., the external balance effects stemming from a change in the time path of labour taxes would be ambiguous because the ambiguity of the wage response implies that the labour input response is ambiguous.

Making now the further assumption that there is no intertemporal substitution in labour supply and setting $L^{s1}{}_{w}2=L^{s2}{}_{w}1=0$, it can be shown that the ambiguity concerning the qualitative labour tax incidence can be resolved.[2] In this case (12) reduces to

(13) $dw^1=w^1L^{d1}{}_{w}1da^1/(L^{s1}{}_{w}1-L^{d1}{}_{w}1)$.

Solving dw^2 from (10) and (11) and setting $L^{s1}{}_{w}2=L^{s2}{}_{w}1=0$ yields

(14) $dw^2=w^2da^2(L^{d2}{}_{a}2+L^{d2}{}_{I}I_{a}2)/(L^{s2}{}_{w}2-L^{d2}{}_{w}2-L^{d2}{}_{I}I_{w}2)$.

Consider first the case with $da^1<0$, implying, by equation (12), $da^2>0$. Hence from (13), $dw^1>0$ and from (14) $dw^2<0$, and the opposite holds for $da^1>0$, $da^2<0$.

Consider next the real product wage response. The real product wage is defined as $w^{pt}=w^t(1+a^t)$. Note that $dw^{pt}=d[w^t(1+a^t)]=dw^t+w^tda^t$. Using this and adding w^1da^1 to both sides of (13), (13) can be written as

(15) $dw^{p1}=w^1da^1[1+L^{d1}{}_{w}1/(L^{s1}{}_{w}1-L^{d1}{}_{w}1)]$

(15) can be written as

(16) $dw^{p1}=w^1da^1L^{s1}{}_{w}1/(L^{s1}{}_{w}1-L^{d1}{}_{w}1)$.

Similarly, (14) can be written as

(17) $dw^{p2}=w^2da^2L^{s2}{}_{w}2/(L^{s2}{}_{w}2-L^{d2}{}_{w}2-L^{d2}{}_{I}I_{w}2)$.

In both (16) and (17) the numerator is positive. Consider first the case $da^1<0$, $da^2>0$. From (16) and (17) this implies $dw^{p1}<0$ and $dw^{p2}>0$ and in the case $da^1>0$, $da^2<0$, the signs are reversed.

It can be noted that, once the intertemporal substitution in labour supply is ignored, the incidence of the labour input taxes depends only on the intratemporal labour

supply and demand elasticities. In this case, on the basis of equation (13), e.g., an increase in the first-period labour tax, a^1, induces a greater cut in the first-period real consumption wage, the smaller is $L^{s1}{}_{w1}$ and the greater is $L^{d1}{}_{w1}$. At the limit when labour supply is perfectly inelastic, i.e. $L^{s}{}_{w1}=0$, and labour demand is perfectly elastic, i.e. $L^{d1}{}_{w1}$ is minus infinity, labour bears the whole burden of the labour tax increase. This result is well known from the tax incidence literature employing static models. However, there do not appear to be any any previous studies which are based on intertemporal models and which have obtained the ambiguous results concerning the qualitative wage response to labour input tax changes.

Finally, consider what can be said about intertemporal tax incidence, i.e. about the ratio between wage changes in the first and second period, dw^1/dw^2. Using equations (10), (11) and (8), dw^1/dw^2, can be written as

$$(18)\quad dw^1/dw^2=R(L^{s1}{}_{w2}+ghL^{s2}{}_{w2}-ghL^{d2}{}_{I}I_{w2}-ghL^{d2}{}_{w2})/$$

$$(L^{d1}{}_{w1}-L^{s1}{}_{w1}-ghL^{s2}{}_{w1}),$$

where $g=-R(w^2L^{d2}{}_{a2}+w^2L^{d2}{}_{I}I_{a2})>0$, $h=-Rw^2L^2L^{d1}{}_{a1}/L^1>0$.

In the denominator of (18), the first term inside the brackets is negative and the remaining three terms are positive. In the numerator the first two terms are negative and the third term is positive. Hence, in general, the sign of dw^1/dw^2 is ambiguous. Omitting the terms involving intertemporal substitution in labour supply, the denominator is positive and the numerator is negative. Hence, in the absence of intertemporal substitution in labour supply, dw^1/dw^2 is unambiguously negative. This obvious result could have also been inferred from equations (13) and (14) above and the fact that da^1 and da^2 have opposite signs.

The following lessons can be drawn from the above

analysis. When the static framework is extended to a dynamic one, an estimate of the elasticity of intertemporal substitution in labour supply is needed, in addition to the usual intratemporal labour supply and demand elasticities, in order to calculate the incidence of labour taxes. Further, in the intertemporal framework, even the qualitative wage response to changes in labour taxes can be ambiguous. Consequently, the real effects, as well as the external balance effects, of labour tax changes can be ambiguous. The intuitive explanation for this is the following. Consider a current-period labour tax cut. Given that the consumption wage response to this, under intertemporally substitutable labour supply, is ambiguous, the product wage effect cannot be signed. This, in turn, implies that the impact on domestic production is also ambiguous.

4.4 The model with demand-determined labour input

Assuming that labour supply is demand-determined and, for the time being, abstracting from consumption taxation, the demand side of the economy can be represented by the following expenditure function

$$(19)\quad E(1,R,u)=\min\{C^1+RC^2 : U(C^1,C^2)\geq u\},$$

where the variable symbols and the properties of the functions are the same as in the previous chapter.

Zero initial tax rates are assumed. As before, this involves no loss of generality in the present framework. This is shown as the last case in Appendix A, where the imported input, rather than the labour input, case is considered, but the analysis is analogous in the case of any variable input.

The production side of the model is assumed to take the same form as in section 2 of this chapter, i.e. the domestic product function is defined by equation (1). Also, the investment function is defined in the first

section of this chapter.

The following analysis also assumes that the demand for labour is always satisfied. This necessitates that there is unemployed labour to start with.

The intertemporal budget constraint of the private sector can now be written as

(20) $E(1,R,u)+I(R,w^2)=w^1L^1+Rw^2L^2$

$+Y^1[1,(1+a^1)w^1,K^1]+RY^2[1,(1+a^2)w^1,K^2]+F^1+RF^2$,

where F^1 and F^2 are the social security transfers, in terms of the final good, received by the private sector. The government collects the labour taxes and distributes the transfers. As in section 2, the government budget constraint is

(4) $F^1+RF^2=a^1w^1L^1+Ra^2w^2L^2$.

Denoting the foreign country variables by an asterisk, the intertemporal budget constraint of the (non-taxing) foreign country is written as

(21) $E^*(1,R,u^*)+I^*(R,w^{*2})=Y^{*1}(1,w^{*1},K^{*1})+RY^{*2}(1,w^{*2},K^{*2})$.

The first- and second-period external balances of the home country are

(22) $b^1=Y^1-I-C^1$.

(23) $b^2=Y^2-C^2$.

According to the intertemporal budget constraint

(24) $b^1+Rb^2=0$.

Equations corresponding to equations (22)-(24) also hold for the foreign country.

The world market clears at both dates so

(25) $b^1=-b^{*1}$,

(26) $b^2=-b^{*2}$.

4.5 The effects of labour input taxation

The effects of labour tax changes in the model can be summarized by the following proposition.

PROPOSITION 5: In the presence of an initial external deficit (surplus), a tax cut (increase) under a labour input tax system improves welfare.

PROOF: Differentiating the government budget constraint, equation (4), keeping F^t constant and assuming zero initial labour tax rates and transfers yields

(27) $Rw^2L^2da^2=-w^1L^1da^1$.

Differentiating the private sector intertemporal budget constraint, equation (20), assuming zero initial tax rates and solving for $E_u du$ yields

(28) $E_u du=-w^1L^1da^1-Rw^1L^2da^2+b^2dR$.

Substituting (27) into (28), (28) reduces to

(29) $E_u du=b^2dR$.

Given that $E_u>0$ and $b^1+Rb^2=0$, the change in welfare, du, is positive with $b^1<0$, $dR>0$ and with $b^1>0$, $dR<0$.

To demonstrate that $da^1<0$ implies $dR>0$ and $da^1>0$ implies $dR<0$, differentiate first b^1 and b^{*1} to obtain

(30) $db^1=w^1L_{a1}da^1-w^1L^1da^1-I_{a2}da^2-C^1{}_u du-I_R dR-C^1{}_R dR$,

(31) $db^{*1}=-c^{*1}_{R}dR-c^{*1}_{u}*du^{*}-I^{*}_{R}dR.$

Using $db^{1}=-db^{*1}$ to solve for dR from (30) and (31) yields

(32) $dR=(w^{1}L^{1}_{a1}da^{1}-w^{1}L^{1}da^{1}-I_{a2}da^{2})/$

$(C^{*1}_{R}+I^{*}_{R}+C^{1}_{R}+I_{R}+c^{*1}_{w}*b^{*2}+c^{1}_{w}b^{2})$,

where, as in Propositions 2-4, c^{1}_{w} is the first-period marginal propensity to consume out of wealth, $W=Y^{1}+RY^{2}$, the corresponding foreign country marginal propensity being $c^{*1}_{w}*$. On the basis of $b^{2}=-b^{*2}$, the homothetic preferences, according to which $c^{1}_{w}=c^{2}_{w}$, $c^{*1}_{w}=c^{*2}_{w}*$, and the budget constraints, implying $c^{1}_{w}+Rc^{2}_{w}=1$, $c^{*1}_{w}*+Rc^{*2}_{w}*=1$, the sum of the last two terms in the numerator of (32) is zero as in Propositions 2-4. The first four terms in the numerator are positive, as in Propositions 2-4. Hence the numerator of (32) is positive. Consider now the case where $da^{1}<0$, implying, by equation (27), $da^{2}>0$. In this case all the terms in the denominator of (32) are positive. Therefore, given that the numerator is also positive, $dR>0$. In the case where $da^{1}>0$, implying $da^{2}<0$, the terms in the denominator are negative while the numerator is still positive. Hence, in this case, $dR<0$. Therefore, on the basis of equation (29), the welfare in the home country improves. Q.E.D.

The intuition behind Proposition 5 is the following. Consider the initial external deficit case. A current labour tax cut increases the demand for labour, leading to an increase in the current output. The implied future labour tax rise decreases the future marginal productivity of capital, which induces a fall in current investment demand. Both of these channels, i.e. the increase in current output and the fall in investment, improve the current external balance, which induces a reduction in the world interest rate. Given that the country runs an initial external deficit, it benefits from this fall in the interest rate.

Note that for a small economy which faces an exogenous interest rate for its external debt and credit, there would be no welfare gain. However, the external balance effects of the labour tax changes would be the same. It can readily be verified, as in Propositions 2-4, that both welfare improving policies of the home country would result in a reduction in welfare in the foreign country.

4.6 Anticipated future tax base change from wages towards consumption

Recall from Chapter 2 that under consumption taxation, the expenditure function is defined as

$$E[(1+s^1),R(1+s^2),u]=\min\{(1+s^1)C^1+(1+s^2)RC^2:u(C^1,C^2)\geq u\},$$

where s^1 and s^2 are the first- and second-period consumption tax rates. The home country private sector budget constraint can be written as

$$(33)\quad E[(1+s^1),(1+s^2)R,u]+I(R,(1+a^2)w^2)=w^1L^1+Rw^2L^2$$

$$+Y^1[1,(1+a^1)w^1,K^1]+RY^2[1,(1+a^2)w^1,K^2]+F^1+RF^2,$$

The government budget constraint is written as

$$(34)\quad F^1+RF^2=a^1w^1L^1+Ra^2w^2L^2+s^1C^1+Rs^2C^2.$$

A permanent shift from labour towards consumption taxation has ambiguous effects on the world interest rate and welfare. This can be demonstrated by differentiating the home and foreign country first-period external balances and solving for dR to yield

$$(35)\quad dR=(w^1L^1_{a^1}da^1-C^1_{s^1}ds^1-C^1_{s^2}ds^2-w^1L^1da^1-w^2I_{a^2}da^2)/$$

$$(C^{*1}_R+I^*_R+C^1_R+I_R+c^{*1}_W*b^{*2}+c^1_Wb^2).$$

A permanent shift from wage-based towards consumption tax-based financing means that $da^1=da^2<0$, $ds^1=ds^2>0$.

In the denominator of (35) the sum of the second and third terms is zero by the homogeneity property, i.e. a permanent proportional increase in consumer prices does not affect the intertemporal consumption decision. The first and fourth terms in the denominator are positive, while the last term is negative because $I_{a^2}<0$ and $da^2<0$. Hence, on the basis of the opposing effects, the world interest rate response to the permanent shift in the financing base cannot be signed.

The ambiguity of the interest rate response is due to the positive effect on investment deriving from the lower second-period wage tax, which increases the marginal productivity of future capital. The implied increase in investment demand means that the external balance does not necessarily improve and consequently the world interest rate may fail to fall. The ambiguity of the interest rate response implies, on the basis of Proposition 1, that also the welfare response cannot be signed.

In practice, economic policies are seldom fully unanticipated and, in fact, many measures are announced beforehand. Therefore, it is interesting to evaluate the effects of future anticipated tax rate changes (see Howitt and Sinn (1989) for an analysis of this issue in a slightly different context). The following proposition can be put forward concerning the effects of an anticipated future shift in the social security financing base.

PROPOSITION 6: In the presence of an initial external deficit, a future shift from consumption tax-based towards wage-based social security financing improves welfare in the home country and reduces it in the foreign country.

