Dynamics of Trade Liberalization

by

Christian KEUSCHNIGG*
Wilhelm KOHLER*

Forschungsbericht /
Research Memorandum No. 350

August 1994

Prepared for Joseph F. Francois and Kenneth Reinert, eds.,
Applied Trade Policy Modeling: A Handbook,
Cambridge: Cambridge University Press.

CHRISTIAN KEUSCHNIGG
Institute for Advanced Studies, Vienna,
Centre for Economic Policy Research, London
Stumpergasse 56
A-1060 Vienna, Austria

Phone: 0043 (1) 59991-147
Fax: 0043 (1) 59991-163
E-mail: chkeu@ihssv.wsr.ac.at

WILHELM KOHLER
University of Essen
Department of Economics
Universitaetsstrasse 12
D-45117 Essen, Germany

Phone: 0049 (201) 183-3655
Fax: 0049 (201) 183-3974
E-mail: wiw000@vm.hrz.uni-essen.de

*We acknowledge financial support by the Austrian Ministery of Science and Research.

Abstract

The basic premise of this paper is that trade liberalization has important dynamic implications which are beyond the scope of static applied general equilibrium models. We argue that incorporating intertemporal optimization in applied general equilibrium modeling is a promising way to capture the dynamics of commercial policy. In particular, this allows one, not only to pin down the growth effects often attributed to liberalization efforts, but also to evaluate these in welfare terms. Moreover, current account adjustment may be addressed in a consistent way. We offer a brief survey of the relevant literature and then illustrate our point by presenting a specific computational model which is calibrated to Austrian data. Our model features overlapping generations with life-time uncertainty. Investment and savings are determined by intertemporal optimization under perfect foresight. The model presentation especially emphasizes the implications of overlapping generations for household dynamics and the measurement of welfare effects. We briefly comment on calibration of dynamic parameters, and then apply the calibrated model to various comercial policy scenarios.

Ausgangspunkt der vorliegenden Arbeit ist die Beobachtung, daß Handelsliberalisierung eine Reihe von dynamischen Effekten hat, die in statischen angewandten allgemeinen Gleichgewichtsmodellen nicht gebührend Beachtung finden können. Durch die Erweiterung solcher Modelle in Form der rigorosen Berücksichtigung intertemporaler Optimierung wird es möglich, die der Handelsliberalisierung oft zugeschriebenen Wachstumseffekte sowie deren Wohlfahrtswirkungen zu berechnen. Darüberhinaus kann auf diesem Wege auch eine konsistente Behandlung von Leistungsbilanzwirkungen der Handelspolitik erfolgen. Wir bieten einen kurzen Überblick über die diesbezügliche Literatur, und präsentieren dann ein konkretes Modell, das anhand österreichischer Daten kalibriert wurde. Das Modell ist charakterisiert durch überlappende Generationen mit unsicherer Lebenserwartung. Investition und Ersparnis resultieren aus intertemporaler Optimierung bei perfekter Voraussicht. Die Modellpräsentation betont die Implikationen übrlappender Generationen für die Haushaltsdynamik und die Messung von Wohlfahrtseffekten. Das kalibrierte Modell wird sodann für die Simulation von mehreren Szenarien der Handelsliberalisierung verwendet.

JEL Codes: D58, F13, F43.

Keywords: trade liberalization, CGE modeling, intertemporal investment, overlapping generations, net foreign assets.

1 Introduction

Why should we bother about making CGE trade policy models dynamic? After all, the theory of commercial policy is largely static in nature, focusing on the welfare consequences of production and consumption distortions attendant upon various trade policy measures. These concerns, one might argue, are adequately captured in static CGE models and, therefore, little can be gained by imposing dynamic machinery on our CGE models which are sometimes quite hard to digest anyway.

Our response to this question is that any treatment of trade liberalization on the basis of static theory potentially misses an important part of the story. Suppose we know that the static efficiency gains of some proposed measure of trade liberalization (or integration) amount to a 2 percent increase of GDP. Should we conclude that welfare of all individuals will increase by this percentage amount? Trade theorists are quick to point out that we should not. For one thing, there may be consumption gains in addition to production gains, ultimately leading to a larger than 2 percent *equivalent income variation*. Moreover, depending on their factor ownership position, individuals may be affected in perhaps dramatically different ways by the policy shift in question. In other words, efficiency gains are likely to have *distributional implications* which should not be ignored in careful policy evaluation. These are the concerns that static CGE models are geared to capture in a rigorous way. But suppose our policy also increases investment and thus the capital stock. Without going into details at this stage, our intuition tells us that the 2 percent static efficiency gain may easily be dwarfed by *accumulated growth effects*. This, at any rate, seems to be a presumption very often alluded to in the rhetoric of trade liberalization, and it is in striking contrast to the absence of growth effects in many numerical treatments of commercial policy. But how are we to evaluate such growth effects in welfare terms? Growth requires investment, and thus forgone consumption or increased foreign indebtedness (if the economy has access to world capital markets). While adding a simple mechanism of capital accumulation to a static CGE model may enable us to capture some of the *positive aspects* of growth, it is quite clear that a satisfactory *welfare analysis* requires introducing intertemporal preferences on the part of households (who decide on savings), as well as intertemporal optimization on the part of firms (who decide on investment). Indeed, one might argue that extending the model structure in this way is nessecary in the first place to identify precisely why a given commercial policy should have growth effects at all, in addition to the static distortionary effects emphasized by traditional theory. Extending CGE models to such intertemporal optimization is the major theme of this chapter. In addition to a general motivation and a brief survey of the relevant literature we present a specific CGE model featuring full intertemporal optimization and overlapping generations which allows us to treat important growth implications of commercial policy. We illustrate this by applying our model, which is calibrated to the Austrian economy, to various commercial policy scenarios.

In addition to giving precise meaning to the notion of *dynamic gains from trade*, intertemporal models allow one to adequately address *current account effects* of commercial policy which invariably command a high level of attention in practical policy debates. Trade theory has a longstanding tradition of putting current account effects into the realm of macroeconomic analysis. This explains why they have for such a long time largely remained outside the scope of CGE trade policy analysis which is firmly rooted in the micoreconomics of exchange. Specifically, current account effects are either assumed away or else are not subject to any intertemporal resource constraint in static CGE models. Traditional macroeconomics of commercial policy, on the other hand, is largely based on models with distinctly Keynesian features, such as price rigidities and unemployed resources, with relatively simple savings and investment hypotheses, and hardly any model structure pertaining to reallocation and distribution, which are so crucial to both the analytical theory of commercial policy and CGE trade policy experiments.[1] However, more recently a whole strand of analytical studies has emerged which address current account adjustment to commercial policies (or analogous "shocks", such as terms of trade changes) within a framework of intertemporal optimization, featuring complete price flexibility and due emphasis on reallocation and distribution aspects.[2] This work has identified a number of interesting channels through which commercial policy, though not primarily aimed at intertemporal decision making, is likely to have important intertemporal effects which show up in a certain pattern of current account dynamics and a long-run change in the level of foreign indebtedness. Hence, incorporating intertemporal optimization in CGE models allows us to demonstrate, numerically, how the pattern of savings and investment which lies behind growth effects translates into a certain pattern of current account dyna-

[1]For a survey of traditional macroeconomics of protection, see Krugman (1982).

[2]A selective list of references includes Matsuyama (1988), Gavin (1990, 1991), Sen and Turnovsky (1989), and Engel and Kletzer (1990).

mics, and to separate these from welfare issues in a rigorous way. This is very important in view of the fact that policy debates in practice very often tend to identify a short-run current account improvement as something which is desirably per se.

An additional point relates to the inherent dynamics which typically characterizes commercial policy. Thus, trade liberalization is very often *anticipated* as being phased in over several periods of time, rather than taking agents by surprise in a once-and-for-all manner. Moreover, some protectionist measures may be *temporary* in nature, due to certain legal restrictions, such as for instance envisaged by certain GATT provisions (countervailing duties, safeguard protection, or antidumping). In either case, it is to be expected that such commercial policy scenarios generate interesting time profiles of adjustment which may be identified with the aid of an intertemporal CGE model. The preference, often revealed by policy makers, for a certain degree of gradualism in policy implementation probably has to do with some vague notion of minimization of adjustment costs. Such costs can be (and usually are) made explicit in intertemporal models, allowing the modeler to evaluate alternative adjustment paths in welfare terms where static models to a large extent have to be agnostic.

The chapter is organized as follows. In section 2, we present some more details as to the advantages of adding intertemporal optimization to large scale CGE models, and we provide a brief survey of the relevant literature. In section 3, we present the structure of our own model and we comment on some of the methods that we have employed when calibrating the model to an Austrian data set. Section 4 turns to an application of this model to certain tariff policy scenarios, featuring both gradual liberalization across the board and transitory protection of individual sectors. Section 5 concludes the paper with a general summary.

2 Dynamic Effects of Commercial Policy

For the sake of a clear focus, we begin by stating precisely what we mean by dynamic effects of commercial policy. One of the most important questions that come up here is whether or not trade policy is allowed to affect the (long-run) *rate of growth*. Traditional growth theory of the Solow type does not allow for any systematic influence of this kind. The long-run rate of growth in GDP is essentially regarded as being exogenous and equal to the rate of growth of effecitve labor units, or determined by innovation which is, in turn, similarly treated as an exogenous influence. Recent developments of growth theory, however, have in various different ways endogenized the technology factor, and this has also served to identify channels through which commercial policy may influence the long-run growth rate. The incoproration of endogenous growth channels in CGE models is still in its infancy and, therefore, remains outside the scope of this chapter.[3]

But even if the policy in question is not allowed to have any lasting influence on the *rate of growth*, it may importantly affect the long-run *levels* of income per capita. This is what Baldwin (1989) has called the *medium term growth bonus*. The easiest way to capture this bonus numerically is to specify some aggregate production function, and to postulate a Solow-type savings and investment relationship which says that a constant fraction of periodic output is saved and invested in physical capital. The static efficiency gain then shifts both the output and the savings-and-investment schedules upwards and, with unchanged population growth and depreciation, initiates accumulation. The long-run increase in GDP, then, is clearly larger than the static efficiency gain. By exactly how much depends on the extent of external scale effects that one wishes to incorporate into the production function. Such external scale effects may, in fact, even generate an endogenous growth model where the policy in question affects the long-run growth rate (long-run growth bonus). This is the knife edge case in which the accumulated factor exhibits a constant overall marginal productivity, due to its external effect on the state of technology.[4] Baldwin (1989, 1993) uses a Cobb-Douglas production function and resorts to econometric evidence on the relevant parameters (including an externality parameter) to compare the growth effects of the European internal market program to the static gain reported by the European Commission. He obtains a medium term growth bonus which is between 30 percent and 136 percent of the static gain, depending on the parameter values for the externality involved and the country considered. If accumulation of human capital is considered in addition to physical capital, then the static efficiency gain is trippled by the growth effect. These numbers serve as a first indication as to the magnitude of the

[3]For a general survey of various relationships between trade and growth, see Francois and Shiells (1993).