PROOF: An anticipated future shift in the financing base from consumption tax-based towards a wage-based system means that $da^2>0$, $ds^2<0$. Consequently, differentiating the home and foreign country first-period external balance and using $db^1=-db^{*1}$ to solve for dR, equation (35) reduces to

(36) $dR=(-C^1{}_{s2}ds^2-w^2I_{a2}da^2)/$

$(C^{*1}{}_R+I^*{}_R+C^1{}_R+I_R+c^{*1}{}_w{}^*b^{*2}+c^1{}_wb^2)$.

The numerator in (36) is the same as in Proposition 6 and hence positive. In the denominator both terms are positive because $C^1{}_{s2}>0$, $ds^2<0$, $I_{a2}<0$, $da^2>0$. Therefore $dR>0$. Differentiating the government budget constraint, equation (34), and solving for ds^2 yields

(37) $C^2ds^2=-w^2L^2da^2$.

Differentiating the private sector budget constraint, equation (33), and solving for E_udu yields

(38) $E_udu=b^2dR-RC^2ds^2-Rw^2L^2da^2$.

By equation (37), the sum of the second and third terms in (38) is zero. Given that $b^1<0$, $b^2>0$ and with $da^2>0$, $ds^2<0$ implying $dR>0$, the first term in (38) is positive. Hence, with $E_u>0$, the change in welfare, du, is positive. The change in foreign country welfare is

(39) $du=b^{*2}dR/E^*{}_u{}^*$.

Given that $b^2>0$, $b^{*2}<0$. Then with $dR>0$ and $E^*{}_u{}^*>0$, $du^*<0$.

Q.E.D.

The intuition behind Proposition 6 is the following. A future consumption tax cut induces substitution from current towards future consumption thus improving the current external balance. The tax cut is financed by the increase in the future labour tax, which lowers the marginal productivity of future capital inducing a fall in current investment demand. This also has the effect of improving the external balance. Hence the policy is a pro-lending policy leading to a fall in the world interest rate. Home country welfare improves owing to the reduction in the home country's debt burden.

One lesson from Proposition 6 is the following. Assume a country which currently has a net external debt and which faces exogenous world market prices, but an endogenous interest rate for its debt. Assume further that the government of that country plans to increase social security contributions and to lower consumption taxation in the future. In this case it would be beneficial to announce the policy in advance because it would improve the external balance and lead to a welfare gain owing to the reduced debt burden resulting from the fall in the interest rate.

4.7 Effects of a tax base change under wage indexation

Casual observation shows that in many countries wages are neither fixed nor market-clearing. Often wages appear to be formed partly on the basis of some form of indexation. For example, the detailed study by Card (1990), using Canadian data, found support for the effects of nominal wage contracts which included both indexed and non-indexed contracts. The degree and nature of indexation varies substantially as Goldstein and Khan (1984) note:

> "In some countries money wages are formally indexed to the cost of living on practically a one-for-one basis; in other countries indexation is used but with a price index that specifically omits changes in the terms of trade; in other countries recourse has sometimes been made to incomes policies that guarantee labour an increased real wage; and in still others, indexation is prohibited."

The analysis in the previous section assumed that the shift from payroll-based to consumption tax-based social security financing keeps the real wage, w/p, constant and lowers both the real product wage, $w(1+a)/p$, and the real consumption wage, $w/(1+s)p$, where p is the (exogenous) final good price. The fall in the real consumption wage is unambiguous because labour supply is inelastic. Under elastic labour supply and a market-clearing real wage, wages would be pushed up in the reform because labour supply depends negatively on the consumer price. It can

readily be shown that, in this case, the real product wage response to the reform is ambiguous, implying ambiguous external balance and welfare effects. Another interesting framework in which the reform may be considered is one where real consumption wages are indexed. In this framework too the reform generally results in ambiguous external balance and welfare effects, as in the model with elastic labour supply.

As was suggested above, wage agreements may include index conditions whereby increases in consumption prices are partly or fully compensated by higher wages so as to ensure a certain level of real consumption wage. This section considers the shift from wage-based towards consumption tax-based social security financing under the assumption that the increase in consumer prices is fully compensated by higher wages. This by itself would imply ambiguous external balance and welfare effects. Consider, however, a policy package consisting of the reform and a temporary wage freeze which is fully compensated in the future. The following proposition can be put forward.

PROPOSITION 7: In the presence of an initial external deficit, a permanent shift from wage-based towards consumption tax-based social security financing with a temporary wage freeze and full future wage compensation, improves welfare in the home country and reduces it in the foreign country.

PROOF: A permanent shift from wage-based towards consumption tax-based social security financing means that $da=da^1=da^2<0$, $ds=ds^1=ds^2>0$. Wage indexation is modelled along the lines of van Wijnbergen (1987, p. 673). The first- and second-period relative wage changes are defined as

$$(40)\quad dw^1/w^1=d[p^1(1+s^1)]/p^1(1+s^1),$$

$$(41)\quad dw^2/w^2=d[p^2(1+s^2)]/p^2(1+s^2).$$

Recalling that the tax rates are initially zero, $s^t=0$, and that the final good is the numeraire good, $p^1=p^2=1$, (40) and (41) reduce to

(42) $dw^1/w^1=ds^1$,

(43) $dw^2/w^2=ds^2$.

A temporary wage freeze means that $dw^1=0$ and full future wage compensation means that

(44) $dw^2/w^2=(1+r)ds^1+ds^2$.

Hence in the second period the first-period indexation foregone is also taken into account. Omitting the interest paid in respect of the postponed wage increase would not change the results obtained.

The signs of the external balance and interest rate responses depend critically on the investment response. The sign of the investment response is determined by the sign of $d[(1+a^2)w^2]$, i.e. by the sign of the second-period real product wage change. Again, it is convenient to use the concept of real product wage, which is defined as $w^{pt}=(1+a^t)w^t$. The sign of dp^{p2} is determined first.

Differentiating the government budget constraint, equation (34), yields

(45) $(C^1+RC^2)ds=-(w^1+Rw^2L^2)da$,

where $ds=ds^1=ds^2$, $da=da^1=da^2$.

Given constant returns to scale, pure profits are zero and then, by the intertemporal budget constraint, the present value of consumption equals the present value of wage income, i.e.

(46) $C^1+RC^2=w^1L^1+Rw^2L^2$.

Solving for C^1 in (46) and substituting this into (45), (45) can be written as

(47) $(ds+da)(w^1L^1+Rw^2L^2)=0$.

Since $w^1L^1+Rw^2L^2>0$, $ds+da=0$. Substituting $ds=-da$ into (44), (44) can be written as

(48) $dw^2/w^2=-(2+r)da$.

(48) can be written as

(49) $dw^2+w^2da^2=-(1+r)w^2da$,

where $da^2=da$. Noting that $dw^{p2}=d[w^2(1+a^2)]=dw^2+w^2da^2$, (49) reduces to

(50) $dw^{p2}=-(1+r)w^2da$.

Hence, since $da<0$ and $w^2>0$, $dw^{p2}>0$, the second-period real product wage increases as a result of the policy package.

Differentiating next the home and foreign country first-period external balances, using the market-clearing condition $db^1=-db^{*1}$, and solving for dR, yields

(51) $dR=(w^1L^1{}_a{}_1da^1-C^1{}_s{}_1ds^1-C^1{}_s{}_2ds^2-w^1L^1da^1-I_{wp2}dw^{p2})/$

$(C^{*1}{}_R+I^*{}_R+C^1{}_R+I_R+c^{*1}{}_w*b^{*2}+c^1{}_wb^2)$.

Given that $I_{wp2}<0$ and $dw^{p2}>0$, the last term in the denominator is positive. As before, the first and fourth terms in the denominator are positive and the sum of the second and third terms is zero. Hence the denominator is positive. Because the numerator is also positive, $dR>0$.

As before, the total differentials of the home and foreign country intertemporal budget constraints reduce to

(52) $E_udu=b^2dR=Rb^1dr$,

(53) $E^*_u \cdot du^* = b^{*2} dR = R b^{*1} dr$.

Given that $ds>0$, $da<0$ together with a temporary wage freeze and future full wage comepensation imply $dr<0$ and that $b^1<0$, $E_u du>0$. Since $E_u>0$, the welfare change, du, is positive. Because $b^{*1}=-b^1$, the foreign welfare response, du^*, is negative. Q.E.D.

The intuition behind Proposition 7 is the following. The cut in the first-period real product wage increases first-period output, inducing a positive external balance effect. The second-period real product wage increases, inspite of the labour tax cut, because in the second period compensation is made for both the second-period consumption price rise and the first-period wage indexation foregone. The increase in the second-period real product wage reduces the marginal product of future capital, inducing a fall in current investment demand, which, in turn, has a positive external balance effect. The improvement in the external balance results in a fall in the world rate of interest. Given that the home country is initially a debtor country, it benefits from this fall in the interest rate. The reform makes the foreign country, which is a creditor country, worse off because the interest yield on its credit falls.

One lesson from Proposition 7 is the following. Assume again that a country is currently a net debtor and that it faces exogenous prices, but an endogenous interest rate. In this case it would be beneficial to also have a policy package which includes a temporary wage freeze in connection with a shift from wage- to consumption tax-based social security financing even though the wage freeze is fully compensated by higher wages in the future. Apparently, the policy issues in Propositions 6 and 7 have not been studied previously in an optimizing intertemporal framework in the literature.

Notes:

[1] The empirical importance of intertemporal substitution in labour supply is largely an unsettled issue as is the dynamics of labour markets in general. It is apparent that the dynamics of labour supply and demand are not independent of each other. Hence, one should not perhaps draw conclusions on the basis of empirical evidence from partial models of labour supply. However, the few studies employing general labour market models do not as yet provide clear evidence on the importance of intertemporal substitution in labour supply (see, e.g., Kennan (1988)).

[2] Once imperfect competition in both the product and the labour markets is introduced, the possibility of overshifting of taxes arises. Using a model with imperfect product markets, sector-specific bargaining, perfectly mobile capital between sectors and immobile labour between sectors, Lockwood (1990) shows that overshifting of, e.g., general labour taxes may occur.

[3] Recently Card (1990) has found support for the role of nominal wage contracts and indexation using a sample of 1293 contracts in 280 Canadian manufacturing sector firms. He found, e.g., that real wage changes induced by an unanticipated price change result in systematic employment responses.

5 TAXING INTERNATIONAL BORROWING AND LENDING

5.1 Introduction

This chapter considers the effects of interest income taxation. In particular, interest income is considered at the national level, so that interest income can be positive or negative depending on whether the country is a net lender or borrower on the world capital market. This kind of interest income tax can also be called a tax on international borrowing and lending. It is well known that a tax on international borrowing is, in general, equivalent to capital import controls because the latter, in effect, increase the cost of foreign borrowing as does an explicit tax.

Although the main goal of the present analysis is not to consider the desirabilty of taxing savings, it is appropriate to comment on it briefly. The debate on this issue in the literature has often been related to the choice between a comprehensive income tax base, which also includes interest income, and the expenditure tax base. In general, by affecting the after-tax interest rate, a tax on savings distorts both intertemporal consumption and labour supply decisions. A permanent proportional compensated change in the expenditure or consumption tax rate distorts the labour-leisure choice, but in many studies this is not the case because labour supply is assumed to be inelastic.

An additional twist in the issue of whether saving should be taxed arises in overlapping generations models without an operative bequest motive. In this framework, welfare maximization may call for a positive tax on savings. As is shown in King (1980), this result seems to hold under rather general assumptions. The intuition behind the result can be explained with the analogy to the Keynesian framework (see Sinn (1987, p. 284-285)). In the Keynesian framework savings can be increased by cutting the tax of high income people who have a higher marginal propensity

to save than low income people and in the overlapping generations framework savings can be increased by cutting the tax of the high saving working generation. In other words, the Keynesian (the overlapping generations) model assumes that the rich (the young) have a higher marginal savings rate than the poor (the old). In fact, the extreme property in the overlapping generations model without an operative bequest motive according to which young wage earners have a marginal savings rate equal to one while the old have a zero rate is critical for the result that the tax on savings is superior to the tax on wage income (see Sinn (1987, pp. 285-286)). However, as Sinn also notes, it is implausible that the marginal savings rate in respect of capital income is lower than in respect of wage income and it is even less plausible that the former is zero and the latter is one.

The overlapping generations model without an operative bequest motive can also be used to show that a tax on consumption and a subsidy on savings is unambiguously desirable even in the presence of an elastic labour supply. The intuition behind this result can be explained by another analogy. In the context of the optimal stucture of indirect taxation, as Corlett and Hague (1953) first showed in a three-good case, welfare maximization calls for a higher tax on the good which is more complementary with leisure. Now, assume that consumption and leisure are complements, which appears to be the case especially in industrialized countries, so that consumption and leisure are complements within a period and substitutes across periods. Then, because in the overlapping generations model there is no labour-leisure choice for the retired generation while the working generation can trade leisure against consumption in both periods, first-period consumption should be taxed while second-period consumption should not be taxed (see also Sinn (1987, p. 281)). Thus, in fact, the elasticity of labour supply provides a case for not taxing savings. It is apparent that this result is refuted once the non-operative bequest motive assumption is relaxed because the distinction

between the retired and working generations becomes immaterial (see also Sinn (1987, p. 282)).

As Lucas (1990) notes, recent research focusing on the effects of fiscal policy is about evenly divided between studies which use an infinitely-lived agent, i.e. a Ramsey model, and those which apply a finitely-lived agent model, i.e. an overlapping generations model without an operative bequest motive. As in the previous chapters, the following analysis employs the former kind of a model.

Diewert (1988) and Krugman and Feldstein (1989) also include analyses of interest income taxation in infinitely-lived agent intertemporal open economy models similar to that used in the present study. However, their analyses are rather informal and confined to the small open economy case. Using a two-period, one-sector, small open economy model, Diewert (1988) shows that removing the interest income tax increases welfare. Then, assuming an inelastic labour supply, Diewert advocates the introduction of an expenditure tax. However, the desirability of the expenditure tax depends critically on the assumption that labour supply is inelastic.

Krugman and Feldstein (1989) use a two-period, two-sector, small open economy model with inelastic labour supply to demonstrate that the move from income taxation towards consumption taxation improves the short-run trade balance. They also assume an inelastic labour supply.

An important feature of interest income taxation which arises in the open economy context is the possibility of tax competition. Because financial capital is, in general, highly mobile, the presence of tax competition may imply that governments cannot tax interest income at all if there is one country which exempts interest income from tax. Razin and Sadka (1989a) and (1989b) analyse interest income taxation in the face of tax competition. The former of these studies focuses on the desirability of tax harmonization and it yields the result that if there is

sufficient cooperation between tax authorities so that foreign source capital income can be taxed, then there is no need for harmonization of tax rates when the residence principle is applied in interest income taxation. On the other hand, the source or origin principle requires tax harmonization, otherwise capital income cannot be taxed because of tax competition. The critical assumption as regards the desirability of the residence principle is the assumption that the foreign source income of domestic investors can be taxed. If in fact this is not possible, then it is optimal to impose quantity restrictions on capital exports, as Razin and Sadka (1989b) show. The following analysis also addresses the desirability of capital export and import controls, but from a different angle than Razin and Sadka.

The following analysis is most closely related to Frenkel and Razin (1987), (1988a) and (1988b) who consider, among other taxes, a tax on international borrowing. They show that this tax, by altering the after-tax discount factor, affects the external balance and the world interest rate. This result is shown in the following in a formal and more general framework which allows for endogenous labour supply. Further, unlike in the Frenkel and Razin studies, the welfare effects of the tax on foreign borrowing are derived.

The chapter is organized as follows. Section 2 sets up a two-country model where the home country government imposes a tax on saving with which it can affect the discount factor of the private sector. Section 3 applies the model to examine the effects of taxing international borrowing and lending.

5.2 The model

This section sets up a two-country model to examine the effects of the introduction of a tax on international borrowing and lending. As before, government net lending is kept intact, hence some other taxes must be reduced

when the tax on saving is imposed. In the following, it is assumed that the balancing measure will be made by a lump sum transfer, but, in fact, any nondistortionary tax cut, such as a permanent cut in the consumption tax, could be used to return tax revenue to the private sector.

The production and household sectors are modelled as in section 5 of Chapter 3, i.e. as in Greenwood and Kimbrough (1985) and Kimbrough (1986). In addition, taxation on international borrowing and lending is introduced into the model.

The production function is assumed to be additive in labour and capital inputs, i.e.

$$Y^t=f(L^t,K^t)=w^tL^t+h(K^t),\ t=1,2,$$

Output is a concave function of the capital sock, i.e. $h_K>0$, $h_{KK}<0$. Assuming again that $K^2=I$, the first order condition for investment is $h_K(I)=1/P$ and the investment demand function can be written as $I=I(P)$; $I_P=-h_K/h_{KK}>0$, where P is the after-tax discount factor, which is defined below.

The household sector is represented by a present value expenditure function defined as

(1) $E(1,P,w^1,Pw^2,u)=$

$$\min\{C^1+PC^2-w^1L^1-Pw^2L^2:U(C^1,C^2,L^1,L^2)\geq u\},$$

where the variable symbols are the same as before. U is a utility function which is concave in consumption and convex in labour supply. P is the discount factor faced by the representative agent and which is defined as $P=1/[1+r(1-y)]$, where y is the tax on international borrowing and lending. To see how this tax is incorporated in the model, write the intertemporal budget constraint of the private sector as

(2) $C^1+C^2+I=w^1L^1+w^2L^2+h(K^1)+h(I)$

$+r(1-y)[h(K^1)+w^1L^1-I-C^1]+T,$

where T is the lump sum transfer from the government to the private sector. On the left hand side of (2) is the expenditure in the two periods and on the right hand side the income in the two periods. The expression inside the square brackets represents net national savings in the first period, i.e. $b^1=h(K^1)+w^1L^1-I-C^1$. From equation (2), $dy>0$ means that international lending, and $dy<0$ that international borrowing, is taxed. In the former case the condition $b^1>0$, and in the latter case the condition $b^1<0$, is required for the tax to yield positive revenue.

Collecting terms, dividing through by $1+r(1-y)$ and denoting $P=1/[1+r(1-y)]$, (2) can be written as

(3) $C^1+PC^2+I=w^1L^1+h(K^1)+Pw^2L^2+Ph(I)+PT.$

Using the expenditure function, as defined in (1), equation (3) can be written as

(4) $E(1,P,w^1,Pw^2,u)+I=h(K^1)+Ph(I).$

The government collects the interest income tax and distributes the revenue from it to the private sector. The government budget constraint can be written as

(5) $yr[w^1+h(K^1)-C^1-I]=T,$

According to equation (5), all tax revenue from the savings tax is redistributed to the private sector.

The (non-taxing) foreign country budget constraint is

(6) $E^*(1,R,w^{*1},Rw^{*2},u^*)+I^*=h^*(K^{*1})+w^{*1}L^{*1}+Rh^*(I^*)+Rw^{*2}L^{*2}.$

The home country first- and second-period external balances are

(7) $b^1=h(K^1)+w^1L^1-C^1-I$,

(8) $b^2=h(I)+w^2L^2-C^2$.

The external balances of the foreign country take a similar form.

The world market clears at each date, so

(9) $b^1=-b^{*1}$,

(10) $b^2=-b^{*2}$.

5.3 Taxing international borrowing and lending

The effects of taxing national interest income, i.e. taxing international lending and borrowing, can be summarized by the following proposition.

PROPOSITION 8: In the presence of an initial external deficit (surplus), a tax on international borrowing (lending) balanced by a lump sum transfer, improves welfare in the home country and reduces it in the foreign country.

PROOF: Differentiating the home country private sector budget constraint, equation (4) yields

(11) $E_u du=b^2dP+PdT$.

Noting that $dp=P_y dy+P_R dR$ and, from equation (5), that $dT=r[w^1L^1+h(K^1)-C^1-I]dy$, (11) can be written as

(12) $E_u=b^2P_R dR+b^2P_y dy+Prb^1dy$,

where $b^1=w^1L^1+h(K^1)-C^1-I$. Noting that $b^2=-(1+r)b^1$ and that $P_y=r/(1+r)^2$, (12) can be written as

(13) $E_u du=b^2P_R dR-rRb^1dy+rPb^1dy$.

Noting that $P=R/[R+(1-R)(1-y)]$ and that $y=0$ initially, $P_R=1$ and $P=R$. Hence (13) reduces to

(14) $E_u du=b^2 dR$.

Differentiating the foreign country budget constraint, equation (6) yields

(15) $E^*_u du^*=b^{*2} dR$.

Differentiating the home and foreign country first-period external balances yields

(16) $db^1=w^1 L^1_p dP-C^1_p dP-C^1_u du-I_p dP$.

$$=w^1 L^1_p P_y dy+w^1 L^1_p P_R dR-C^1_p P_y dy-C^1_p P_R dR$$

$$-C^1_u du-I_p P_y dy-I_p P_R dR.$$

(17) $db^{*1}=w^{*1} L^{*1}_R dR-C^{*1}_R dR-I^*_R dR-C^{*1}_u du^*$.

Using $c^1_w E_u=C^1_u$ and (14) in (16) and similarly $c^{*1}_w E^*_u=C^{*1}_u$ and (15) in (17) and solving for dR from (16) and (17) yields

(18) $dR=(w^1 L^1_p P_y dy-C^1_p P_y dy-I_p P_y dy)/$

$$(C^{*1}_R-w^{*1} L^{*1}_R+I^*_R+C^1_p P_R+I_p P_R-w^1 L^1_p P_R+c^{*1}_w b^{*2}+c^1_w b^2).$$

Now consider first the case where the home country is a net borrower, i.e. $b^1<0$, and where the home country imposes a tax on foreign borrowing, i.e. $dy<0$. The sum of the last two terms in the numerator is zero and the remaining terms are positive (note that $L^{*1}_R<0$ and $L^1_p<0$). In the denominator, given that $dy<0$, $P_y>0$, $C^1_p>0$, the second term is positive given that $L^1_p<0$, $P_y>0$, $dy<0$, the first term is positive, and given that $I_p>0$, $P_y>0$, $dy<0$, the third term is also positive. Hence the denominator is positive and, since the numerator is also

positive, $dR>0$. Therefore, given that $b^1<0$, implying $b^2>0$, the tax on foreign borrowing leading to $dR>0$ results in $du>0$ on the basis of equation (14). According to the market-clearing condition $b^{*2}=-b^2$, hence $b^{*2}<0$ and so $dR>0$ implies, by equation (15), $du^*<0$. Similarly, from equation (18), a tax on international lending, i.e. $dy>0$, can be seen to result in $dR<0$, i.e. in a fall in the world interest rate. In this case, given that $b^1>0$ and $b^2<0$, $du>0$ and given that $b^{*2}>0$, $du^*<0$. Q.E.D.

The intuition behind Proposition 8 is the following. Consider first the case where the country is a net debtor country. In this case the desirable policy was $dy<0$, implying a fall in the discount factor, $P=1/[1+r(1-y)]$, i.e. an increase in the after-tax interest rate. This leads to a substitution from current towards future consumption, thus inducing a positive external balance effect. The fall in the discount factor increases current labour supply and output, which improves the current external balance. In addition, the increase in the after-tax interest rate reduces current investment demand, which also contributes to the improvement in the external balance. For the world capital market to clear as a result of the pro-lending policies by the home country, the world interest rate must fall. As the home country is currently a debtor country, it benefits from the fall in the interest rate. Similarly, the interest yield on the credit granted by the foreign country decreases, thus making the foreign country worse off. The intuition in the case where the country is a net creditor country is the opposite and apparent from the above analysis.

The general lesson from the above analysis is that saving incentives which increase the after-tax interest rate can be used to improve the external balance. Further, it was shown that there exists a welfare theoretic case for capital controls in a perfectly competitive setting if the country in question faces an endogenous world interest rate. As was mentioned in Chapter 2, currently such countries, or blocs of countries, could include, e.g., the

United States, Japan and the EC. The policy lessons from the above analysis are the following. If the country is currently a net debtor on the world capital market it would be beneficial for this country to impose restrictions on capital imports to bring about a fall in the world interest rate. If, on the other hand, the country is currently a net creditor country then it would be desirable to limit capital exports to bid up the world interest rate. For a small open economy, provided that it faces an exogenous interest rate for its net external debt, such policies offer no gain. By casual observation, however, also in the case of small countries the interest rate on foreign borrowing appears to depend, at least to some extent, on the amount of net external debt held by the country because indebtedness is presumably some kind of a proxy for the risk of default. This risk appears to be more important for less developed countries than for industrialized countries.

6 TAXATION AND WORLD EQUILIBRIUM

6.1 Introduction

So far, the tax policies of a country facing an endogenous interest rate, but exogenous world prices, have been considered. However, in many contexts it may be appropriate to relax the exogenous terms of trade assumption. The following analysis employs a world economy model where the world consists of industrialized and developing countries and where both the world interest rate and the terms of trade are endogenous. The subsequent analysis introduces a third, raw material-producing, country which sets the raw material price exogenously. These models are similar to Marion and Svensson (1986) and van Wijnbergen (1988).

Section 2 of this chapter presents a two-country model of the world economy. Following van Wijnbergen (1988), the two large countries are labelled the OECD bloc and the LDC bloc. A phenomenon that has attracted much attention since the beginning of 1980s is the large external net debt of many LDC countries. To incorporate this fact in the model, it is assumed that the LDC bloc is currently a net debtor country and hence that the OECD bloc is currently a net creditor country.

Another phenomenon which has received much attention is the structure of trade. The LDC bloc countries produce and export relatively more non-manufacturing goods than the OECD bloc and other industrialized countries. To incorporate this fact in the model, it is assumed that investment goods are not manufactured in the LDC bloc and that this bloc imports these goods from the OECD bloc.

Section 3 employs the model to examine the effects of an investment tax incentive by the OECD bloc. Apart from the pure tax policy perspective, the rationale for examining this measure, is that it will stimulate demand exclusively within the OECD bloc. This kind of a stimulus could also

be the result of general economic cooperation among the industrialized countries or it could be due to intensified economic integration between the OECD countries.

Section 4 presents a three-country model where, in addition to the two large countries, there is a raw material producing-country which, again following van Wijnbergen (1988), is called the OPEC bloc. By casual observation, a distinctive feature of the real OPEC bloc has been that it has, at least to some extent, been able to influence the world market price of oil. To incorporate this feature in the model, it is assumed that the OPEC bloc sets the raw material price according to the Hotelling Rule. This framework is then used to evaluate the effects of a tax on the imported raw material by the OECD bloc. The non-economic rationale for such a tax could be the aim to reduce the dependency on exhaustible resources. Another rationale could be the goal to limit the use of fossil fuels in order to control carbon dioxide emissions. In fact, the effect of such a tax has been analysed in a computable general equilibrium model by Whalley and Wigle (see Whalley (1991)). Their model also divides the world economy into three blocs: the developed countries, the oil exporters and the developing countries. However, there appears to be no previous attempt in the literature to address the issue in an optimizing intertemporal general equilibrium framework.