[4]The case where the accumulated factor exhibits increasing marginal productivity involves explosive behavior (and is unreasonable on this account), whereas the reamaining case of diminishing marginal productivity brings us back to the traditional Solow model. See the discussion by Romer (1994), Solow (1994), Grossman and Helpman (1994), and Pack (1994).

dynamic effects involved.

Suppose we have numbers like these that we believe in. What, then, are the welfare implications of our policy? Intuition tells us that the extra welfare resulting from accumulation is much lower than the extra output that it generates, for accumulation requires forgone consumption. We have already emphasized in the introduction that any satisfactory treatment of welfare issues requires introducing intertemporal preferences. One way to do this is to stipulate a representative, infinitely lived household with an additively separable intertemporal utility function. We may briefly explore the implications of this for the aggregate approach considered above. If households choose an intertemporal allocation of their lifetime resources so as to maximize such a utility function, the steady state capital stock is governed by the condition that the marginal private rate return to capital be equal to the rate of time preference plus the rate of depreciation. Knowing these parameters, one can then calculate long-run accumulation effects and medium-run growth bonuses just like above, but it turns out (as expected) that such an accumulation per se does not guarantee a welfare increase. Indeed, Baldwin (1992) shows that if there is no divergence between the social and private return to capital the welfare effect of a small trade liberalization is entirely determined by the static efficiency gain. The future increase in consumption facilitated by growth is exactly offset, in welfare terms, by the necessary forgone consumption. This is a very important point which tends to be overlooked in policy oriented debates where growth bonuses are sometimes equated with extra welfare. There are, of course, many ways in which a divergence may arise between the social and private return to capital. In this regard, a distinction may be drawn between the type of externalities emphasized by the new growth literature, and distortions due to taxes/subsidies which may similarly drive a wedge between the social and private returns to capital. Baldwin (1992) calibrates a specific model of the former type and calculates that the implied dynamic gains from trade are significant, though still small relative to the static gains from trade. As to the divergencies caused by taxes/subsidies, this is where we might hope for help from CGE models, since a detailed representation of a whole system of taxation has traditionally been a prime concern in applied general equilibrium modeling. In a further step, one might then merge the two aspects by incorporating "new growth" externalities also in large scale CGE models, but we have already indicated above that this is still part of a future agenda, and we shall restrict this chapter to the dynamic implications of the type of tax imposed divergencies that are at the core of conventional

CGE models.

Whether there will be dynamic gains or losses from trade liberalization depends on the direction of the divergence, and on whether liberalization will actually increase or reduce the marginal return to the accumulated factor. The aggregate production function approach outlined above relies on some external estimate for the static efficiency gain and identifies this as a Hicks-neutral productivity boost. A dynamic welfare gain would then materialize if the social marginal rate of return to capital were to exceed the rate of time preference plus rate of depreciation, and vice versa. However, from a trade theory perspective an increase in the marginal productivity of capital seems far from certain. Thus, in the two commodity world of the Heckscher-Ohlin-Samuelson model the marginal productivity of capital is governed by the Stolper-Samuelson effect, while in the Ricardo-Viner model the rate of return is industry specific, defying a general conclusion for the economy as a whole. Again, CGE analysis seems the appropriate way to identify the precise way in which sectoral marginal productivities of capital (or the single marginal productivity if capital is assumed mobile as between sectors) respond to a given commercial policy scenario. We may also add that a CGE approach allows one to consider large policy changes, in which case accumulation has welfare implications even without any divergence of the sort indicated above.

Equating investment with savings, as in all the approaches discussed so far, ignores the possibility of international borrowing, or mobility of financial capital, which is such an important feature of the present day world economy. This is of particular relevance if the focus of the analysis is on a single country or a subgroup of countries. The appropriate way to allow for international capital mobility is to model investment independently from savings. A convincing way to accomplish this is to assume that installation of new capital is costly. Specifically, if we assume that it is subject to some form of convex adjustment cost, we may view investment as being governed by the kind of intertemporal optimization by forward looking agents that we have already encountered on the household side above. With investment thus being divorced from the savings decision, absorption is also divorced from income. As a consequence, the current account dynamics is endogenously determined by intertemporal optimization and, therefore, also subject to an intertemporal resource constraint.

The first study of this kind was Goulder and Eichengreen (1989), where the focus is on savings- and investment promotion. In Eichengreen and Goulder (1991) and Goulder and Eichengreen (1992), the same model (called GE model in what follows) is applied to commercial policy.[5] We shall abstain from discussing any model details at this stage. We focus, instead, on the broad characteristics and the issues that the GE model and other models of this kind have been brought to bear upon. Details will more conveniently be discussed in connection with the relevant parts of our own model in the following section. The GE model is a two country model (U.S. and rest of the world), featuring a representative, infinitely lived household with exogenous labor supply. A unique feature which proves of crucial importance in almost all model applications is an assumed preference on the part of households for domestic assets (corporate debt and equity) in their portfolio decisions. This gives rise to diverging interest rates for the two countries. Moreover, it allows the model to capture varying degrees of international mobility of (financial) capital. Households allocate expenditure across time so as to maximize lifetime utility subject to a dynamic budget constraint. The production side of both countries features maximization of sectoral firm values which are determined in a forward looking way by a no-arbitrage condition incorporating risk adjustment and a rich structure of taxation. Physical capital is sector specific and its accumulation is subject to convex adjustment costs. The model covers 10 different sectors with conventional utility nests. Solution of the model underlies the assumption of perfect foresight.

In Goulder and Eichengreen (1989) the model is used to evaluate two different savings- and investment promoting tax policies in terms of their effect on the capital intensity of production, export performance (taken to proxy international competitiveness), and the trade balance. The two policies considered are a reduction in the marginal income tax rate, balanced in a revenue neutral way by increased indirect commodity taxation (savings promotion), and an increase in investment tax credits (investment promotion). It turns out that in the presence of international capital mobility the outcome is significantly different for the two policies, although both imply a medium term growth bonus. Savings promotion increases exports (and the trade balance) in the short run, but hurts export performance in the long-run, while the reverse is true with respect to exports (but not the trade balance) for investment promotion. These results are driven by the capital account reactions to the two types of policies, and the ensuing interest rate effects.

[5] The model is also discussed in Bovenberg and Goulder (1991) which, in addition, also contains more general observations on the desirability of extending CGE models to intertemporal optimization.

The GE model compares the counterfactual growth path of the model economy to a benchmark steady state growth path with zero foreign indebtedness and, therefore, balanced trade and current account. Eichengreen and Goulder (1991) generate a growth path with an initial trade (and current account) deficit (by an assumed increase in household's time preference and an exogenous increase in public expenditure, respectively), and then investigate what the model can tell us about the effects of certain policies that are sometimes proposed to cure trade deficits. It is important to see that a model of this kind would never view a trade deficit at any point in time as undesirable per se, hence the motivation of the exercise is entirely based on the fact that measures to reduce a given trade deficit are often proposed in practical policy debates, in particular in the U.S. Given the intertemporal constraint on the trade balance, it is clear that such measures can only change the time profile of the trade balance, with its present value remaining the same in each case. The results are as expected: both a temporary and a permanent import surcharge reduce the trade deficit in early periods and reduce the trade surplus in later periods. Again, the degree of international capital mobility is quite important, in particular for the short-run trade balance effect. Both policies also entail a medium term growth bonus. Two important further aspects of this model application are noteworthy. Since the trade deficit is introduced via an exogenous shock, it is possible to discriminate between the effects of import surcharges under differenct assumptions about the cause of the initial trade deficit. Moreover, since the model is rigorously based on optimization, it also gives the welfare consequences of the policies in question, in addition to their trade balance effects. An import surcharge is revealed to increase welfare, measured by an equivalent wealth variation (see below), but this effect is larger for a permanent than for a temporary surcharge. It should be noted, however, that this is due to favorable terms of trade effects, not to the short-run improvement of the trade balance as such. Hence U.S. welfare increase is at the expense of the rest of the world.

In Goulder and Eichengreen (1992), the GE model is used to evaluate the positive and normative consequences of U.S. tariffs and some non-tariff trade barriers. As with the import surcharge, the results are importantly driven by terms of trade effects. The terms of trade deteriorate upon a unilateral tariff removal, and this causes a U.S. welfare loss. We also observe a negative medium-run growth "bonus", but in light of what we have said above we should be cautious in equating this with a negative dynamic gain which aggravates the terms of trade effect. By way of contrast, eliminating quantitative restrictions increases U.S. welfare, the reason being that the quota rents are modeled so as to accrue to the foreign country. Also, in this case the medium-run growth bonus is positive. International capital mobility lowers the welfare loss in the case of tariff removal and increases the welfare gain of eliminating quota. If one assumes that the foreign country has the same system of tariffs and quotas, multilateral liberalization is a Pareto-improvement. Finally, we observe a temporary deterioration of the trade balance upon the tariff removal, whereas the trade balance improves on impact if we eliminate quotas. In the long-run, both policies lead to a trade surplus and increased foreign indebtedness.[6]

The GE model assumes an exogenous effective labor supply which is assumed to grow at an exponential rate. Endogenizing labor supply introduces a further important channel through which medium term growth effects might emerge. Cheaper commodities may induce households to substitute commodity consumption for leisure and, thus, to increase their labor supply.[7] This exerts a downward pressure on wages and initiates capital accumulation. An important CGE model capturing such a mechanism has been presented by Jorgensen and Wilcoxen (1990), where it is used to evaluate environmental policies. In Jorgensen and Ho (1993), the model (henceforth called JWH model) is applied to a trade policy scenario. The JWH model is unique in several respects, only some of which can be mentioned here. It imposes exogenous time trends at various places in order to take into account important developments not explained by the model itself. Thus, there is an exogenous productivity growth which operates differently as between industries, and which also depends on factor prices. To make the model consistent with a steady state equilibrium, however, productivity growth is assumed to take a logistic time trend, so that it peters out in the long-run. A further point worth mentioning is that the JWH model, like the GE model, assumes that imports are imperfect substitutes for home produced

[6]Apparently, in this model, a long-run increase in foreign indebtedness does not require any trade deficit along the adjustment path. This contrasts with our own model presented below, but the difference is easily explained. In the GE model, domestic wealth as well as the net foreign asset position are denominated in domestic currency, whereas in our model all assets are denominated in terms of import goods whose prices are all normalized to unity and remain constant throughout any counterfactual exercise. In the GE model, the exchange rate plays an important role in commodity market clearing since it enters the relative price of domestic to foreign commodities. It will, therefore, typically change on impact, and this has revaluation effects on wealth components. The net foreign asset position may thus change on impact which is impossible in our model.

[7]See Sen and Turnovsky (1989) for an analytical study emphasizing this mechanism.

goods, but it incorporates a time trend of (price independent) import penetration. As with the other time trends, this effect must eventually disappear for the economy to reach a well defined steady state. On the consumption side, the model allows for non-homothetic preferences and, again, some boundary has to be imposed on the exogenous projection of the aggregate household size (in terms of time endowment) to allow for a steady state. Finally, the model assumes an independent time trend for foreign income (determining export demand) which is similarly assumed to decline to zero in the long-run. Household behavior evolves around the notion of full consumption, comprising both commodity consumption and leisure. Intertemporal allocation of full consumption is determined by forward looking optimization on the part of infinitely lived households, and within period allocation of expenditures follows a largely conventional system of nests, except for the fact that households also consume capital and labor services (e.g., housing, consumer durables). The model also features a rich structure of demographic characteristics which influence household behavior. Producers are similarly assumed to be forward looking when deciding on accumulating an economy wide physical capital stock which, by assumption, is malleable and completely mobile across all uses (including household use).[8] Unlike the GE model, the JWH model does not extend to a symmetric treatment of the foreign economy (rest of the world). Instead, import prices are assumed to be given whereas export demand is governed by a constant price elasticity and a time trend (trough foreign income). In this regard, the JWH model is comparable to our own model, except for the fact that JWH use domestic labor instead of imports as the numéraire.[9] While the GE model endogenizes the composition of household portfolios, the JWH model imposes an exogenous allocation of household savings to the three assets involved: firm equity, government bonds, and foreign assets. Accordingly interest rates are assumed exogenous, rather than being determined by the model as in the GE case. Moreover, assuming an exogenous projection for the current account, the JWH model, unfortunately, does not allow one to address issues of current account adjustment. Further important differences between the GE and the JWH model lie in the sectoral disaggregation which is much higher in the case of JWH (35 sectors as opposed to 10), and in the method of empirical implementation: While the

[8]This contrasts with the assumption of sector specificity employed in both the GE model and our own model to be presented below.

[9]This implies that another variable must enter the picture since JWH fix the nominal values of two prices: imported goods *and* the domestic wage rate. This is a sort of exchange rate, or terms of trade variable, determining the price of home goods relative to imports.

GE model is calibrated to a single data point, JWH use econometric models based on duality theory to estmiate their coefficients from time series.

Looking at the results obtained by Jorgensen and Ho (1993) for a multilateral tariff liberalization scenario, we observe that the effects are rather modest, as with all previous experiments that disregard scale economies and imperfect competition, but the medium term growth bonus as such is quite substantial. Thus, while the impact effect on commodity consumption is 0.16 percent, it increases by as much as 0.82 percent in the long-run. If quantitative restrictions are lifted as well, the corresponding figures are 0.36 and 1.08 percent, respectively. By way of comparison, the GE model reveals a comparable long-run effect, but a much higher impact effect, so the implied growth bonus is much lower. This may be due to the fact that the GE model does not capture labor supply effects which figure importantly in the JWH model. It is also quite illuminating to see that sizable medium term growth bonuses are achieved by very modest differences in average annual growth rates of output. These differences are, in fact, well below one tenth of a percentage point.

A further example of intertemporal CGE analysis is Mercenier and Akitoby (1993), henceforth MA, who investigate the importance of accumulation effects of the European internal market program. Unlike the calculations presented by Baldwin (1989, 1992, and 1993), MA do not rely on an external estimate of the static gain, such as the Commission's own estimate in the case of Baldwin, but instead deal with static and dynamic effects in a unified framework. In addition, their model is disaggregated into 9 sectors, and it covers 6 regions, including non-EC countries. As to the dynamic part of the MA model, it aggregates an underlying infinite time dimension of the type considered above to two periods. The principal reason for this is that it allows to "apprehend dynamic features for which adjustment mechanisms and speed are not fully understood". These features relate to the labor market and industrial organization. Thus, MA assume different labor market mechanisms in the two periods to capture short-run real wage rigidity and elements of hysteresis.[10] As to industrial organization, the assumption is that firm entries/exits

[10]The interesting thing to note here is that their setting implies that first period real wage rigidity is conducive to employment in the second period. Higher productivity as brought about by integration is not absorbed by higher wages but, instead, by higher employment in the first period. And in the second period wages are flexible to ensure the increased employment inherited from the first period (this is the hysteresis element).

do not take place in the first period so that nonzero profits may emerge, while profits are competed away even in differentiated sectors in the second period. Investment and savings are modeled in an integrated way such that a representative household maximizes intertemporal utility (specified in the usual way as above) subject to an acccumulation relationship for physical capital and an intertemporal budget constraint.[11] The scenario simulated is a disappearance of all non-tariff trade barriers that may enable firms to price discriminate between different national markets within Europe. This is simply captured by setting all perceived price elasticities equal to the average perceived elasticity observed initially in a static Cournot Nash game. Mercenier and Akitoby (1993) find that there is a medium term growth bonus in the amount of a one percent increase in the capital stock. While this is far from being insignificant, the overall gain concluded by MA is well below the Commission estimate of 2 to 6 percent. Moreover, due to the specific treatment of industrial organization aspects in the two periods smaller (larger) European countries observe a lower (higher) second period welfare, while all European countries experience a higher first period welfare. If the labort market is modeled differently in the two periods as well (see previous footnote), then there are unambiguous gains for all European countries in second period labor market.

Growth implications and issues of adjustment through time have also played a significant role in the recent debate on the North American Free Trade Area (NAFTA), in particular as regards trade and capital movements between the U.S. and Mexico. Again, a number of researchers have pointed out that static models may underestimate the gains from liberalization, and various attempts have been made to address the issue in a growth oriented context. Among the studies surveyed in Francois et al. (1992), the one coming closest to a fully specified growth model is Young and Romero (1992), henceforth YR.[12]

[11] Even though investment and savings are modeled in an integrated way, there is no restriction saying that investment has to equal savings, hence current account effects may emerge. These are, however, not addressed in Mercenier and Akitoby (1993).

[12] Other studies involving dynamic aspects are Kehoe (1992), Levy and van Wijnbergen (1992), and McCleery (1992). Kehoe analyses endogenous growth channels in an aggregate econometric approach. Levy and van Wijnbergen address issues of agricultural liberalization and income distribution in a CGE model which is basically static in nature, but amended by certain assumptions regarding the evolution through time of some key exogenous (including policy) variables. McCleery focuses on international capital movements and aspects of learning by doing. In his model, capital accumulation in Mexico and in the U.S. is driven by net savings available for investment in the two countries, and these are assumed to be certain fractions of GDP which are, in turn, made dependent in an ad-hoc way on the rates of

Like Jorgensen and Ho, YR conduct econometric investigations based on duality theory, instead of implementing their model by means of calibration to a single data point. As with the model to be presented below, a crucial channel through which liberalization affects capital accumulation is the price of capital goods. Thus, the precise composition of the capital stock is made explicit in the model, and steady state accumulation effects are determined by the familiar condition that the steady state user cost of capital (which is importantly determined by the acquisition cost for capital goods) equals the rate of return on capital in production. Having determined steady state effects, YR then exogeneously specify a given point in time at which the economy is assumed to reach its steady state, and calculate adjustment paths that maximize the transition period GDP, evaluated at domestic prices. Under these assumptions YR calculate substantial dynamic "gains from trade": first period GDP is about 1.8 percent higher under liberalization than with tariffs in place, while after 11 periods when the steady state is assumed to be reached the difference amounts to 3.3 percent. This holds for a 10 percent real interest rate, but if the real interest rate is reduced to 7.5 percent, then first period GDP is somewhat lower under liberalization than with tariffs, but in the final steady state the difference jumps up to 6.4 percent.

All the approaches considered so far rely on the notion, explicit or implicit, of an infinitely lived household when addressing welfare issues. This dynastic view of preferences is obviously a very extreme one. It disregards the simple fact that the generations who save in early periods to facilitate accumulation are different from those harvesting the returns of accumulation in the long-run. If we treat welfare on a generation specific basis, then, of course, the welfare neutrality theorem of Baldwin (1992) is no longer available, and we must expect serious welfare implications of accumulation quite irrespective of any divergence between the social and private marginal return to the accumulated factor. These implications are largely distributional in nature, the principal question simply being

return. In addition, Mexico receives additional investment financing through direct foreign investment from the U.S. This comes about because of an exogenous reduction in the risk premium that investors require for holding Mexican equity, the underlying assumption being that NAFTA increases investor confidence. Finally, McCleery captures endogenous growth mechanisms by assuming that productivity growth is driven by investment rates and capital goods production (U.S.) and capital inflow (Mexico). Plausible as all of these assumptions may be, the crucial difference between the McCleery model and our concern in this chapter is that dynamic effects of trade liberalization are not generated by an extension of optimization to intertemporal dimensions.

(in a somewhat limplified wording) whether dynamic gains from trade accrue to older or younger generations. The model that we shall turn to in detail below incorporates this type of distributional dimension by specifying an overlapping generation structure on the household side, and we shall see that this has quite important implications for commercial policy scenarios.

3 A Computational Model

We now move on to illustrate the usefulness of intertemporal CGE analysis by turning to the details of a specific model. The following model presentation as well as the the specific policy scenarios that it is applied to are intended to be complementary to our earlier work [see Keuschnigg and Kohler (1994a) and (1994b)]. In particular, we shall place more emphasis on household dynamics and generational welfare analysis, than we did in our previous presentations. As regards the policy scenarios, we include multilateral (in addition to unilateral) tariff liberalization, and we extend the application to temporary tariff protection targeted towards individual sectors, as well investment promotion by means of a selective removal of all tariffs on investment demand.