The relation of the models in this chapter to the existing literature can be described by comparing them to the models by Marion and Svensson (1986) and van Wijnbergen (1988). First, it should be noted that the rather informal van Wijnbergen model is based on the Marion and Svensson model and its aim is to provide a theoretical framework for an empirical model rather than a vehicle for analytical policy evaluation.

For the reasons given above, the present models differ from those of Marion and Svensson (1986) and van Wijnbergen (1988) in the following ways. First, taxation

is introduced into these models. Second, unlike in Marion and Svensson, but as in van Wijnbergen, one country (the LDC bloc) is assumed to import its investment goods from the other country (the OECD bloc). Third, unlike in van Wijnbergen, but as in Marion and Svensson, the models do not assume a non-operative bequest motive, so that issues arising from overlapping-generations considerations are not addressed. Fourth, unlike in van Wijnbergen and the main version of Marion and Svensson, the models assume that one of the countries (the LDC bloc) is currently a net debtor country. Fifth, unlike in Marion and Svensson and van Wijnbergen, a two-country model, without the OPEC bloc, is also considered. Sixth, unlike in van Wijnbergen, but as in Marion and Svensson, in the three-country model, the third country (the OPEC bloc) sets the price of the exhaustible raw material according to the Hotelling Rule.

6.2 A two-country model

To extend the models in the previous chapters to the endogenous terms of trade case, the following assumptions are made. There are two large countries, called the home and foreign country, which face endogenous world prices. There are two goods produced in the first period: home and foreign goods. In period two a common final good is produced.

Assume, as in van Wijnbergen (1988), that the output of only one country can be used as an investment good and that this country is the home country. In the van Wijnbergen model, the two large countries are the OECD countries and the less developed countries (LDC), and the LDC bloc imports its capital goods from the OECD bloc. In the following the OECD bloc is treated as the home country and the LDC bloc as the foreign country. Assume further that the OECD bloc is currently a net creditor country and consequently that the LDC bloc is currently a net debtor country.

The demand side is equivalent to the one in Marion and

Svensson (1986). Hence the first-period home and foreign goods are substitutes in consumption and the first-period goods and the second-period commonly produced goods are substitutable in consumption. The demand side of the home economy is represented by a present value expenditure function, which is defined as

(1) $E(1,p,R,u)=\min\{C_h+pC_f+RC^2: u(C_h,C_f,C^2)\geq u\}$,

Note that the government output, G^t, does not enter the utility function. There are two reasons for this. First, the analysis focuses on the effects of distortionary taxes. Second, this appears to be the typical solution in the literature (see, e.g., Greenwood and Kimbrough (1985), van Wijnbergen (1986) and Durlauf and Staiger (1990)). One exception is Kimbrough (1986) in which it is assumed that government purchases are substitutes for private consumption at a constant proportional rate.

The home country output is used as the numeraire so this price, p_h, is set to unity. Home and foreign goods are denoted by subscripts h and f, respectively, and $p=p_f/p_h$ is the price of the foreign good. R is the discount factor, which is defined as $R=1/(1+r)$, where r is the endogenous world interest rate. C_h is the first-period consumption of the home good, C_f is the first-period consumption of the foreign good and C^2 is the second-period consumption of the common final good.

In this chapter, the production side takes the same form as in Chapters 2, 3 (except section 4) and 5. Hence the labour input is fixed in both periods. This is in line with labour being fixed in domestic supply and internationally immobile.

The home country investment is derived as a solution to the following optimization problem

$$\max_{\{I\}}\{(1-v^1)[Y^1(K^1,L^1)-I]+(1-v^2)RY^2(K^2,L^2)\}$$

subject to L^t and K^1 fixed and $K^2=I$.

From this the first order condition for investment takes the following form

(2) $RY^2_I=(1-v^1)/(1-v^2)$.

Denoting the right hand side of (2) by c, the investment function can be written as $I=I(c,R)$, where $I_c<0$, $I_R>0$, $c=(1-v^1)/(1-v^2)$. Assuming constant initial tax rates, $RY^2_I=1$.

The private sector budget constraint is written as

(3) $E(1,p,R,u)=(1-v^1)[Y^1(1,K^1,L^1)-I(c,R)]$

$+R(1-v^2)Y^2(1,K^2,L^2)$,

The government budget constraint is written as

(4) $G^1+RG^2=v^1(Y^1-I)+Rv^2Y^2$,

where G^t is public consumption of the home good and where the arguments of the profit and investment functions have been suppressed.

Substituting (4) into (3), the home country intertemporal budget constraint can be written as

(5) $E(1,p,R,u)+G^1+RG^2+I=Y^1+RY^2$.

Denoting the (non-taxing) foreign country variables by an asterisk, the foreign country budget constraint is written as

(6) $E^*(1,p,R,u^*)+I^*(R)=Y^{*1}(p,K^{*1})+RY^{*2}(1,K^{*2})$.

The assumption that the home country is currently a net

creditor and the foreign country a net debtor means that the first-period external balances are $b^1>0$, $b^{*1}<0$. By the budget constraints $b^1+Rb^2=0$ and $b^{*1}+Rb^{*2}=0$, this implies that $b^2<0$, $b^{*2}>0$.

In equilibrium all markets clear. By Walras's law one market can be omitted and, as in Marion and Svensson (1986), this market is here the future final goods market.

The equilibrium conditions for the first-period home- and foreign-produced good are

(7) $E_1+E^*_1+I+I^*=X^1$,

(8) $E_2+E^*_2=X^{*1}$,

where the notation of Marion and Svensson (1986) is followed. Hence, e.g., E_1 denotes the partial derivative of the home country expenditure with respect to the first argument of that function. X^1 and X^{*1} denote the first-period home and foreign gross outputs, respectively.

Equations (5)-(8) describe the world equilibrium. Differentiating the first-period market-clearing conditions, equations (7) and (8), and taking into account the welfare effects as obtained from the differentation of (5) and (6), yields the following two equation system

(9) $$\begin{bmatrix} d_{hR} & d_{hp} \\ d_{fR} & d_{fp} \end{bmatrix} \begin{bmatrix} dR \\ dp \end{bmatrix} = \begin{bmatrix} s_h \\ s_f \end{bmatrix}$$

where d_{hR} is the partial derivative of the world excess demand for the home goods with respect to the discount factor, d_{hp} is the partial derivative with respect to the price of foreign goods, d_{fR} and d_{fp} are the corresponding partials of the world excess demand for foreign goods. On the right hand side of (9), s_h and s_f are the changes in the excess supplies of the home and foreign goods, respectively. The partials d_{hR}, d_{hp}, d_{fR} and d_{fp} are

analogous to those in Marion and Svensson (1986). These partials are listed in Appendix B.

Solving (9) for dR and dp yields

(10) $dR=(d_{fp}s_h-d_{hp}s_f)/D$,

(11) $dp=(d_{hR}s_f-d_{fR}s_f)/D$,

where D is the determinant $D=d_{hR}d_{fp}-d_{hp}d_{fR}$. Assuming gross substitutability, $d_{hp}>0$ and $d_{fp}<0$, i.e. an increase in $p=p_f/p_h$ raises world excess demand for home goods and reduces world excess demand for foreign goods. A fall in the world interest rate, i.e. an increase in R, increases the excess demand for home and foreign goods, so $d_{hR}>0$ and $d_{fR}>0$. Therefore the determinant $D=d_{hR}d_{fp}-d_{hp}d_{fR}<0$.

6.3 Effects of an investment incentive

The rest of this chapter examines the effects of tax policies pursued by the OECD bloc, or the North, on the world economy. It is difficult to compare the analysis and its results to the existing literature because there appears to be no published research on the effects of tax policies in an intertemporal North-South framework. The welfare effects of distortionary taxes in a static North-South model are examined by Slemrod (1990b) who lists the extension to the intertemporal framework as a future research topic. There seems, however, to be a rapidly growing literature, focusing on diverse issues, which employs dynamic North-South models. For example Helpman and Grossman (1989) use an intertemporal two-country model of the world economy, where one country is relatively rich in human capital, to explain the pattern of trade.

Following van Wijnbergen (1988), the labels OECD and LDC blocs, rather than North and South, are used here. Consider a revenue-neutral tax policy measure by the creditor country, i.e. by the OECD bloc, consisting of a current-period increase in the corporate income tax

followed by a future cut in that tax. This has the effect of providing an investment incentive because a current tax cut increases tax deductions in respect of investment and the future tax cut raises the marginal product of future capital; both of these have the effect of stimulating current investment. The effects of an investment incentive have recently been evaluated in an intertemporal open economy framework by Sen and Turnovsky (1990). However, their analysis is confined to a small open economy model based on convex investment adjustment costs.

PROPOSITION 9: An investment incentive by the creditor country improves its terms of trade and welfare and reduces the terms of trade and welfare of the debtor country.

PROOF: A current tax increase, $dv^1>0$, met by a future tax cut, $dv^2<0$, implying $dc<0$, provides an investment incentive. Differentiating the government budget constraint, equation (4), assuming zero initial tax rates and unchanged government expenditure and solving for dv^2 yields

$$(12)\quad dv^2=(I-Y^1)dv^1/RY^2.$$

Hence $dv^1>0$, $dv^2<0$ is consistent with the government budget constraint only if $Y^1>I$, which is assumed to be the case. Allowing for non-zero initial tax rates would not change any of the results given that there is an upward-sloping Laffer curve, which rules out the possibility that $dv^1>0$ would necessitate $dv^2>0$ for the government tax revenue to be unchanged. Differentiating the excess supply of home goods and keeping R and p constant yields

$$(13)\quad s_h=-I_c dc.$$

Given $I_c<0$, $dc<0$, $s_h<0$. The excess supply by the foreign country is not affected by the changes in home country capital income taxation, hence $s_f=0$. The sign of the world discount factor is given by

(14) $\text{sign}(dR)=\text{sign}(-d_{fp}s_h)$.

With $d_{fp}<0$ and $s_h<0$, $dR<0$, i.e. the world interest rate rises. The sign of the terms of trade response is given by

(15) $\text{sign}(dp)=\text{sign}(d_{fR}s_h)$.

With $d_{fR}>0$ and $s_h<0$, $dp<0$, i.e. the price of foreign goods falls and the home country terms of trade improve.

To obtain the welfare effect on the home country from its investment incentive, differentiate the home country intertemporal budget constraint, equation (5), to obtain

(16) $E_u du=-C_f dp-C^2 dR-I_c dc+RY^2{}_I I_c dc-I_R dR+Y^2 dR+RY^2{}_I I_R dR$.

By the first order condition for investment, $RY^2{}_I=1$, hence the sum of the third and fourth terms and the sum of the fifth and last terms in (16) are zero. Further, noting that $b^2=Y^2-C^2$, (16) can be written as

(17) $E_u du=-C_f dp+b^2 dR$.

Given that $C_f>0$, $dp<0$, the first term in (17) is positive. Given the initial surplus of the home country, i.e. $b^1>0$, and the intertemporal budget constraint implying $b^1+Rb^2=0$, there must be a second-period external deficit, i.e. $b^2<0$. This and the increase in the world interest rate, i.e. $dR<0$, imply that the second term in (17) is also positive. Therefore the change in welfare, du, is positive.

Differentiating the debtor country intertemporal budget constraint, equation (6), yields

(18) $E^*_u du^*=(X^{*1}-C^*_f)dp+b^{*2}dR$.

Given that $X^{*1}-C^*_f>0$, $dp<0$, $b^{*2}>0$, $dR<0$, the debtor country welfare response, du^*, is unambiguously negative.

Q.E.D.

The intuition of the above results is the following. The investment incentive increases the domestic demand for investment, and hence for domestic production, giving rise to an increase in the relative price of home goods. The impact effect of the increase in domestic investment is to worsen the domestic current external balance, which, in turn, induces an increase in the world interest rate. Given the initial external surplus of the home country, i.e. it is a net creditor, this country will benefit from the increase in the world interest rate. The fall in the relative price of foreign-produced consumption goods also improves the home country welfare. Further, the deterioration in the debtor country terms of trade and the rise in the world interest rate reduces the welfare of that country.

The above result, i.e. an improvement in the creditor country terms of trade and welfare, is attained by any policies which stimulate investment exclusively within the creditor country bloc. This stimulus could be achieved by, e.g., increased economic integration between the creditor countries. The possible surge in investment and consumption demand resulting from integration within the creditor countries improves the terms of trade of this bloc and drives the world interest rate up. In other words, one practical lesson from Proposition 9 is the following. If the OECD bloc was to agree to stimulate demand exclusively within the bloc, then this would reduce the LDC bloc welfare. Note that the debtor country could dampen the effects of the creditor country policies only by pro-lending policies, i.e. by policies reducing current investment or consumption.