3.1 Household Behavior

3.1.1 Determining Overall Consumption

Our model exhibits exogenous trends in both labor productivity (at rate x) and population (at rate n). The number of efficiency units, therefore, increases at a rate $\bar{g} = (1+x)(1+n)$. For a clear separation of endogenous dynamics from exogenous trends, we present all variables in detrended form through division by $(1+\bar{g})$. The economy is populated by an infinite number of overlapping generations with life-time uncertainty.[13] In each period, individuals of different ages choose a certain amount of commodity consumption and labor supply, and face a constant probability θ of dying thereafter. For each generation, we postulate a von Neumann Morgenstern intertemporal utility function which is additively

[13]We follow Blanchard (1985), Frenkel and Razin (1987), Buiter (1988), and Weil (1989) in specifying the household side of our model.

time separable and which features a constant intertemporal elasticity of substitution. Felicity is Cobb-Douglas in commodity consumption C and leisure $1 - L^s$ (where the time endowment is normalized to unity and L^s denotes labor supply).[14] We simplify our notation by writing $v_{.,t}$ for full consumption (i.e., consumption of commodities and leisure) as of period t of an arbitrary generation (and analogously for other generation specific variables). Aggregate consumption is denoted by v_t. A typical generation maximizes

$$\sum_{s=t}^{\infty} \left[(1-\theta)\beta\right]^{s-t} u(v_{.,s}), \tag{1}$$

subject to an intertemporal budget constraint of the form

$$A_{.,t} = \frac{1+r_t}{1-\theta} \frac{A_{.,t-1}}{1+x} + y_{.,t} - p_t^v v_{.,t}. \tag{2}$$

$v_{.,t}$ is already detrended from productivity growth, hence the discount factor β includes both the subjective discount rate and the rate of exogenous productivity growth x. Lifetime uncertainty effectively increases the rate of individual discounting, and it increases the effective rate of interest paid on financial assets A, which are denominated in imported goods and detrended from productivity growth. r denotes the (net of tax) real interest rate in terms of imported goods, and we assume that this is given exogenously from the rest of the world. Thus, the stock of financial assets at the end of period t is determined by financial assets inherited from the previous period, scaled down according to productivity growth and augmented by effective interest, plus savings out of peropd t full disposable wage income $y_{.,t}$.[15] p_t^v is a price index dual to the full consumption aggregate, and we shall henceforth write $M_{.,t} \stackrel{\text{def}}{=} p_t^v v_{.,t}$ for full consumption expenditure. Note that this is real expenditure in terms of imported goods whose prices are all normalized to unity and held constant throughout the paper. Analogous interpretations hold for financial assets and wage income.[16]

As we show in the appendix, Lagrangean methods may be employed to solve this problem, and we obtain the following determination of generational consumption:

[14] Cobb-Douglas is, admittedly, a restrictive parameterization, but given our exogenous trends it is necessary for the model to possess a well defined steady state. For more details, see our appendix which is available upon request.

[15] y is nothing but the value of time endowment agumented by sump-sum government transfers.

[16] The appearance of life uncertainty in the dynamic budget constraint is motivated by the existence of a competitive insurance industry, as in Blanchard and Fischer (1989). See our appendix for more details.

$$
\begin{aligned}
&(a) \quad p^v_t v_{.t} = \Omega_t^{-1} \mathcal{W}_{.t}, \qquad \Omega_t \stackrel{\text{def}}{=} \sum_{s=t}^{\infty} [(1-\theta)\beta]^{\gamma(s-t)} \left[\frac{p^v_s}{p^v_t} R_{t+1,s}\right]^{1-\gamma}., \\
&(b) \quad \mathcal{W}_{.t} \stackrel{\text{def}}{=} \frac{1+r_t}{(1-\theta)} \frac{A_{.t-1}}{(1+x)} + y_{.t} + H_{.t}, \qquad H_{.t} \stackrel{\text{def}}{=} \sum_{s=t+1}^{\infty} y_{.s} R_{t+1,s}. \\
&(c) \quad R_{t,s} \stackrel{\text{def}}{=} \prod_{u=t}^{s} \frac{(1+x)(1-\theta)}{(1+r_u)}, \quad R_{t,t-1} \stackrel{\text{def}}{=} 1.
\end{aligned} \tag{3}
$$

Here, γ is the constant intertemporal elasticity of substitution. As usual, real consumption expenditure is determined by total wealth $\mathcal{W}$ via a maringal propensity to consume, Ω^{-1}, which is in turn determined by the utility discount factor and the consumption based real interest rate. Total wealth is composed of (updated) financial assets inherited from the past, plus current period real wage income and human capital H which is the discounted future stream of real wage income.

We can now aggregate over all generations to obtain aggregate consumption. If generations are sufficiently large we can invoke the law of large numbers to equate the proportion of a generation surviving any given period with θ. Given a population growth rate of n, this implies a constant gross birth rate of $n + \theta$, and an age distribution of the population according to

$$
\omega_a = \omega_0 \left(\frac{1-\theta}{1+n}\right)^a, \qquad \omega_0 \stackrel{\text{def}}{=} \left(\frac{n+\theta}{1+n}\right), \tag{4}
$$

where ω_a is the weight of a generation of age a. It is easily seen that aggregate full consumption per efficiency unit can be written as

$$
v_t = \sum_{a=0}^{\infty} \omega_a v_{t-a,t}. \tag{5}
$$

Assuming (1) that wage income (inclusive of government transfers) is age independent, and (2) that successive new generations always enter without any financial wealth (no bequests), and realizing that all generations face identical prices and life-expectancies, aggregate consumption can be described by the following set of equations:[17]

[17]For details, see again our appendix.

$$
\begin{aligned}
&(a) \quad M_t \overset{\text{def}}{=} p_t^v v_t = \Omega_t^{-1}\mathcal{W}_t. \\
&(b) \quad \mathcal{W}_t \overset{\text{def}}{=} \frac{1+r_t}{1+\bar{g}}A_{t-1} + l_t + y_t + H_t, \\
&(c) \quad A_t = \frac{1+r_t}{1+\bar{g}}A_{t-1} + y_t - p_t^v v_t, \\
&(d) \quad H_{t-1} = \left(\frac{1+\bar{g}}{1+r_t}\right)\left(\frac{1-\theta}{1+n}\right)[y_t + H_t], \\
&(e) \quad \Omega_{t-1} = 1 + (1-\theta)\beta^\gamma\left[\left(\frac{1+x}{1+r_t}\right)\frac{p_t^v}{p_{t-1}^v}\right]^{1-\gamma}\Omega_t.
\end{aligned}
\tag{6}
$$

It is important to note that individual life-uncertainty is cancelling out in the evolution of aggregate financial wealth (c), while it does show up in the equation of motion for the aggregate human capital stock (d) and the marginal propensity to consume (e).

3.1.2 Dynamics of Aggregate Consumption and Wealth

To develop a deeper understanding of the complex mechanism determining our model behavior, we offer a brief investigation into the dynamics of aggregate consumption and wealth under the simplifying assumption of a constant price index p^v, in addition to a constant real interest rate r. For the time being, we thus disregard all the sectoral detail behind the price index p^v. These details will be an important ingredient of the story to be told from the subsequent simulation exercise, but the dynamic forces operating on the household side may conveniently be understood, for the time being, by picturing a one good economy. Such an economy will exhibit a constant marginal propensity to consume:[18]

$$
m \overset{\text{def}}{=} \Omega^{-1} = 1 - (1-\theta)\left(\beta\frac{1+r}{1+x}\right)^\gamma \frac{1+x}{1+r}. \tag{7}
$$

Given the definition of $\bar{g}$, we may note that

$$
1 - m \equiv (1+\xi)/\bar{\mu}, \quad \text{where} \quad \bar{\mu} \overset{\text{def}}{=} \left(\frac{1+r}{1+\bar{g}}\right)\left(\frac{1+n}{1-\theta}\right), \quad \text{and} \quad (1+\xi) \overset{\text{def}}{=} \left(\beta\frac{1+r}{1+x}\right)^\gamma. \tag{8}
$$

Note that $\bar{\mu}$ is the effective discount factor for human capital (equation 6d above).

[18]This will also be the steady state value of Ω^{-1} in our counterfactual exercises below, but in the present context it should not be confused with the steady state; we have simply imposed it on the model by assuming a constant aggregate price index.

We show in detail in our appendix that equations 6a through 6d above imply the following system of difference equations for consumption expenditure, M, and financial wealth, A:

$$\begin{bmatrix} M_t \\ A_t \end{bmatrix} = \begin{bmatrix} (1+\xi) & -z_1 \\ -(1+\xi) & (\frac{1+r}{1+\bar{g}} + z_1) \end{bmatrix} \begin{bmatrix} M_{t-1} \\ A_{t-1} \end{bmatrix} + \begin{bmatrix} 0 \\ y_t \end{bmatrix}, \qquad \text{with} \quad z_1 \stackrel{\text{def}}{=} \omega_0 m \bar{\mu}. \tag{9}$$

It is clear, intuitively, why household behavior as described by the equation system (6) above should imply such a system of difference equations. For financial wealth this is straightforward: Current assets are previous assets plus savings. But savings are determined by current income and consumption which, in turn, depends on previous financial assets and current plus future income. Present income and human capital are related to human capital of the previous period which is, in turn, related to previous consumption. Hence, current financial wealth is determined from previous financial wealth, previous consumption, and current income. Similar reasoning applies to consumption which is a function of wealth. Wealth is defined as previous financial assets augmented by current income and human capital. Financial assets of the previous period are, in turn, related to previous consumption and previous human capital. But previous human capital is also related to previous consumption, hence the first line in the above system of difference equations which is nothing but an aggregate version of the Euler equation.

We may now explore the existence of a steady state and stability of the above system, given some value for full disposable income. Denoting steady state values by a subscript ∞, we have

$$M_\infty = \frac{-m\omega_0\bar{\mu}y}{|I-Z|} > 0, \qquad A_\infty = \frac{-\xi y}{|I-Z|} > 0,$$

where Z is the coefficient matrix of the above system. The inequalities in these expressions assume that the determinant $|I-Z|$ is strictly negative. This is also necessary for saddle-path stability which can be seen as follows. The characteristic roots of Z can be shown to be (see our appendix)

$$\mu = (1-m)\frac{1+r}{1+\bar{g}} = (1+\xi)\frac{1-\theta}{1+n}, \qquad \text{and} \qquad \bar{\mu} = \frac{1+\xi}{1-m} = \frac{1+r}{1+\bar{g}}\frac{1+n}{1-\theta}.$$

Dynamic efficiency requires $\bar{g} < r$ and thus $\bar{\mu} > 1$. Hence, stability requires that $0 < \mu < 1$ which also implies $|I-Z| < 0$.[19] $\mu = 1$ would imply a zero determinant $|I-Z|$, in which case we could not uniquely determine a steady state from y. Being able to compute

[19]The reader may wish to check stability by focusing on the eigenvalues of the matrix $Z - I$ instead

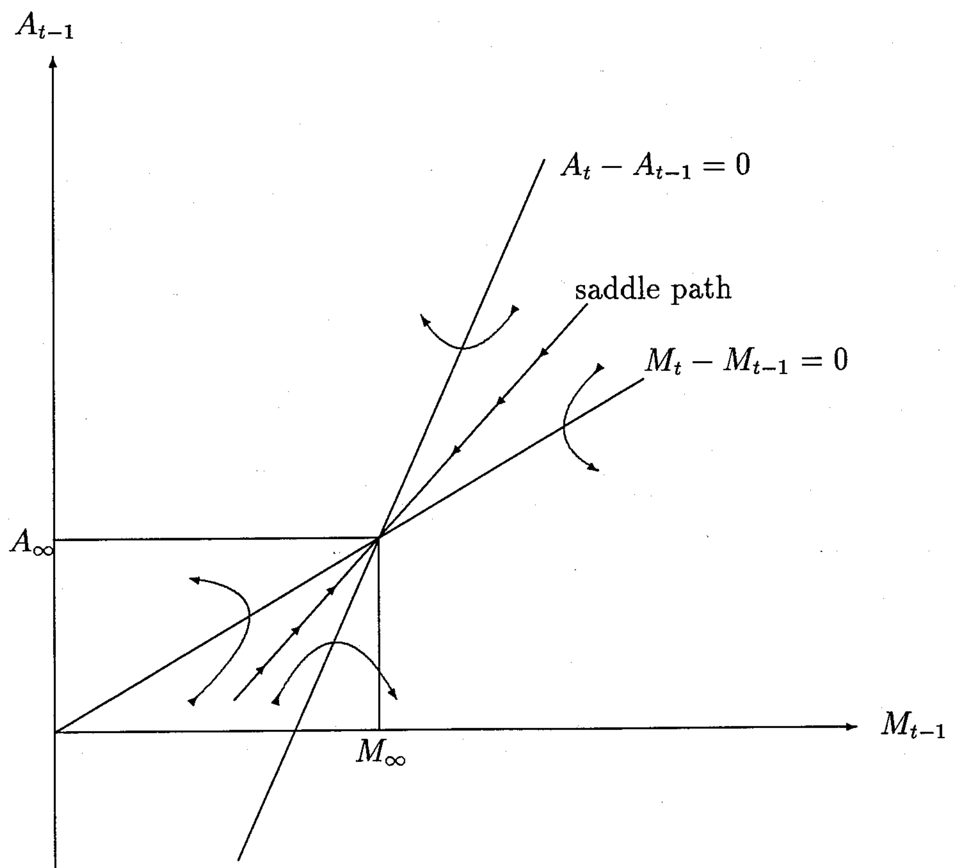


Fig. 1: Dynamic adjustment of consumption and financial wealth.

the steady state independently of initial conditions and the adjustment path is a very convenient property of this type of model from a computational point of view (see below). Accordingly, $\mu < 1$ is an important condition to be imposed on the calibration procedure.

We can depict dynamic adjustment of consumption and wealth by the usual phase diagram in the (A, M) space. Taking the Euler equation for consumption first, we can derive a line through the origin with slope $\xi/z_1 > 0$, along which consumption remains stationary. Similarly, financial wealth remains stationary on a line with slope $[1+\xi]/[(1+r)/(1+\bar{g})+z_1-1]$, and intercept $-[(1+r)/(1+\bar{g})+z_1-1]^{-1}y$. Saddle

of the matrix Z. The eigenvalues of this matrix are $1-\mu$ and $1-\bar{\mu}$, respectively. The above condition then translates into the usual formulation according to which the eigenvalues split into a positive and a negative one.

path stability implies that this latter line is steeper than the stationary Euler line, and their intersection determines the steady state values M_∞ and A_∞. Figure 1 depicts the saddle path leading the system to this steady state. An increase in income y shifts the A-schedule. The dynamic behavior, however, crucially depends on whether or not financial wealth has a forward looking component. If it does not, the system jumps horizontally onto a new saddle path leading to the new steady state (not drawn to avoid clutter). But in our case financial wealth includes equity which is evaluated in a forward looking way. Hence, financial wealth may jump on impact. In addition, disposable wage income may change gradually because of sticky capital accumulation, thereby shifting the A-schedule in a gradual way and generating more complicated adjustment dynamics [see Keuschnigg (1994)]. It must also be emphasized that the adjustment dynamics of figure 1 holds for a constant interest rate, and a constant price index p^v. The model dynamics emerging in our counterfactual exercises below is importantly influenced by changes in p^v, so we must be cautious in trying to find too much of the present adjustment pattern in the results to be presented below. But the simplified exposition of this section should nonetheless contribute to a deeper understanding of our results.

3.1.3 Generational Welfare Analysis

We have pointed out in the previous section that accumulation may be carried out through savings of present generations who may not benefit from increased future consumption. We now address this issue by means of a full generational welfare analysis, and in doing so we depart from the previous assumption of a constant full consumption price index p^v. Indeed, variations in p^v through time now become an integral part of the story to be told, as are variations in income y.

Before we go into the details, we must point out that demographic change, while being present, is captured in a rather crude way in our model. In particular, the welfare calculations to be presented here do not literally incorporate individuals who actually die during the adjustment period. Instead, we have generations who enter the economy at different points during the transition, or who have entered in the old or will enter in the new steady state, all of which have an *identical life expectancy.*[20] And expected lifetime utiliy is all that we look at for each generation. In what sense, then, can different

[20] This is why models of the present type are sometimes called models of perpetual youth.

generations be affected differently by a given poliy. The first crucial point to note here is that different parts of the price and wage income (or transfer) profiles will be relevant for different generations, depending on when they enter the economy. The second point is the simple assumption that each generation enters the economy without any financial wealth. This implies that generations not yet born at the time when new information on some policy change arrives cannot be affected by the resulting impact revaluation of financial wealth, while old generations are, and are so to a different extent, depending on how important these assets are in their overall wealth portfolios.

We now derive a money equivalent measure of utility changes which allows us to quantify the welfare effect of a given policy separately for each generation. Given intertemporal optimization on the household side, this is a wealth equivalent variation, rather than the income equivalent measure which is familiar from static models. Equation (1) above gives expected life-time utility, as of the beginning of period t, for a generation aged a. We denote this by $EU_{t-a,t}$, and we first look at the generation with age 0, i.e., the generation born at the beginning of period t. We substitute out all future consumption, $v_{t,s}$ for $s > t$, by utilizing the Euler equation and the constant intertemporal elasticity formulation of $u(\cdot)$. As a result, we can write expected life-time utility as a function of present full consumption and intertemporal prices as embodied in the marginal propensity to consume, Ω:

$$EU_{t,t} = \Omega_t \frac{(v_{t,t})^{1-1/\gamma}}{1-1/\gamma}. \tag{10}$$

Using the consumption function (3a) to replace present (full) consumption, we arrive at the indirect utility function

$$EU(\mathcal{P}_t, \mathcal{W}_{t,t}) = \frac{(\mathcal{W}_{t,t})^{1-1/\gamma}}{1-1/\gamma} \times \mathcal{P}_t, \qquad \mathcal{P}_t \overset{\text{def}}{=} \Omega_t^{1/\gamma} (p_t^v)^{(1-\gamma)/\gamma}. \tag{11}$$

We have introduced a convenient intertemporal price factor $\mathcal{P}_t$, which is the same for all generations alive at the beginning of period t. Inverting the indirect utility functions, we derive an intertemporal expenditure function of the form

$$e(\mathcal{P}_t, EU_{t,t}) = \left[(1-1/\gamma) EU_{t,t}/\mathcal{P}_t\right]^{\gamma/(\gamma-1)}. \tag{12}$$

This is the amount of wealth that our generation would need, given intertemporal prices as embodied in $\mathcal{P}_t$, to achieve an expected life-time utility equal to $EU_{t,t}$. Suppose that with the initial policy, this generation would have faced intertemporal prices $\mathcal{P}_t^0$ and its wealth would have been $\mathcal{W}^0_{t,t}$, with expected life-time utility implicitly given by $\mathcal{W}^0_{t,t} = \left[(1-1/\gamma)EU^0_{t,t}/\mathcal{P}^0_t\right]^{\gamma/(\gamma-1)}$. Suppose, moreover, that at the beginning of period t new information hits the economy on some policy change, say trade liberalization. As a result, expected life-time utility changes to $EU^1_{t,t}$, due to a variation in both intertemporal prices and period t wage income plus human wealth. Note that this generation does not have any financial wealth at the time of the policy change. The equivalent variation in full wealth for this generation is then defined as

$$EV_{t,t} \stackrel{\text{def}}{=} 100 \times \frac{e(\mathcal{P}^0_t, EU^1_{t,t}) - \mathcal{W}^0_{t,t}}{\mathcal{W}^0_{t,t}}. \tag{13}$$

This measure translates the welfare change into a pure wealth change at notionally unchanged prices. A positive value of $EV_{t,t}$ indicates a welfare gain, and vice versa. It is clear that what we have just said about the generation entering the economy at the time of the policy change can be applied by complete analogy to all subsequent generations. We henceforth call generations born at the beginning of period t or later new generations. Successive new generations will have different equivalent variations because their new expected life-time utility will be different. Thus, a generation born s periods after the policy change would have $EU^1_{t+s,t+s} = EU(\mathcal{P}^1_{t+s}, \mathcal{W}^1_{t+s,t+s})$.