6.4 A three-country model

The above analysis ignored taxes on imports and on inputs other than capital and labour. However, a feasible tax policy may also involve taxes on imports or on inputs other than capital and labour. The analysis below

considers the effects of taxing an imported raw material. A variant of the three-country model of Marion and Svensson (1986) and van Wijnbergen (1988) is used in the analysis. Recall that the differences with respect to these two models were stated at the beginning of this chapter.[1]

To set up the model, the model presented in section 6.2 above is modified by including an imported raw material input good. This input is called oil, which is assumed to be produced by a third country called the OPEC bloc. This bloc is assumed to produce only oil and set its price according to the Hotelling Rule and supply the quantity demanded at these prices.[2] For simplicity, it is assumed that the OPEC bloc consumes only in the second period. This assumption has no effect on the subsequent analysis provided that the marginal propensity to consume home and foreign goods in the third country is sufficiently small. The intertemporal budget constraint of the third country is written as

(19) $RC^{o2}=qS$,

where C^{o2} is the second-period consumption of the OPEC bloc, q is the output price of the good produced in the third country and S is the supply of this good. As in Marion and Svensson (1986), the OPEC bloc supplies whatever quantity is demanded at the prices which it exogeneously sets. In equilibrium, the demand for the third country output is equal to the supply of it so

(20) $S=M^1+M^{*1}+M^2+M^{*2}$,

where M^t and M^{*t} are the home and foreign country demands for the third country output, respectively.

The profit functions of the home and foreign countries are modified to include the tax-inclusive imported input as an argument.

Assuming that the tax revenue from oil import taxes is transferred back to the private sector of the home economy, the private sector intertemporal budget constraint of the home country can now be written as

(21) $E(1,p,R,u)+I=X^1+RX^2-(1+z^1)qM^1-R(1+z^2)(q/R)M^2+T,$

where X^t is gross output, q is the tax-exclusive price of the imported good and z^t is the rate of the tax, i.e. tariff, levied on that good in the home country and T is the government revenue from the tax on the imported oil. The labour input and capital stock arguments have been suppressed in the profit functions in (21).

There is no corporate income taxation. Hence the first order condition for investment takes the form $RY^2_I=1$ and the investment function is written as $I=I(R)$, $I_R>0$.

The government budget constraint of the home country is written as

(22) $T=z^1M^1+Rz^2M^2,$

where T is a government transfer to the home economy.

Again it is assumed that there is an upward-sloping Laffer curve. In fact this assumption is necessary only if T is restricted to be a positive transfer. Alternatively, one could assume that T is a balancing lump sum tax or transfer, depending on the shape of the Laffer curve.

The lump sum transfer assumption is made for the sake of convenience. Alternatively, one could assume that the tax revenue due to the introduction of the tax on the imported raw material is returned by a permanent cut in the income tax rate, where the income tax system takes the same form as in the previous section. This permanent income tax cut would also be a non-distortionary measure because only changes in the time profile of that tax have real effects.

The production side is represented by profit functions where first-period capital stock and labour input at both dates are fixed. The first-period profit function is defined as,

$$Y^1[1,(1+z^1)q,K^1,L^1]=\max\{X^1-(1+z^1)qM^1 : X=f(K^1,L^1,M^1)\}.$$

The second-period profit function is defined as

$$Y^2[1,(1+z^2)q/R,K^2,L^2]=$$

$$\max\{X^2-(1+z^2)(q/R)M^2 : X^2=f(K^2,L^2,M^2)\},$$

Capital, K, and the imported raw material, M, are not assumed to be gross complements.[4] If, in fact, capital and the imported raw material were so strongly complementary that the tax on M decreased domestic output less than domestic investment, the qualitative analysis would be affected. In this case the change in the excess supply of home goods would be positive, i.e. $s_h=X^1_z dz-I_z dz>0$, which, by casual empiricism, appears to be implausible. In other words, it is claimed that $X^1_z<I_z$, i.e. that as a result of an oil price increase, the output response is more negative than the investment response.

Equation (21), can now be written as

$$(23)\quad E(1,p,R,u)+I=Y^1(1,(1+z^1)q)+RY^2(1,(1+z^2)q/R)+T.$$

The foreign country budget constraint is written as

$$(24)\quad E^*(1,p,R,u^*)+I^*=Y^{*1}(p,q)+RY^{*2}(1,q/R),$$

Recall that the home country is a creditor and that the foreign country is a debtor country so $b^1>0$, $b^{*1}<0$, implying $b^2<0$, $b^{*2}>0$. For the purpose of the subsequent analysis, suppose that the LDC bloc's current net debt is sufficiently large so that $b^2+(q/R)M^2<0$. By the intertemporal budget constraint, according to which $b^2=-(1+r)b^1$, and by the market-clearing condition, according to which $b^{*1}=-b^1$, this implies that $b^{*1}<-qM^2$.

Hence, the absolute value of the current LDC bloc debt has to be greater than the value of future oil imports, at current prices, by the OECD bloc.

The equilibrium conditions of the home and foreign country output in the first period take the form

(25) $E_1+E^*_1+I+I^*=X^1$,

(26) $E_2+E^*_2=X^{*1}$,

where X^1 and X^{*1} are the gross outputs of the home and foreign countries, respectively.

Differentiating the market-clearing conditions, equations (25) and (26), and taking into account the welfare effects as obtained from the differentation of (23) and (24) yields an equation system corresponding to (9) above. Solving the system for dR and dp yields the equations corresponding to (10) and (11)

(27) $dR=(d_{fp}s_h-d_{hp}s_f)/D$,

(28) $dp=(d_{hR}s_f-d_{fR}s_f)/D$,

where the variable symbols are the same as before. The partials of the excess demands are given in Appendix B.

6.5 Effects of taxing an imported input

The following analysis considers the effects of an introduction of a tax on the imported raw material input by the creditor country, i.e. by the home country, which was labelled the OECD bloc. As before, only the home country implements the tax policy and tax rates are assumed initially to be zero.[3] That this does not involve any loss of generality is shown in Appendix A.

The effects of the tax on the raw material can be summarized by the following proposition.

PROPOSITION 10: A tax on the imported raw material input by the creditor country reduces the debtor country welfare. When the debtor country's external debt is sufficiently large, so that $b^{*1} \leq -qM^2$, this policy will improve the creditor country welfare; when $b^{*1} > -qM^2$, the creditor country welfare response is ambiguous.

PROOF: Differentiating the government budget constraint, equation (22), assuming zero initial tax rates, yields

(29) $dT = M^1 dz^1 + RM^2 dz^2$.

Differentiating the excess supply of first-period home goods, as defined from equation (25), keeping R and p constant, yields

(30) $s_h = X^1_z dz - C_{hu} du$,

Differentiating the home country budget constraint, equation (23), keeping R and p constant, yields

(31) $E_u du = dT - (M^1 + RM^2) dz$,

where $dz = dz^1 = dz^2$.

Define the home country's marginal propensity to consume home goods out of wealth as $c^1_{hH} = C_{hu}/E_u$. Note that c^1_{hH} is the partial derivative of the uncompensated Marshallian home country demand function for home goods with respect to domestic wealth (see also Svensson (1984, p. 658)). Using $C_{hu} du = c^1_{hH} E_u du$ to substitute (31) into (30), (30) can be written as

(32) $s_h = [X^1_z + c^1_{hH}(-dT + M^1 + RM^2)]dz$,

where, by equation (29), the second term inside the square brackets is zero, hence $s_h = X^1_z dz$, which is negative given that $X^1_z < 0$, $dz > 0$.

Differentiating the excess supply of foreign goods, keeping R and p constant, yields

(33) $s_f=-c^1_{fH}[dT-(M^1+RM^2)dz]du,$

where $c^1_{fH}=-C_{fu}/E_u$. The term inside the square brackets of (33) is zero by equation (29), hence $s_f=0$.

From (28) the sign of dp is given by

(34) $\text{sign}(dp)=\text{sign}(d_{fR}s_h-d_{hR}s_f).$

With $d_{fR}>0$, $s_h<0$, $s_f=0$, $dp<0$.

From (27), the sign of dR is given by

(35) $\text{sign}(dR)=\text{sign}(d_{hp}s_f-d_{fp}s_h).$

With $s_f=0$, $d_{fp}<0$, $s_h<0$, $dR<0$.

Consider next the welfare effect on the home country of the tax on the imported input when the changes in the world interest rate and terms of trade are taken into account. Differentiating the home country's intertemporal budget constraint yields

(36) $E_u du=dT-(M^1+RM^2)dz-I_R dR+RY^2_1 I_R dR+[b^2+(q/R)M^2]dR-C_f dp.$

The sum of the first two terms in (36) is zero. Since $RY^2_1=1$, the sum of the third and fourth terms is also zero. The fifth term is positive because $dR<0$ and $b^2+(q/R)M^2<0$; the latter inequality holds when $b^{*1}\leq -qM^2$. When $b^{*1}>-qM^2$, the sign of the fifth term, and hence also the home country welfare response, is ambiguous. With $dp<0$ and given $C_f>0$, the last term is also positive. Hence, given that $E_u>0$, $du>0$.

Differentiating the debtor country intertemporal budget constraint, equation (22) yields

(37) $E^*_u du^* = (X^{*1} - C^*_f)dp + [b^{*2} + (q/R)M^{*2}]dR.$

Given $dp<0$, and given that $X^{*1}>C^*_f$, the first term is negative. With $b^{*2}+(q/R)M^{*2}>0$ and $dR<0$, the second term is also negative. Hence the change in the debtor country welfare, du^*, is unambiguously negative. Q.E.D.

The intuition behind Proposition 10 is the following. By imposing a tax on the imported input and returning the resulting tax revenue to its own economy, the creditor country decreases the excess supply of its goods. The creditor country's policy is a pro-borrowing policy because domestic output is decreased but demand is kept unchanged. The resulting increase in the world interest rate also benefits the creditor country. Both of these effects, i.e. the terms of trade and the interest rate effects, make the debtor country worse off.

One lesson from Proposition 10 is that if the OECD bloc was to agree to limit the use of oil and if this was to be attempted by taxing oil in the OECD bloc, then this policy would reduce welfare in the LDC bloc. Provided that the LDC bloc's external debt is sufficiently large, this policy would lead to an unambiguous welfare improvement in the OECD bloc.

Notes:

[1] A similar framework, i.e. a two-period, perfect foresight model with a large oil importer country and with zero marginal extraction costs of oil is used by Maskin and Newbery (1990) to prove a time consistency problem. They show that optimal tariff policy is time inconsistent if the government cannot commit itself to an announced time path of import tariffs on oil.

[2] The Hotelling Rule states that the efficient pricing rule for an exhaustible natural resource is:

$$p^t - m^t = (p^0 - m^0)(1+r)^t, \quad t=0,\ldots,N,$$

where p^t is the exogenously given market price of the exhaustible resource in period t and m^t is the constant marginal extraction cost of the resource in period t. In other words, the price of the resource, net of marginal extraction costs, should grow at a rate equal to the rate of interest. Testing this rule in an ingenious way, Miller and Upton (1985) find support for this hypothesis using data on U.S. petroleum-producing companies.

[3] Marion and Svensson (1984b, pp. 98-99) consider the effects from taxing the imported oil input in a two-country model with an oil producing and an oil importing country. They also assume zero initial tax rates.

[4] The intuitive explanation for the relatively small negative (or even positive) investment response is that the need to invest to enhance energy efficiency, or to invest in less oil-intensive production technology, increases as a result of an oil price increase. For the general conditions under which two inputs are gross substitutes and those under which they are gross complements, see, e.g., Chambers (1988, pp. 136-137).

7 INTERNATIONAL TAX POLICY COORDINATION

7.1 Introduction

Countries may attempt to attain welfare improvements through international economic policy coordination. The literature on this field is vast and it has been surveyed in, e.g., Cooper (1984). On the other hand, international coordination of tax policies has received relatively little attention. Recently, however, particularly capital income tax coordination has been subject to much research, apparently because of the increasingly integrated world capital market. In addition, the theoretical literature on commodity tax harmonization, which has its origins in international trade theory literature on multilateral tariff reforms, is growing rapidly. Research on both capital income and commodity tax coordination has been surveyed in Sorensen (1990). In the following, some additional issues and studies which are not covered by the Sorensen survey are considered first.

Traditionally, the literature on international tax policy coordination has focused on the possible efficiency gains from coordination. Coordination or tax harmonization is desirable from the efficiency point of view because international differences in taxation imply that resources are not allocated efficiently across countries. This has led many to argue in favour of international factor tax harmonization, and in favour of capital tax harmonization in particular. However, in the presence of international tax competition, the taxation of an internationally mobile factor is driven to the level chosen by the country with the lowest taxation of that factor. In this case the burden of taxation is shifted to the internationally immobile factors, but the resulting equilibrium is still efficient (see Razin and Sadka (1989a)).[1, 2] Making the assumption of a nonoperative bequest motive and employing an overlapping generations model, pure efficiency gains from tax harmonization may be available. For Pareto improving tax policy coordination in such a framework, see

Sorensen (1989).

As regards commodity taxation, tax harmonization may not be desirable on efficiency grounds even in the absence of tax competition. This is because the objective of consumption tax harmonization is usually a more uniform tax rate structure across countries, which typically also implies a shift towards a more uniform rate structure within a country. However, a more uniform consumption tax rate structure within a country may or may not bring about efficiency gains. This follows from the non-optimality of uniform commodity taxation in general. As Keen (1989) concludes, the case for consumption tax harmonization appears to be strong when the tax system is currently used for protectionist purposes. Hence, in this case, the efficiency gain is due to gains from trade in general rather than more uniform tax rate structure itself.

A frequent practice in the literature, and one which is not exclusive to tax policy coordination studies, is to focus on Pareto improving policies starting from an initial situation with distortionary taxes and presume that there is no rationale for such taxes; the desirable ultimate policy being, of course, to replace all distortionary taxes by lump sum taxes.

The fallacy of looking for Pareto improvements independently of, e.g., distributional issues and the constraints on lump sum transfers and taxes is forcefully put forward in Hammond (1990). In fact, the existing distorted equilibrium can be a constrained optimum where deadweight losses can be viewed as sunk costs. In this case, as Hammond (1990, p. 13) notes, "They [deadweight losses] are no more relevant to the design of good policy than sunk costs are to good investment policy by the firm".