The above procedure, however, does not fully describe the utility change for generations who were born prior to the policy change (old generations). The reason is that they are affected by a revaluation of their financial wealth, in addition to changes in income and human capital. Note that every old and the first new generation face identical period t incomes and stocks of human wealth: $H_{t-a,t} = H_{t,t}$ and $y_{t-a,t} = y_{t,t}$. Hence, they will all be affected in identical ways in these terms. Without any policy change, total wealth of a generation aged $a > 0$ as of the beginning of period t, would be equal to $\mathcal{W}_{t-a,t} = y_{t,t} + H_{t,t} + (1+r)/\left[(1-\theta)(1+x)\right] A_{t-a,t}$ (see equation 3b above). All financial assets (including equity holdings) would yield a real return of r, due to the no-arbitrage condition which would hold between periods $t-1$ and period t if no new information had been arriving in between. But if such information hits the system, then the no-arbitrage condition is violated for firm values, and dividends plus capital gains (or losses) imply an effective rate of return on equity which is different from the given interest rate r.[21] To obtain equivalent variations for old generations, we calculate an average economy wide

[21]For details on the no-arbitrage condition for equity, see below. A more detailed account of or procedure to derive equivalent variations for old generations can be found in the appendix.

rate of return for financial wealth between periods $t-1$ and t, and apply this to financial wealth of all old generations to obtain generation-specific figures for total wealth, as of period t, under the new policy. This implies that all individuals hold the same economy wide portfolios. Moreover, it requires knowledge of the distribution of existing financial wealth across old generations in the initial steady state. We detail in the appendix how this distribution can be derived. Ultimately, we arrive at generation-specific welfare measures $UE^1_{t-a,t}$ which we then use to calculate generation specific equivalent variations $EV_{t-a,t}$ according to the above definition.

This approach enables us to provide a full generational welfare analysis of the policy scenarios that we shall address below. We may thus also address the question of intergenerational redistribution, in addition to distributional issues along the sectoral or fatoral dimension which have so far been at the center of CGE analysis. In addition to equivalent variations for a large number of old and new generations, we shall also report a steady state welfare equivalent variation in our results below. This is nothing but the above definition applied to steady state values of total wealth and the price factor $\mathcal{P}$.

3.1.4 Linking Households to the Rest of the Economy

Financial wealth consists of three types of assets all of which are perfect substitutes: government debt, net foreign assets (which may be negative), and domestic equity.[22] They all earn the same rate of return r, and their supplies evolve according to laws of motion which are completely analogous to equation (6c) above, with the corresponding flows being the primary government deficit, the trade balance, and dividends plus capital gains on equity (see below). This, of course, raises the question of capital market equilibrium: the end-of-period overall financial wealth position that households wish to attain has to be equal to the sum of all asset supplies as determined by their previous values and current period flow magnitudes. We shall return to this question below.

In determining full consumption expenditure M, we have assumed a given price index p^v in each period. This is nothing but the unit expenditure function associated with $v(C, 1-L^s)$. Since $v(\cdot)$ is strictly quasiconcave and linearly homogeneous, p^v is

[22]Goulder and Eichengreen (1989) assume that domestic and foreign assets are imperfect substitutes, so that they need not yield equal rates of return in equilibrium. They model imperfect substitutability by incorporating a portfolio preference index in the felicity.

a well-behaved, quasi-concave function of a commodity price index p^c and the price of leisure which is nothing but the net wage rate w^n: $p^v(p^c, w^n)$. In turn, p^c is the unit expenditure function corresponding to the commodity aggregate C which is again strictly quasi-concave and linearly homogeneous in sectoral aggregates C_i. On the bottom level, we employ the so-called Armington assumption which says that C_i is composed of an imported good and a domestic good, again using a quasi-concave and linearly homogeneous parameterization. The important thing to notice is that this utility nest allows households to employ multistage budgeting: Given expectations on all future prices and future incomes (as embodied in the forward looking variables Ω and H), they determine the intertemporal allocation of full consumption expenditure. On the second stage, they allocate periodic consumption expenditure between overall commodity consumption and leisure, depending on prices p^c and w^n. The next stage allocates overall commodity consumption across different sectors, and so on. The reader will have recognized that within-period decisions follow standard procedures, hence we abstain from any more detailed presentation.[23]

Labor supply and commodity demand determined in this way feed back into market clearing conditions for each period which, in turn, determine prices for each period. But since household behavior is subject to expectations on future prices (through Ω and H), this raises the question of whether these expectations will be borne out by future prices or, more generally, the question of how expectations are formed. We have employed the assumption of perfect foresight (see below).

3.2 Firm Behavior

Firms decide on production and investment. Production is subject to sectoral production functions which are Leontief in intermediate inputs and a value added product. Intermediate input requirements are in terms of a composite good according to the Armington assumption mentioned above. Value added is generated according to a strictly quasi-concave and linearly homogeneous production function, using intersectorally mobile labor and sector-specific physical capital as inputs. Physical capital within every sector is predetermined by history, while firms determine labor demand L^d so as to equate the marginal

[23]More details may be found in Keuschnigg and Kohler (1994a).

productivity of labor with the gross wage rate. Net outputs for every sector are thus determined in the usual way by purely static considerations. Moreover, given constant returns to scale, the number and scale of firms is not determined, but nor does it play any role in our model economy.

In static models this is all we would have to say about firm behavior. Intertemporal models, however, now add a dynamic dimension through forward looking investment. Firms are owned by households who require a net-of-tax rate of return on holding equity which is equal to that obtained for all other assets (government debt and foreign assets).[24] The rate of return on equity is determined by dividend payments χ and capital gains on firm values V. The no-arbitrage condition is

$$V_t = \frac{1+r}{1+\bar{g}} V_{t-1} - \chi_t, \tag{14}$$

where we abstain from sector indices to avoid clutter. Forward integration of this equation gives the fundamental ex-dividend value of the firm as

$$V_t = \sum_{s=t+1}^{\infty} \chi_s \prod_{u=t+1}^{s} \frac{1+\bar{g}}{1+r_u}. \tag{15}$$

Given the gross wage rate w^g and, therefore, the marginal productivities of labor and capital, dividend payments are determined by how much firms decide to spend on investment, and on how they decide to finance investment expenditure. We assume that all investment is financed internally through retained earnings, so that dividends emerge as

$$\chi_t = (1-t_y)\big[\tilde{p}_t\big(F(\frac{K_{t-1}}{1+\bar{g}}, L_t^d) - \Phi_t\big) - w_t^g L_t^d\big] - (1-et_y)p_t^I I_t, \tag{16}$$

where we have again omitted sectoral indices. t_y is the marginal income tax rate, $\tilde{p}$ is the net output (or value added) price[25], F is the value added product, Φ_t denotes capital installation costs, e is the fraction of investment expenditure allowed as a deduction from the tax base, and I is the quantity of gross investment with an associated price of the capital good p^I.[26] We specify installation costs as $\Phi = \psi\big[K_{t-1}/(1+\bar{g}) - (\bar{g}+\delta)\big] I_t$ which is

[24] Alternatively, one may require a larger, risk-adjusted rate of return on equity, as in Goulder and Eichengreen (1989).

[25] With an eye on the effective protection literature, $\tilde{p}$ might also be called the *effective* price.

[26] Our modeling of capital taxation is rather simple and is primarily dictated by data restrictions. In particular, our model does not capture the double taxation feature of a separate corporate tax or a capital gains tax in addition to a personal income tax. For comparison, see Goulder and Eichengreen (1989).

linearly homogeneous in the capital stock and gross investment, decreasing in the capital stock, and strictly quasi-convex in investment. The linear homogeneity property allows us to equate marginal and average shadow values of sectoral capital stocks [see Hayashi (1982)]. Notice also that the capital input in the value added production function is expressed per efficiency unit of the current period.

Firms are now assumed to maximize firm values as given above subject to the usual equation of motion for capital stocks:

$$K_t = (1-\delta)\frac{K_{t-1}}{1+\bar{g}} + I_t. \tag{17}$$

All sectors use the same capital good which is an aggregate commodity. The detailed composition of this commodity is modeled as with the consumption aggregate C above. The acquisition price p^I must therefore be seen as a function of all commodity prices. As we show in Keuschnigg and Kohler (1994a), this problem may be solved with Lagrangean methods, and we obtain sectoral equations for investment demand which may be written as

$$I_t = I(p_t^I, \tilde{p}_t, K_{t-1}, V_t). \tag{18}$$

Note that in addition to present prices (as embodied in p_t^I and $\tilde{p}_t$) and the predetermined capital stock, investment demand also depends on the forward looking firm value. Hence, firm behavior is subject to expectations on future prices. As with household behavior, we implement the assumption of perfect foresight also with respect to firm values. Having determined investment for every sector, we then translate this into commodity demands by invoking the familiar principle of multi-stage budgeting.

3.3 Government and Foreign Sector

3.3.1 Government

Our government collects a variety of taxes which it uses for government procurement and a lump-sum transfer to households. There are three types of indirect taxes (value added tax, general excise tax, and tariff), a social security tax, and a general income tax subject to a lump-sum deduction which is intended to capture a progressive income tax schedule. Government procurement is kept constant per efficiency unit in terms of an aggregate commodity. In modeling the allocation of government expenditure across different commodities we follow the principle of multi-stage budgeting that we have alredy introduced above. We allow debt finnacing, but we impose a pre-specified path of government debt, with the base case scenario holding government debt constant in terms of imported goods. Lump-sum transfers are then adjusted in each period to keep the government on this debt path.

3.3.2 Foreign Sector

We have already pointed out above that within every sector imported goods are imperfect substitutes for domestic goods (Armington assumption). This allows us to treat prices of imported goods as constants (set to one by implicit scaling) without generating extreme specialization effects in trade policy scenarios. On the export side, we assume downward sloping export demand schedules with constant price elasticities.[27] Being able to endogenously determine the trade balance and the associated path of foreign indebtedness was among the prime motivations for constructing models like the present one (see the introduction). Hence, we do not force the trade balance to be zero or to take on any pre-specified value in any period. Instead, domestic households may sell unlimited amounts of domestic assets on world capital markets as long as these assets yield a return equal to the given world interest rate r. Similarly, they may buy unlimited amounts of foreign assets at this interest rate. We thus assume perfect international capital mobility.[28] The trade balance, however, is subject to an intertemporal constraint, so that perfect capital mobility does not constitute the possibility of a free lunch for the domestic economy. This is ensured by the intertemporal budget constraint that we have imposed on household behavior. The path of the net foreign asset position evolves according to an equation of motion which is completely analogous to that of financial wealth.

[27]Whalley and Yeung (1984) explore the properties of such external sector closing rules for static models. Given that we endogenously determine the trade balance, however, their results cannot directly be applied to our model. Our treatment of the foreign sector is similar to Jorgensen and Ho (1993), but again different from Goulder and Eichengreen (1989) who model import supply by a symmetric treatment of foreign production. On the export side, however, Goulder and Eichengreen also resort to the type of demand functions that we postulate in our model.

[28]Goulder and Eichengreen (1989) implement imperfect capital mobility by specifying portfolio preference functions for domestic and foreign households. In this case, an endogenous risk premium emerges between the foreign and domestic interest rates.

3.4 General Equilibrium

A detailed presentation of equilibrium conditions may be found in Keuschnigg and Kohler (1994a) as well as the appendix, so we can be very brief here. General equilibrium must be thought of as a sequence of *temporary equilibria* which are interconnected by backward looking and forward looking variables. Each temporary equilibrium requires market clearing for all commodities as well as the labor market. In addition, the government budgetary balance must satisfy the prespecified government debt path and, finally, overall savings generated by households must equal the sum of investment outlays, the current account, and the government deficit (which may be seen as a flow version of capital market equilibrium). Walras' Law implies that commodity and labor market clearing plus the restriction on the government balance imply equilibrium also on the capital market (see the appendix). Such a temporary equilibrium is connected to all previous equilibria due to stocks inherited from the past (physical capital stocks plus net foreign assets and government debt). Moreover, it is conditional on expectations about future prices as embodied in firm values, human capital, and the marginal propensity to consume (see above). As we have repeatedly pointed out above, we implement the assumption of perfect foresight. Agents form their expectations such that their own actions, which are subject to these expectations, will prove them right. For instance, investment depends on expectations about the future, but it also determines the future through the capital stock that it accumulates and which forms the basis of future production. Perfect foresight simply implies that the investor entertains expectations which lead him to invest such that his expectations will be borne out by future temporary equilibria. A complete *intertemporal equilibrium* is, therefore, characterized by all laws of motion for backward *and* forward looking variables being satisfied between any two temporary equilibria. The procedure that we use to compute a complete perfect foresight intertemporal equilibrium is due to Wilcoxen (1989) and is described in detail by Keuschnigg (1991). It requires knowledge of terminal values of all forward looking variables. These are generated by an independent computation of the steady state equilibrium which is characterized by the stationary versions of all laws of motion, in addition to clearing commodity and labor markets.

3.5 Calibration

We have calibrated this model to a 1976 data set for the Austrian economy. Again, we may abstain from details here since we have described these in Keuschnigg and Kohler (1994a) and the appendix. We restrict ourselves to pointing out a few special problems which relate to the intertemporal structure of our model. First of all, the calibration procedure is such that the model generates the benchmark data set as a steady state equilibrium. We do not, of course, intend to say that the Austrian economy was in a steady state position 1976. But calibrating a model like this for non-steady state situations (i.e., for a temporary equilibrium along some adjustment path) raises unresolved issues and would, at any rate, require much more data information than is typically available. In our view, then, there is no way to avoid admitting that CGE work along these lines can claim to be empirical work (in the usual interpretation) only to a very limited extent. Perhaps it should better be seen as theory with numbers.

What are the magnitudes that calibration of a dynamic model needs to determine, over and above the parameters of static models? On a general level, the answer is quite easily stated: Take the laws of motion for all dynamic variables plus the optimality conditions from intertemporal optimization, write them in stationary form, and see which of the magnitudes involved are given from the data or some extraneous econometric evidence. It is conceivable that one might end up with too much information in the sense that data plus econometric evidence violate some steady state restriction. Suppose, for instance, that the data gives us independent information on y, $p^v v$, r, $\bar{g}$, *and* the stock of overall financial wealth A. We could then not possibly expect that these values would exactly satisfy the stationary version of equation (6c) above. In this case, we would have to discard the information that we are least comfortable with, and determine the respective magnitude from (6c). The typical case, however, is one where information is much more sparse, and there is ample room to determine various magnitudes so as to ensure steady state versions of dynamic relationships. We have in this way calibrated all stock variables, in addition to the productivity growth rate x (as embodied in the overall growth factor $\bar{g}$) and the subjective discount rate ρ, which reflects savings behavior, from the flow magnitudes observed in our data set, and econometric evidence and informed guesses on certain intertemporal parameters as listed in table 1. These parameters are intended to capture past trends of the Austrian economy. Notice that in this model the rate of time preference is not dictated by the choice the interest ratė, as is the case for models with a representative infinitely lived household. This is most easily seen by looking at the steady state version of the Euler equation for full consumption above. Moreover, intertemporal parameters also have to satisfy the stability condition for full consumption derived above, as well as the condition for dynamic efficiency ($\bar{g} < r$). Table 2 gives an overview of some important features of the data set as well as the Armington elasticity parameters taken from outside econometric sources. It also gives shorthand expressions for sectors for later use. The foreign tariff rates of table 2 are industrial countries' average pre-Tokyo-round tariff rates computed from Deardorff and Stern (1986). More details can be found in the appendix.

4 Simulation Results

Unfortunately, our data restrictions do not allow us to carry out policy scenarios that are directly related to the present or future trade liberalization agenda. Our scenarios are partly historical, and partly hypothetical, hence the principal purpose of this section is illustration rather than ex-ante evaluation of immediately relevant policy proposals. Since our earlier applications featured a complete *unilateral* tariff removal across all sectors [see Keuschnigg and Kohler (1994a and 1994b)], we now extend the application to *multilateral* liberalization. Given that our benchmark equilibrium is pre-Tokyo-round, it appears natural to contrast a complete multilateral tariff liberalization with the cuts negotiated in the Tokyo-round. These followed the simple harmonizing formula

$$t_1 = \frac{16 t_0}{16 + t_0}, \tag{19}$$

where t_1 and t_0 denote post- and pre-Tokyo-round tariff rates, respectively, expressed in percentage terms. We distinguish between a once-and-for-all tariff cut which takes all agents by surprise (referred to as the instantaneous scenario below), and a gradual implementation which is anticipated four periods ahead and which spreads out the tariff cuts in equal steps over 7 periods. This corresponds, roughly, to what happened with the Tokyo-round cuts, and we shall subsequently call it the gradual scenario. The second scenario that we want to focus on is *temporary* tariff protection granted to a single sector, such as might occur under the safeguard provision of the GATT. We take metal processing (sector 11) as the targeted sector on the grounds that it has low initial protection and that it is rather important in terms of both value added and trade volume. We assume, again, that the event is anticipated four years ahead and that it lasts for 7 periods. We contrast targeted protection of a single sector with a general import surcharge applied to all sectors. The points of interest here are the dynamic adjustment to temporary protection and the general equilibrium repercussions of targeting individual sectors. A final scenario has tariffs removed only for investment demand. This might be considered a special policy of investment promotion. Again, we are primarily interested in the adjustment dynamics involved, in particular as regards financial wealth and foreign indebtedness.

4.1 Multilateral Liberalization

Table 2 gives pre-Tokyo-round tariff rates for Austria and average tariffs of industrial countries which are computed from Deardorff and Stern (1986). These are now simultaneously removed, or reduced according to the above Tokyo-round formula, to compare the Tokyo-round effects with a move to free trade. Using a single country model in this way to simulate multilateral tariff cuts is, admittedly, less than perfect. In particular, since the model does not extend to a fully symmetric treatment of the rest of the world, we have to ignore possible effects of multilateral liberalization on world prices of traded goods. Instead, we maintain our assumption of given world prices for imports. Moreover, export demand is driven exclusively by changes in domestic prices and foreign tariffs, precluding general equilibrium feedbacks on export demand, such as would occur if foreign countries would experience expansionary or contractionary effects of the policy on capital stocks or labor supply. These effects are emphasized for the domestic economy, but assumed away for the rest of the world. Limited as no doubt it is, our exercise nevertheless nicely serves to highlight certain intertemporal aspects of multilateral, as opposed to unilateral, tariff reductions.

For easier comparison, table 3 first reproduces the long-run macro effects of a unilateral tariff removal from Keuschnigg and Kohler (1994b), and then reports the results for Tokyo-round cuts and multilateral free trade in columns 2 and 3. The difference between these two is largely a matter of degree, while unilateral and multilateral liberalization produce a markedly different pattern of results. Perhaps most importantly, under multilateral liberalization increased export demand due to lower foreign tariffs causes a terms of trade improvement and, therefore, avoids the welfare loss implied by the unilateral scenario.

We observe a positive steady state equivalent variation in the amount of 0.6 percent. Greater demand for home goods also causes the wage rate to increase despite increased labor supply. The expansionary effect on labor supply is somewhat lower than under unilateral liberalization, but the medium term growth bonus due to fixed capital formation is significantly larger. This also expands the tax base, thus requiring a lower cut in household transfers. Together with the higher wage rate, this makes for a significant increase in disposable wage income, both in nominal terms and deflated by the overall price index p^v. Looking at table 4 which contains sectoral information, we realize that capital intensities increase throughout.[29] As a consequence, the marginal productivity of capital falls. However, because of higher output prices this is more than offset by the increase in the shadow value of capital, hence firm values increase, both in the aggregate and in all sectors individually. Notice, however, that capital deepening in some sectors (mostly non-traded goods sectors) is accompannied by a fall in employment.

Figures 1 through 4 reveal some aspects of dynamic adjustment, again including a comparison with the (gradual) unilateral policy. These figures strongly suggest that the Tokyo-round cuts were a relatively small step towards free trade. There remains a lot to be gained from further liberalization. While the long-run capital stock is determined by the equality between the marginal productivity of capital and its user cost, the short-run behavior is determined by movements in the shadow value of capital and its acquisition cost. Interestingly, the medium term growth bonus sets in immediately even in the gradual scenario, while a unilateral policy, if implemented in a gradual way, causes capital decumulation during an initial phase in which agents delay investment until tariff cuts and lower home goods prices reduce acquisition costs. With multilateral cuts, domestic prices move in the opposite direction, hence the incentive for intertemporal substitution is much lower and there is no initial capital decumulation, though capital formation does set in somewhat more slowly in the gradual scenario.