As an example of the possible fallacies in the reasoning based on reductions in deadweight losses, consider the result according to which a strict Pareto improvement can

be generated by commodity tax policy coordination where each country reduces its extreme commodity tax rates (see Theorem 5 in Turunen-Red and Woodland (1990) and the references cited in relation to that theorem). By casual observation the highest commodity tax rates in many countries are on tobacco, alcohol, gasoline or on some other commodity the use of which induces a negative externality. It is apparent that this externality, and the possibility that the only feasible way to limit it is distortionary commodity taxation, should be taken into account when considering the desirability of cutting the tax on the commodity in question.

The following analysis will not consider Pareto improvements arising from tax policy coordination which are based on removing specific distortions through, e.g., restructuring tax rates in commodity taxation. Rather, the analysis focuses on possible Pareto improvements resulting from the reduction of intertemporal tax distortions. Further, distributional questions in tax policy coordination will be considered explicitly.

The chapter is organized as follows. Section 2 considers the possibilities for Pareto improving tax policy coordination in the general case where tax rates are initially not constant. Section 3 examines the less general, but perhaps not very unrealistic, case where the time path of tax rates is initially flat. Finally, it shows how equity questions between countries can be incorporated into tax policy coordination analysis.

7.2 Coordination with non-constant initial tax rates

International policy coordination is desirable, from the pure efficiency point of view, if it benefits at least one country without making the other countries worse off. This section considers the general situation where taxes initially distort the intertemporal decisions and examine whether efficiency gains can be attained through coordination. In this case the analysis is analogous to

the traditional static tax reform literature which seeks Pareto improvements through changes in distortionary taxes or tariffs. As in that literature, efficiency gains can be attained by reducing intertemporal distortions, but in this case the distortions are intertemporal.

For two reasons, Pareto improving tax reforms which reduce intertemporal distortions appear to be more realistic than those which reduce static distortions. Both of these reasons are related to the arguments put forward in Hammond (1990). First, an important difference between the reductions in static and intertemporal distortions is that the former usually necessitate lump sum taxes to finance the reform while the latter do not. This is because a reduction in intertemporal distortions generally requires only an adjustment between the present and future tax rates which can be designed so as to leave tax revenue unchanged. Second, static tax distortions are often motivated on distributional grounds or on the basis of some externality, but this appears not to be the case in intertemporal distortions. In particular, static distortions may be part of the constrained second best optimum which can be viewed, following Hammond (1990), as sunk costs. It should be noted, however, that one form of intertemporal tax distortion is in many ways similar to the static distortions. Interest income taxation is apparently largely motivated on distributional grounds and the reduction in the distortion due to interest income taxation is not, in general, self-financing.

If intertemporal tax distortions are not motivated on distributional grounds or by the aim to limit some externality, what can be the rationale for these distortions? One answer is given by the results in Chapters 3-6. That is, a country can use intertemporal tax distortions to attain welfare improvements by affecting the terms of trade and the world interest rate. A natural extension of the previous analysis is to consider the case where all countries strive for welfare improvements given the decisions of the other. In this context it is

interesting to examine whether these Nash strategies are dominated from the welfare point of view by some tax policy coordination alternative.

In the general situation where there is initially a surplus or deficit in the external balance, Nash strategies would imply that governments distort the intertemporal decisions of firms or households so as to reduce the imbalance. That a shift towards a reduced external imbalance is welfare improving was shown in Chapter 2. Now, it can be shown that if countries initially pursue Nash strategies, a coordinated tax policy which reduces the distortions due to the Nash strategies and which leaves the world interest rate unchanged leads to a strict Pareto improvement. In the following this is shown using the general model of Chapter 6 where also the terms of trade are endogenous.

Define first, analogously to Keen (1989), the strict Pareto improvement arising from policy coordination as a policy which leaves the foreign country welfare unchanged, i.e. $du^*=0$, and which results in a strict improvement in the home country welfare, i.e. $du>0$. The following proposition can be put forward.

PROPOSITION 11: Starting from a Nash equilibrium, a coordinated tax policy which reduces distortions in both countries and which leaves the world interest rate unchanged is Pareto improving.

PROOF: Recall the two-country model of section 2 in Chapter 6. Recall also that the home country was assumed to be a creditor country, i.e. the home country was assumed to have a positive external balance in the first period so: $b^1>0$, implying $b^2<0$, $b^{*1}<0$, $b^{*2}>0$. Assuming that the foreign country also has corporate income taxation which it can use to distort the investment decision, Proposition 9 implies that the Nash strategies for the two countries are such that the home country tax system encourages investment while in the foreign country

it discourages investment. Hence, in the home country $c=(1-v^1)/(1-v^2)<1$ so that $v^1>v^2$ and in the foreign country $c^*>1$ so that $v^{*1}<v^{*2}$.

Given that the Nash equilibrium is a distorted one, and that the foreign country also pursues tax policies, the welfare changes in the two countries (corresponding to equations (17) and (18) in Chapter 6) take the form

$$(1)\quad E_u du=b^2 dR-C_f dp+(RY^2{}_I-1)I_R dR+(RY^2{}_I-1)I_c dc,$$

$$(2)\quad E^*{}_u{}^* du^*=b^{*2} dR+(X^{*1}-C^*{}_f)dp+(RY^{*2}{}_I{}^*-1)I^*{}_R dR$$

$$+(RY^{*2}{}_I{}^*-1)I^*{}_c{}^* dc^*,$$

where $RY^2{}_I=(1-v^1)/(1-v^2)<1$ and $RY^{*2}{}_I{}^*=(1-v^{*1})/(1-v^{*2})>1$.

Recall that a Pareto improving tax policy was defined as one which leaves the foreign country welfare unchanged, i.e. $du^*=0$, and which results in a strict improvement in the home country welfare, i.e. $du>0$. Setting $du^*=0$ and substituting (2) into (1), yields

$$(3)\quad E_u du=(X^{*1}-C_f-C^*{}_f)dp+(RY^2{}_I-1)I_R dR$$

$$+(RY^{*2}{}_I{}^*-1)I^*{}_R dR+(RY^2{}_I-1)I_c dc+(RY^{*2}{}_I{}^*-1)I^*{}_c{}^* dc^*.$$

The first term on the right-hand side of (3) is zero by the market-clearing condition for the foreign-produced good. The second and third terms are also zero by the condition that the policy leaves the world interest rate unchanged; note that $dr=0$ is equivalent to $dR=0$. That $dr=0$ is compatible with a reduction in distortions in both countries can be shown by recalling that the change in the world discount factor takes the form (equation (10) in Chapter 6)

$$(4)\quad dR=(d_{fp}s_h-d_{hp}s_f)/D,$$

where D is the determinant $D=d_{hR}d_{fp}-d_{hp}d_{fR}<0$. As in

Chapter 6, the change in the excess supply of foreign-produced goods in the first period, s_f, is not affected by the changes in c or c^* because the foreign country does not produce investment goods. Hence, given that $s_f=0$ and recalling that the partial derivative of the excess demand for foreign goods with respect to the relative price of the foreign good, d_{fp}, is negative, $dR=0$ if and only if $s_h=0$. s_h is the change in the excess supply of home-produced goods and it is obtained by differentiating equation (7) of Chapter 6 in the case where both countries implement changes in their corporate income taxation, i.e.

$$(5)\quad s_h=-I_c dc-I^*_c{}^* dc^*.$$

Setting (5) equal to zero and solving for dc, one obtains the required change in the home country tax treatment of investment as a function of the corresponding foreign change, dc^*, and the investment responses in the two countries

$$(6)\quad dc=-dc^*(I^*_c{}^*/I_c),$$

where the term in brackets is positive since the own price derivatives of investment, I_c and $I^*_c{}^*$, are of the same sign, i.e. both are negative. Equation (6) defines the welfare improving tax policy coordination rule. In general, given that $(I^*_c{}^*/I_c)>0$, (6) states that non-zero dc and dc^* must have opposite signs.

Differentiating the home country budget constraint, equation (4) in Chapter 6, and not assuming zero initial tax rates, yields

$$(7)\quad (Y^1-I-v^1I_{v^1}+v^2Y^2{}_I I_{v^1})dv^1+(Y^2+v^2Y^2{}_I I_{v^2}-v^1I_{v^2})dv^2=0.$$

The differential of the foreign country government budget constraint takes the same form. Assuming an upward-sloping Laffer curve ensures that dv^1 and dv^2 have opposite signs. This assumption means here that the first-period tax revenue is an increasing function of the first-period tax

rate and that the second-period tax revenue is an increasing function of the second-period tax rate.

Recalling that c is defined as $c=(1-v^1)/(1-v^2)$, $dc=[-(1-v^2)dv^1+(1-v^1)dv^2]/(1-v^2)^2$ and dc^* is defined similarly. In the case of the home country, given the initial Nash equilibrium where $v^1>v^2$, a reduction in the tax distortions requires $dv^1<0$ and $dv^2>0$ so that $dc>0$ given that $v^1<1$, $v^2<1$. Similarly, in the case of the foreign country, given the initial Nash equilibrium where $v^{*1}<v^{*2}$, a reduction in the tax distortions requires $dv^{*1}>0$ and $dv^{*2}<0$ so that $dc^*<0$ given that $v^{*1}<1$, $v^{*2}<1$.

Omitting the terms which are equal to zero, equation (3) reduces to

$$(8)\quad E_u du=(RY^2_I-1)I_c dc+(RY^{*2}_I{}^*-1)I^*_c{}^* dc^*.$$

In (8), the first term on the right-hand side is positive given that $RY^2_I>1$ and $dc>0$. The second term is also positive given that $RY^{*2}_I{}^*<1$ and $dc^*<0$. Therefore, given that $E_u>0$, $du>0$. Q.E.D.

The intuition behind Proposition 11 is the following. Both the home and the foreign economy are dynamically inefficient in the Nash equilibrium. Owing to the distorted investment decisions the home country invests too much while the foreign country invests too little. Both countries gain from a move towards the first best conditions, which are: $RY^2_I=1$ and $RY^{*2}_I{}^*=1$ for the home and the foreign country, respectively.

Coordination is needed because a unilateral distortion reduction by one country would not result in an unambiguous welfare improvement in that country. This follows from the fact that, say, a unilateral reduction in the investment incentive by the home country would improve its external balance and reduce the world interest rate. The fall in the interest rate would make the home country worse off because it is currently a net creditor in the

world capital market. The coordination rule, equation (6), ensures that the world interest rate is left unchanged. This rule states that the increase in dc has to be greater the greater is the fall in dc^* and the larger is the absolute value of $I^*_{c^*}$ and the smaller is the absolute value of I_c.

Propositions analogous to Proposition 11 can be put forward in the models of Chapter 2-5 where the terms of trade are exogenous. Also in those models, given an initial Nash equilibrium where one country uses its tax system to promote foreign lending and the other to promote foreign borrowing, a coordinated reduction in these distortions will be Pareto improving if the world interest rate is left unchanged.

7.3 Coordination with constant initial tax rates

In the competitive framework and starting from an initial situation where tax rates are constant, tax policy coordination cannot be used to generate a pure efficiency gain. Consider this claim in the general endogenous terms of trade two-country framework which was presented in section 2 of Chapter 6. Later it is shown that the claim also holds in the models of Chapters 2-5 where markets are cleared through the world interest rate only. The following proposition can be put forward.

PROPOSITION 12: In the presence of perfect competition and constant initial tax rates, coordinated tax policies cannot be used to generate a strict Pareto improvement.

PROOF: In the framework of section 2 of Chapter 6, tax policy effects on welfare reduce to the following equations (equations (17) and (18) in Chapter 6)

(9) $E_u du = b^2 dR - C_f dp,$

(10) $E^*_{u^*} du^* = b^{*2} dR + (X^{*1} - C^*_{f^*}) dp.$

Setting $du^*=0$ in (10) and using the equilibrium condition $b^{*2}=-b^2$ to substitute b^{*2} from (10) into (9), yields

(11) $E_u du=(X^{*1}-C^*_f-C_f)dp.$

In (11), the expresssion inside the brackets is zero by the market-clearing condition of the foreign-produced good. Hence, given that $E_u>0$, $du=0$. Therefore strict Pareto improvements, resulting in $du>0$, are not possible.

Q.E.D.

The intuition behind Proposition 12 is the following. In a perfectly competitive setting, any policy change will induce only a movement from one income distribution between the countries to another along the Pareto optimal frontier. Hence what one country gains, the other country loses. This result is rather self-evident since it is known that in the presence of perfectly competitive markets, pecuniary externalities are irrelevant and all equilibria are Pareto optimal (see Laffont (1988, pp. 30-31)).

The result in Proposition 12 is demonstrated implicitly, in the case of tariffs, in Gardner and Kimbrough (1989, p. 100), where the welfare effects arising from the imposition of a temporary tariff by the home country reduce to the following equation

$$E_u du=-E^*_u{}^* du^*>0,$$

where, if one sets $du^*=0$, $du=0$ given that $E_u>0$.

That Proposition 12 also holds under exogenous terms of trade can be shown by recalling that the effects of tax policies in Chapters 3-5 reduce to the following

(12) $E_u du=b^2 dR,$

(13) $E^*_u{}^* du^*=b^{*2} dR.$

Setting $du^*=0$, $b^{*2}dR=0$. Given that $b^{*2}=-b^2$, then also $b^2dR=0$. Hence by equation (12), given that $E_u>0$, $du=0$ and thus strict Pareto improvements are not available.

As Laffont (1988, p. 30) also notes, once deviations from the Arrow-Debreu world are allowed, by introducing, e.g., increasing returns to scale, there exist equilibria which are not Pareto optimal.[3] It is interesting to impose some market imperfections and examine how the policy conclusions differ. In particular, consider the model in section 4 of Chapter 6 where the market for the raw material is not competitive. In this framework, the following proposition holds.

PROPOSITION 13: In the presence of an uncompetitive raw material market, coordinated tax policies by the raw material-importing countries which induce a fall in the world interest rate generate a strict Pareto improvement for these countries.

PROOF: In the model of section 4 of Chapter 6, tax policy effects on welfare reduce to the following equations (equations (36) and (37) in Chapter 6)

(14) $E_u du=[b^2+(q/R)M^2]dR-C_f dp$,

(15) $E^*_u{}^* du^*=(X^{*1}-C^*_f)dp+[b^{*2}+(q/R)M^{*2}]dR$.

Setting $du^*=0$ and using $b^2dR=-b^{*2}dR$, (15) can be written as

(16) $b^2dR=(X^{*1}-C^*_f)dp+(q/R)M^{*2}dR$.

Substituting (16) into (14) yields

(17) $E_u du=(M^2+M^{*2})(q/R)dR$.

Given that the policy induces a fall in the world interest rate, i.e. $dr<0$, $dR>0$. Further, given that $M^2>0$, $M^{*2}>0$, $q>0$, $R>0$, $E_u>0$, $du>0$. Q.E.D.

The intuition behind Proposition 13 is the following. Given that the raw material is priced according to the Hotelling rule, a fall in the world interest rate decreases the second-period price of the raw material thus inducing a benefit to both of the raw material-importing countries.

Consider next which policies would induce a fall in the world interest rate. It is apparent that all coordinated pro-lending policies by the raw material-importing countries would have this effect. Further, from Propositions 9 and 10 in Chapter 6, it is clear that the introduction of an investment disincentive by the home country or of a subsidy on the imported raw material input by the home country would also result in a fall in the world interest rate.

7.4 Distributional issues in tax policy coordination

The criteria for desirable tax policy coordination can be extended from the pure Pareto principle to also cover distributional issues. In this case, tax policy coordination may be desirable even if some countries suffer a welfare loss as a result of coordinated policies.

As was noted in the introduction to this chapter, policies aiming at Pareto improvements may have little to do with desirable policies. It is well known that among the Pareto optimal allocations there are equilibria which cannot be desirable on any reasonable equity ground (see, e.g., Hammond (1990) and the references cited therein). In fact, it is likely that economic policy objectives are seldom based only on efficiency arguments and that distributional questions are inherent in most policy issues.

To demonstrate that distributional issues may also have a bearing on international tax policy coordination, reconsider Proposition 11 above when taking into account the original setting of Chapter 6 where the home country

is the OECD bloc which is rich relative to the foreign country, which was labelled the LDC bloc. In particular, assume that the representative agents in the home and foreign countries have identical concave utility functions and that the wealth level in the former country is higher than in the latter. In this case the marginal utility of wealth in the foreign country is higher than in the home country. Assume further that the objective of coordinated tax policies is the sum of utilities of the representative agents in the two countries. In other words, assume that the world social welfare function is utilitarian.[4] In this case it can be shown that coordinated tax policies which result in a fall in the world interest rate or improve the foreign country's terms of trade are welfare improving although no Pareto improvements are available. To show this, use equations (9) and (10) of this chapter to write the sum of welfare changes as

$$(18)\quad du+du^{*}=E_{u}^{-1}[b^{2}dR-C_{f}dp]+E^{*}_{u^{*}}{}^{-1}[b^{*2}dR+(X^{*1}-C^{*}_{f})dp].$$

Using $b^{2}=-b^{*2}$, (18) can be written as

$$(19)\quad du+du^{*}=(E_{u}^{-1}-E^{*}_{u^{*}}{}^{-1})b^{2}dR$$
$$+E^{*}_{u^{*}}{}^{-1}[X^{*1}-C^{*}_{f}-(E_{u}^{-1}/E^{*}_{u^{*}}{}^{-1})C_{f}]dp$$

In equation (19), E_{u}^{-1} and $E^{*}_{u^{*}}{}^{-1}$ are the marginal utilities of wealth in the two countries. To demonstrate this, recall that the intertemporal budget constraint of, say, the home country can be written as

$$(20)\quad E(1,R,u)=W,$$

where E is the present value expenditure function and W is wealth, i.e. the present value of national income, defined as $W=Y^{1}+RY^{2}$, where Y^{t} are the domestic product or profit functions. Differentiating (20), keeping the discount factor, R, constant and solving for du/dW, yields (see also Dixit and Norman (1980, pp. 60-61))

(21) $du/dW=E_u^{-1}$,

where du/dW is the marginal utility of wealth of the home country. Now, given identical preferences across countries and that the home country wealth level is higher, the marginal utility of wealth in the foreign country is higher, i.e.

(22) $E_u^{-1}<E^*_{u^*}{}^{-1}$.

Recall next from Chapter 6 that the foreign country, i.e. the LDC bloc was assumed to be currently a net debtor country, i.e. $b^{*1}<0$, implying that $b^1>0$ and $b^2<0$. Hence, given inequality (22) and $b^2<0$, the first term in (19) is positive if and only if $dR>0$. Recalling that $R=1/(1+r)$, this requires that $dr<0$. In other words, a fall in the world interest rate increases the sum of welfare changes in the two countries, as it was sought to demonstrate.

Consider next the terms of trade effect. The expression inside the square brackets in the second term on the right hand side of (19) is positive because by the market-clearing condition for the foreign-produced good, $X^{*1}-C^*_f-C_f=0$ and $(E_u^{-1}/E^*_{u^*}{}^{-1})<1$. Therefore, given that $E^*_{u^*}{}^{-1}>0$, the second term is positive if and only if $dp>0$, i.e. the sum of welfare changes increases if the foreign country terms of trade improve, as it was sought to demonstrate.

It is apparent in the above that both the fall in the world interest rate and the improvement in LDC bloc's terms of trade improvement make the OECD bloc worse off. Hence the welfare improving coordinated policy redistributes wealth from the OECD bloc to the LDC bloc.

This chapter has served the following purposes. First, it was shown that in a general perfectly competitive world economy with constant initial tax rates, efficiency gains cannot be attained through tax policy coordination. Second, it was shown that if the assumption of perfect

competition is dropped, pure efficiency gains may be available from policy coordination. Third, it was shown that the tax competition outcome can be improved upon by coordinated policies. Fourth, it was shown that a case for tax policy coordination can be made on equity grounds. This case is likely to be particularly strong in a North-South setting where equity considerations are central.

In general, welfare improving tax policy coordination may be particularly appealing since it does not necessarily involve lump sum transfers between countries, which appear to be required in the traditional gains from customs union argument, as Haaparanta (1988) has shown. In particular, compared to previous welfare improving policy analyses in the literature which are based on the North-South setting, tax policies have the desirable feature that direct transfers from North to South, which are known to involve many practical difficulties, are not needed.

Notes:

[1] The literature on international tax competition draws on the earlier literature on local government expenditure and taxation when individuals are mobile between jurisdictions, which was initiated by Tiebout (1956). The idea put forward by Tiebout was that interjurisdictional mobility ensures the efficient allocation of public goods. Later, it has been shown that this result is not very general (see, e.g., Bewley (1981)).

[2] Wilson (1987) has shown that taxing a mobile factor may cause an inefficient distribution of public goods across regions (countries) and that this is accompanied by an inefficient pattern of trade.

[3] In international trade theory literature, interest in models which incorporate scale economies grew rapidly in the late 1970s. The reason for this interest was perhaps more due to the fact that the implications of models with scale economies could be in line with the observed phenomena of, e.g., intraindustry trade rather than the generality of the increasing returns assumption. For example, although in some contexts and to a certain extent scale economies appear plausible, there is no clear empirical evidence for it. Further, as Helpman and Krugman (1986, p. 33) note: "Very recent managerial literature now stresses the problems of incentive, control, and morale which arise as organizations grow large and which can outweigh purely technical factors". The new industrial organization literature emphasizing "flexibility" in contrast to "fordism" also appears to be largely incompatible with scale economies; for the modern view of manufacturing organisation (see Milgrom and Roberts (1990)). It should be noted, however, that many economists believe in significant increasing returns to scale and the dominance of imperfect competition arising from it. For example, Helpman and Krugman (1989) employ several partial equilibrium models based on scale economies to produce a number of paradoxical results concerning desirable trade policies. In reality, the number of possible sources and forms of market imperfections is, of course, very large (see, e.g., Krugman (1990, Chapter 14)). To what extent the results drawn from the perfectly competitive framework bear relevance in the real world, which is strictly speaking always characterized by a range of market imperfections, is ultimately an empirical question.

[4] A lucid survey on the informational and ethical requirements of the utilitarian social welfare function is presented in Boadway and Bruce (1984, Chapters 5 and 6). The utilitarian social welfare function requires total comparability, i.e. information about both the utility levels and about variations in the utility of the agents is required.

8 SUMMARY AND CONCLUDING REMARKS

The study examined open economy tax policies in intertemporal general equilibrium models. Tax policies are often evaluated in static general equilibrium models which are unable to address issues concerning, e.g., the short- and long-run and external balance effects of tax policies. The extension to the intertemporal setting brings tax policy analysis in line with modern open economy macropolicy analysis, which uses models based on on dynamically optimizing agents and which take into account the intertemporal budget constraints which individuals and governments face.

The study evaluated the effects of changes in distortionary taxes. In fact, in models which may be regarded as general benchmark models, monetary policy or fiscal policy involving lump sum taxes or other non-distortionary measures have no real effects since the government faces a binding intertemporal budget constraint. To refute the neutrality proposition one has to make at least one assumption which can be regarded as arbitrary or rather strong, such as the cash-in-advance monetary mechanism or the absence of an operative bequest motive. Unlike in the case of monetary policy or non-distortionary fiscal policy, there is wide agreement in the literature that distortionary taxes have real effects.

All the policy measures examined in the study were compensated measures in the sense that the present value of government tax revenue was kept unchanged. Each policy issue was analysed with a model which was considered suitable for analysing the particular issue in question. From the many possible policy combinations, a few interesting policy cases, most of which have been addressed both in the literature and in the public debate, were examined. The choice of the policy issues also reflected the aim of showing how the effects depend on the nature of the policy, i.e. whether the policy consists, e.g., of permanent or anticipated future measures or

whether it involves changes in the time profile of tax rates. Similarly, the range of models put forward in the study made it possible to focus on numerous issues in open economy tax policy. Using these modelling solutions, the effects of those policy combinations which were omitted can also readily be evaluated.

The study used duality theory to model household and producer behaviour. This allowed a general and rigorous analysis of the policy issues. In particular, the formal analysis enabled the derivation of the welfare effects of tax policies.

The effects of tax policies were summarized in the propositions for which also formal proofs were presented. In addition, emphasis was put on providing the intuitive explanation for each proposition and hence the substance of the results, as well as their implications, can be understood without familarity with the techniques of the analysis.

The contributions of the study to the literature are roughly the following. The modelling solutions for analysing different tax policy issues under different assumptions in an intertemporal framework using duality theory facilitate further studies on the effects of tax policies in open economies. The new results concerning the effects of tax policies, and most of which are contained in the propositions put forward, form the other group of contributions to the existing knowledge. In the following some of the key results are summarized.

Chapter 2 started by examining the relation between the external balance and welfare targets. Although current account imbalances have aroused much concern in practice, the theoretical rationale for policies aiming at external balance seems to be missing. Related to this is the empirical puzzle according to which the contemporaneous correlation between national saving and investment is high. Thus, there appears to be some mechanism which tends

to balance the current account fairly rapidly.

In the analysis, it turned out that the external balance and welfare targets coincide under an endogenous, world capital market-clearing, interest rate. This result holds, however, only for countries which face an endogenous interest rate for their external borrowing and lending.

Chapter 3 formalized a two-country model, put forward by Frenkel and Razin (1987), (1988a) and (1988b), where terms of trade are fixed and equilibrium is attained through the world capital market, which is cleared by an endogenous interest rate. In this framework, the effects of tax policies are transmitted internationally by changes in the interest rate. This may be realistic given that the goods market prices tend, as a result of, e.g., possible market imperfections and costs of changing prices, to be relatively unresponsive to changes in the conditions of supply and demand. On the other hand, capital markets are presumably more efficient because, e.g., different assets are close substitutes. Hence one would expect the rate of interest to be an important channel via which adjustments take place, especially in the short run.

In addition, using the formal models in Chapter 3 confirmed the results from the graphical analysis of Frenkel and Razin (1987), (1988a) and (1988b). Further, their analysis was extended by deriving the welfare effects of tax policies.

Chapter 4 extended the framework to allow for demand-determined employment. In this framework the effects of changes in employers' social security or labour taxes were evaluated. It was shown, e.g., that, in a two-country framework with demand-determined employment and an initial external deficit, a current cut and a future increase in the labour input tax improves the external balance and welfare. Further, the incidence of labour input tax changes were examined in a more general model with endogenous labour supply and demand and labour market-

clearing wages. It was shown that, in an intertemporal model and unlike in a static model, the wage response to labour tax changes can, in general, be ambiguous.

Chapter 5 examined the effects of interest income taxation. In particular, the effects of taxing international borrowing and lending were examined. By changing the after-tax interest rate, this tax affects the external balance and the world interest rate. A general lesson from the analysis was that saving incentives which increase the after-tax interest rate improve the external balance. The analysis also provided a welfare theoretic case for restrictions on international capital movements.

Chapter 6 examined the effects of tax policies by one country in a general equilibrium of the world economy by relaxing the exogenous terms of trade assumption. First, the effects of an investment incentive were reconsidered in a two-country model. The model was set up in the so-called North-South setting and, following van Wijnbergen (1988), the two countries were called the OECD bloc and the LDC bloc.

The OECD bloc was assumed to be currently a net creditor, and the LDC bloc a net debtor country. Further, it was assumed that the LDC bloc imports its investment goods from the OECD bloc. It was shown that an investment incentive by the OECD bloc improves its terms of trade and welfare and increases the world interest rate. This policy worsens the LDC bloc's terms of trade and increases the debt burden of this bloc; hence the welfare of the LDC bloc decreases. Any policies which would stimulate current demand exclusively within the OECD bloc would have similar effects. Such policies could include intensified economic integration between the OECD countries. The LDC bloc could dampen the effects of these policies only by pro-lending policies which necessitate cuts in current consumption or investment.

In section 4 of Chapter 6, the framework was extended to a

three-country model, where, in addition to the OECD and LDC blocs, there was an oil producing country called the OPEC bloc. The OECD and LDC blocs were assumed to import all their oil used in production from the OPEC bloc. In this framework, the effects of the OECD bloc imposing a tax, i.e. a tariff, on the imported oil input and distributing the revenue from this back to its own economy were evaluated. The non-economic reasons for such a tax include the goal to limit carbon dioxide emissions and the aim to limit the dependency on exhaustible natural resources. It was shown that the tax on the imported oil would, in general, improve the OECD bloc's terms of trade and increase the world interest rate. The deterioration in the LDC bloc terms of trade and the rise in the interest rate would decrease the welfare of the LDC bloc.

Chapter 7 considered international tax policy coordination. If the initial equilibrium is a tax competition outcome with intertemporal tax distortions in both countries, a coordinated tax policy can be used to attain a Pareto improvement. It was shown also that in a general competitive framework where tax rates are initially constant, tax policy coordination cannot be used to generate Pareto improvements. However, this result does not hold, in general, if there are market imperfections or if tax rates are initially not constant. Even in the perfectly competitive non-distorted framework, tax coordination between countries may increase the sum of welfare in the two countries although efficiency gains are not available. This is because unequal marginal utilities of wealth across countries give rise to gains from policy coordination. In this case, the world welfare improving policies are, in effect, redistributive policies where richer countries lose and poorer countries gain. It is important to note that the welfare improving tax policies do not require direct transfers between countries.

There are, of course, several limitations in the study. The most obvious possible extensions are those which were listed and discussed at the beginning of the study. One

could, e.g., make allowance for uncertainty or for some monetary mechanism to consider the sensitivity of the results. Another interesting extension would be to explore the effects of taxation on growth by introducing, e.g., endogenous human capital accumulation; for a closed economy analysis of this issue, see Lucas (1990).

Perhaps the most important task in future research is to test the intertemporal open economy models empirically. In fact, Sheffrin and Woo (1990) test an intertemporal model of the current account for Belgium, Canada, Denmark and the United Kingdom using data from 1955-1985. Only for two of these countries does their model provide a good explanation of current account developments. However, they have important reservations concerning their model as well as the data.

Another important area for future research is to augment the analytical policy analyses by quantitative assessments. In fact, quantitative models have also been constructed on the basis of models which are similar to the ones considered in this study. Frenkel, Razin and Symansky (1989) have built a simulation model for the major OECD countries using a similar framework to those considered in Chapters 2, 3 and 5. Diewert and Morrison (1988) have estimated a model for the U.S. economy which has some of the characteristics of the model in sections 4-6 of Chapter 4. The three-country model considered in Chapter 6 was based largely on the same assumptions as the empirical OECD-LDC-OPEC model of van Wijnbergen (1988). These models represent, however, only the first attempts to quantify some of the key relationships and much remains to be done in this field.

APPENDIX A

As was noted in Chapter 1, in the presence of the Ricardian equivalence and a given government revenue requirement, the income effects resulting from changes in taxes vanish. The purpose of this appendix is to show that this holds. In particular, it is shown that under constant non-zero initial tax rates, the income effects cancel out and that no loss of generality is implied by the assumption of zero initial tax rates. The analysis is carried out for the consumption, corporate income, wage income and input tax in the general case where adjustments in the time path of the tax parameters are made. The analysis in the case of permanent changes in the tax parameters is obtained as a special case. The only case where the zero inital tax rate assumption implies a loss of generality is the interest income tax case considered in Chapter 3.

To show that the analyses based on zero initial tax rates also hold under constant non-zero initial tax rates, it must be shown that the total differentials of the intertemporal budget constraints are unaffected once constant non-zero initial tax rates are allowed. It suffices to show that the total differentials of the intertemporal budget constraints reduce, under constant non-zero initial tax rates, to the ones obtained using zero initial tax rates.

Consider first the consumption tax case. Assume a constant non-zero initial consumption tax rate $s=s^1=s^2$ and differentiate equation (7) in Chapter 2 to obtain

$$(A1)\quad C^1ds^1+RC^2ds^2+C^2dR+s^2C^2dR+E_u du-G^2dR=$$

$$Y^2dR+(RY^2_K-1)I_R dR+C^1+RC^2ds^2+s^2C^2dR+$$

$$s^1C^1_{s^1}ds^1+s^1C^1_{S}2ds^2+Rs^2C^2_{s^1}ds^1+Rs^2C^2_{s^2}ds^2.$$

Proceeding as from equation (3) to (4) in Chapter 3, but

not setting s=0, (A1) reduces to

(A2) $E_u du=b^2dR+s^1C^1{}_{s1}ds^1+s^1C^1{}_{s2}ds^2+Rs^2C^2{}_{s1}ds^1+Rs^2C^2{}_{s2}ds^2$.

Noting that the expenditure function is homogeneous of degree 1 in prices, the demands are homogeneous of degree 0 in prices. Then by Euler's theorem

(A3) $C^1{}_{s1}+RC^1{}_{s2}=RC^2{}_{s2}+C^2{}_{s1}=0$.

Collecting in (A2) the terms involving ds^1 and ds^2 and using (A3), (A2) can be written as

(A4) $E_u du=b^2dR+s(RC^2{}_{s2}+C^2{}_{s1}-RC^1{}_{s2}+RC^2{}_{s1})ds^1$

$+s(C^1{}_{s2}+C^1{}_{s1}+RC^1{}_{s2}-C^2{}_{s1})ds^2$.

By Euler's theorem, the sum of the first two terms inside the first brackets is zero and the sum of the second and third terms inside the second brackets is also zero. Hence (A4) can be written as

(A5) $E_u du=b^2dR+Rs(C^2{}_{s1}-C^1{}_{s2})ds^1+s(C^1{}_{s2}-C^2{}_{s1})ds^2$.

Expressing C^1 and C^2 using the partials of the expenditure function and collecting terms, (A5) can be written as

(A6) $E_u du=b^2dR+(E_{s2s1}-E_{s1s2})(Rsds^1-sds^2)$.

Given that the substitution matrix is symmetric, i.e. that $E_{s2s1}=E_{s1s2}$, (A6) reduces to

(A7) $E_u du=b^2dR$,

which is equivalent to equation (4) in Chapter 3, as it was sought to show.

Differentiating the government budget constraint and keeping the discount factor in this constraint constant, yields

(A8) $C^1ds^1+RC^2ds^2+s^1C^1_{s1}ds^1+s^1C^1_{s2}ds^2$

$+Rs^2C^2_{s1}ds^1+Rs^2C^2_{s2}ds^2=0$

The last four terms on the left hand side of (A8) are the same as the last four terms on the right hand side of (A2), and carrying out an analogous derivation as from (A3) to (A6) above, reduces (A8) to equation (9) in Chapter 3,
i.e.

(A9) $C^1ds^1+RC^2ds^2=0$,

which was also obtained when zero initial tax rates were assumed.

Consider next the permanent consumption tax change case, which is examined in Chapters 4 and 5. In this case $ds^1=ds^2$ and (A7) follows directly from (A2) and (A9) directly from (A8).

Consider next the income tax case. Assuming a constant non-zero initial tax rate, $v=v^1=v^2$, and differentiating (7) yields equation (14) in Chapter 3, i.e.

(A10) $E_udu=b^2dR+(RY^2_K-1)(I_RdR+I_{v1}dv^1+I_{v2}dv^2)$.

On the basis of equation (2) in Chapter 3, $RY^2_K=1$ in the case of $v^1=v^2$. Hence also in this constant non-zero initial tax rate case, the first bracketed term on the right hand side of (A10) equals zero and (A10) reduces to (A7).

Differentiating the government budget constraint, keeping the present value of expenditure constant, yields

(A11) $(y^1-I)dv^1+RY^2dv^2+v^1(Y^1-I_{v1}-I_{v1})dv^1$

$+Rv^2Y^2_II_{v2}dv^2+v^1(Y^1_II_{v2}-I_{v2})dv^2+Rv^2Y^2_II_{v1}dv^1=0$.

Noting that $Y^1_I=0$ and rearranging, (A11) can be written as

(A12) $(Y^1-I)dv^1+RY^2dv^2+v(RY^2_I-1)dv^1+v(RY^2_I-1)dv^2=0.$

Noting that $RY^2=1$, (A12) reduces to equation (13) in Chapter 3, as it was was sought to show.

Consider next the wage income tax case. In the case of Chapter 3, it suffices to show that the total differential of the government budget constraint, equation (22), reduces to (27). The total differential of the economy's intertemporal budget constraint is unaffected by the zero initial tax rate assumption because it does not involve the tax parameters. Differentiating equation (22), yields

(A13) $w^1L^1dm^1+Rw^2L^2dm^2+m^1w^1L^1_{m1}dm^1$

$+m^1w^1L^1_{m2}dm^2+Rw^2L^2_{m1}dm^1+Rw^2L^2_{m2}dm^2=0.$

Note first that if first order effects are omitted, (A13) reduces immediately to (27). However, even when the second order effects cancel out each other. This can be shown by using Euler's theorem according to which

(A14) $w^1L^1_{m1}+Rw^2L^1_{m2}=0,$

$Rw^2L^2_{m2}+w^1L^2_{m1}=0.$

Denoting $m=m^1=m^2$, (A13) can be written as

(A15) $w^1L^1dm^1+Rw^2L^2dm^2$

$+m(w^1L^1_{m1}+Rw^2L^2_{m1})dm^1+m(Rw^2L^2_{m2}+w^1L^1_{m2})dm^2=0.$

By (A14), the terms inside the brackets are zero, hence (A15) reduces to equation (27), as it was sought to show.

Consider next the input taxation case. The analysis is analogous to the labour input tax case of Chapter 4 and

the imported input tax case of Chapter 6. Hence here only the latter is considered. Differentiating the government budget constraint, equation (22) in Chapter 6, to the second order and assuming constant non-zero initial tax rates, yields

(A16) $dT=M^1dz^1+RM^2dz^2+z^1M^1{}_{z^1}dz^1+Rz^2M^2{}_{z^2}dz^2$.

Using (A16), instead of equation (29) in Chapter 6, the welfare effect of the tax policies is unaffected. Differentiating the home country's intertemporal budget constraint, one obtains the following version of equation (36) in Chapter 6

(A17) $E_u du=dT-(M^1+RM^2)dz-(z^1M^1{}_{z^1}+Rz^2M^2{}_{z^2})dz$

$$-I_R dR+RY^2{}_I I_R dR+[b^2+(q/R)M^2]dR-C_f dp.$$

Using $dT-(M^1dz^1+RM^2dz^2+z^1M^1{}_{z^1}dz^1+Rz^2M^2{}_{z^2}dz^2)=0$ in equation (A17), the first three terms in (A17) cancel out and the welfare effect is equivalent to the one obtained in Chapter 6, as it was sought to show.

APPENDIX B

In this appendix the partial derivatives of the excess demands in Chapter 6 are presented. The partial derivatives of the excess demands in equation system (9) of Chapter 6 are

(B1) $d_{hR}=C_{hR}+c^1_{hH}(Y^2-C^2)+C^*_{hR}+c^{*1}_{hH}(Y^{*2}-C^{*2})+I_R+I^*_R$,

(B2) $d_{fR}=C_{fR}+c^1_{fH}(Y^2-C^2)+C^*_{pR}+c^{*1}_{fH}(Y^{*2}-C^{*2})$,

(B3) $d_{hp}=C_{hp}-c^1_{hH}C_f+C^*_{hp}+c^{*1}_{hH}C_f+I_p+I^*_p$,

(B4) $d_{fp}=C_{fp}-c^1_{fH}C_f+C^*_{fp}+c^1_{fH}C_f-Y^{*1}_p$.

The partial derivatives of the excess demands in equations (27) and (28) are

(B5) $d_{hR}=C_{hR}+c^1_{hH}[b^2+(q/R)M^2]+C^*_{hR}+c^{*1}_{hH}[b^{*2}+(q/R)M^{*2}]$,

(B6) $d_{fR}=C_{fR}+c^1_{fH}[b^2+(q/R)M^2]+C^*_{fR}+c^{*1}_{fH}[b^{*2}+(q/R)M^{*2}]$,

where $b^2=X^2-C^2-(q/R)M^2$ and $b^{*2}=X^{*2}-C^{*2}-(q/R)M^{*2}$. The expressions for d_{hp} and d_{fp} are the same as in (B3) and (B4), respectively.

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