Figure 2 depicts how expected life-time utility of individual generations changes as a result of various policies. We know from above that old generations are affected by windfall profits or losses on their equity holdings, in addition to human capital and in-

[29]We show in Keuschnigg and Kohler (1994a) that this effect depends on the movement of the acquisition price of capital (p^I) relative to the sectoral effective price $\tilde{p}$. In the present case the effective price increases for all sectors, while p^I falls, and this implies a higher capital intensity in the new steady state.

tertemporal price changes.[30] In the unilateral case, we observe a significant welfare loss of all new generations, and a marked redistribution towards old generations. By way of contrast, multilateral liberalization increases welfare for all generations, with hardly any discernible redistributive effect for the Tokyo-round cuts. In the case of complete tariff removals, the gradual scenario implies a very moderate redistribution towards new generations. The instantaneous scenario, on the other hand, favors very old as well as future generations, relative to generations entering at the time of the policy change. Generations born immediately after this change do not gain from equity revaluation, while at the same time having to go through initial periods of relatively modest wage increases. The later on a generation enters the economy, the more it will gain from an increasing profile of wage income, the more favorably, therefore, will its human capital be affected by the policy.

Figures 3 and 4 turn to dynamic adjustment of the trade balance and foreign indebtedness. One might perhaps intuitively expect that trade liberalization will cause a temporary worsening of the trade balance and, accordingly, a long-run increase in foreign indebtedness. This is, indeed, what our model shows, but what are the forces at work? First, there is intertemporal smoothing of full consumption carried out by successive generations with differing expected income profiles. The gradual policy implies a rising time profile of disposable income during almost the entire adjustment path, while the instantaneous policy causes a large impact effect in the first period, followed by a slight overshooting and gradual reduction to the long-run income level (the graph is not shown for shortage of space). On this account alone, we would thus expect a temporary worsening of the trade balance in the gradual scenario, while the instantaneous policy may conceivably imply a temporary improvement. There are, however, additional effects which defy any clear-cut presumption. In particular, there is intertemporal substitution caused by the precise intertemporal pattern of prices, and within-period substitution between home goods and imports, depending on market clearing prices for domestic goods. On the production side, any expansionary effect on the capital stock implies increased investment demand which precedes the increase of production. This again exerts an influence towards a temporary worsening of the trade balance. Finally, any wealth redistribution from future to presently living generations will – all other things being equal – increase

[30]In Keuschnigg and Kohler (1994b), we have also shown the intersectoral pattern of these windfall gains/losses.

present expenditure and thus worsen the trade balance in initial periods of adjustment.[31] While the early adjustment path is pretty much dominated by intertemporal substitution effects, and is characterized by temporary improvements of the trade balance in the gradual unilateral scenario, such is not the case in the gradual multilateral scenario. One explanation is that lower prices for imported goods, due to tariff removals, are now accompanied by rising prices for domestic goods, due to cuts in foreign tariffs and higher export demand. There is thus much less incentive to postpone expenditure to later periods. Indeed, the intertemporal substitution effects appear to operate in the opposite direction. In the long-run, however, the multilateral liberalization scenario causes increased foreign indebtedness, albeit to a lower extent than does a unilateral tariff removal. Moreover, adjustment is much faster for multilateral moves than for a unilateral policy.

Among the set of most important parameters driving these results is the price elasticity of export demand which we have taken from econometric studies of trade flows, as usual. Column 4 of table 3 presents results for a complete multilateral tariff removal that we have obtained upon scaling up these base case elasticities by a factor of 5. With a higher price elasticity of export demand, foreign tariff removals have a greater effect on export demand, thus tending to raise domestic prices to an even greater extent. At the same time, the movement along free trade export demand schedules which is implied by domestic expansion now entails a much smaller downward pressure on home goods prices. For both reasons, a more favorable picture emerges, more than doubling the equivalent variation of the base case scenario, and reducing foreign indebtedness in the long-run. For shortage of space, we abstain from presenting the detailed adjustment paths that obtain for higher elasticity values, but we should like to briefly point out a few differences that emerge.[32] The overall capital stock now exhibits a slight overshooting after period 10 for the gradual scenario. The movements in the trade balance are much more pronounced than in the base case, with an impact fall from a surplus down to a deficit in the amount of 0.2 percent of initial value added for the gradual scenario. After a 4 year period of further decline it improves while tariff cuts are phased in, but much more dramatically than in the base case and significantly overshooting its long-run value

[31] These mechanisms of current account adjustment through intergenerational redistribution are characterized in detail for somewhat different model setups by Engel and Kletzer (1990), Eaton (1989), Matsuyama (1988).

[32] The relevant figures can be obtained upon request.

for an extended period of time. As regards intergenerational distribution, there is now a clear redistribution in favor of new generations, and this is much more pronounced for the gradual than for the instantaneous scenario. We must conclude from all of this that some of our results, including dynamic adjustment patterns, are quite sensitive with respect to the price elasticity of export demand, thus strengthening the need for reliable econometric information on trade elasticities to be used in CGE work.

Our model also allows us to examine adjustment paths on the sectoral level, such as for instance for capital capital stocks and firm values. Available space precludes any such detailed presentation, but we may point out that there is a fair amount of intersectoral diversity as to the pattern of adjustment dynamics, with some sectors running through initial phases of capital decumulation followed by expansion later on. Firm values in some cases very quickly jump to their steady state values, while adjusting more slowly or overshooting their long-run values in others.

4.2 Temporary Protection

Temporary import surcharges are a frequently considered form of trade intervention, be it because policy makers are worried by peaking trade deficits, or because individual sectors are seeking relief from import competition which would otherwise supposedly cause serious injury. Temporary protection presumably is attractive also because it allows policy makers to accommodate protectionist concerns, while at the same time seemingly maintaining a long term commitment to free trade. There are many reasons to believe that this may turn out to be an uneasy compromise, but we shall not dwell on these here. Instead, our concern is primarily with how such policies may be modeled. By their very nature, such policies require an intertemporal modeling setup, and for this reason they have so far received relatively little attention in CGE analysis.[33] We intend to show some important dynamic implications that emerge if we look at temporary protection through the lense of our intertemopral CGE model. While the model is not particularly geared towards the above mentioned concerns that might give rise to temporary protection proposals, it nontheless serves a useful purpose in highlighting some of its consequences.

We contrast temporary protection granted to a single sector with a general import

[33]To our knowledge, Eichengreen and Goulder (1991) is the only study of this kind.

surcharge, both of which are anticipated four periods ahead and last for 11 periods. In the first case, we increase tariffs on imported metal processing goods by 15 percentage points, and in the second case we assume a uniform increase of all tariffs by 15 percentage points. Neither of these policies has any lasting effects in our model where the steady state is path-independent. All effects are strictly transitory in nature.

Intuition might lead us to expect that granting protection to a single sector is at the expense of other sectors, where recources are pulled out to be employed in the protected sector. Our results, however, show that intertemporal effects generate an overall picture where intersectoral differences, though discernible, only play a minor role. Thus, in figure 5 we can see a great deal of similarity between sectors 3 (foodstuff), 7 (chemicals), 11 (metal processing), and 13 (Construction) in the evolution of capital stocks through time.[34] Consider targeted protection with the base case elasticities of export demand first. Sectors 3, 11 and 13 build up physical capital during initial periods, in anticipation of higher acquisition prices for the capital good which will prevail later. Whether or not this type of intertemporal substitution causes initial accumulation also depends on the impact effect on the shadow price of capital, and in sector 7 we observe a very moderate increase which does not suffice to initiate temporary accumulation. However, all sectors use the period of protection to temporarily run down their capital stocks, and thus delay production to later periods when capital will become cheaper. This holds for both targeted protection and a general surcharge, but it is more pronounced for an overall import surcharge and for high price elasticities of export demand. Although a quick glance might suggest that targeted protection is not much different in result from a general import surcharge, it should be noted that the difference is, indeed, most pronounced for the targeted sector.

Figures 6 through 9 show certain features of aggregate adjustment and welfare. The most conspicuous result is a significant increase in disposable wage income during the period of higher tariffs which mainly reflects a terms of trade improvement. The time profile of wage income is clearly reflected in the intergenerational pattern of welfare changes, where the largest equivalent variation is observed for the generation entering in period 5 when the tariff increase becomes effective. The welfare increase of following generations falls dramatically, until the generations born immediately after the return to initial tariff levels faces a welfare loss in all scenarios. Old generations are affected by an adverse

[34]Each of these sectors represents a pattern of adjustment that can also be found for others. More figures may be obtained upon request.

revaluation (in real terms) of their equity, and this effect gains importance with older generations. The welfare gain for most generations is turned into an unambiguous welfare loss if export price elasticities are sacled up by a factor of 5. This, again, testifies to the importance of terms of trade effects as a driving force behind the results. We conclude that temporary protection is associated with a marked pattern of intergenerational redistribution to the disadvantage of those entering the economy shortly after returning to initial tariff levels. As regards the trade balance, all policies show a temporary improvement during the period of protection, followed by a sharp deterioration immediately thereafter, and a lengthy period of lower than initial balance before returning to its new steady state value. This pattern, which is also found by Eichengreen and Goulder (1991), is explained by expenditure switching during the period of high import prices, and the effect is, of course, more pronounced with a general import surcharge than with targeted import protection.

4.3 Tariffs on Investment

It is widely recognized that the effect of a tariff crucially depends on whether it is a tariff on intermediate input demand, or a tariff on final demand. Trade theory has a long tradition of highlighting this difference. Thus, the so-called theory of effective protection tries to identify the effective protection implicitly granted to different sectors through a given structure of nominal tariffs which are simultaneously applied to final as well as intermediate input demand. However, in a dynamic world with capital accumulation, a similar distinction arises between different types of final demand, i.e., between investment demand and consumption demand. This type of distinction is less widely recognized in empirical trade policy evaluations, since it only arises in a dynamic context. As a final scenario, we therefore focus on a tariff elimination which selectively applies to investment demand. The motivation for such a policy might, for instance, lie in the desire to give trade liberalization a touch of investment promotion.

The steady state results obtained are summarized in the two final columns of table 3, and in figures 10 through 13. At first sight, the steady state macro effects for the base case appear to be simply down-scaled effects of a unilateral elimination of all tariffs (column 1 of table 3). However, closer inspection reveals two important differences. First, the expansionary effect on the capital stock is significantly larger for the investment policy than for general tariff cuts. And the acquisition price for capital now falls, relative to other prices in general, and most importantly relative to value added prices. Both differences are intuitive and need no further comment. The same goes for the difference between the base case and high export elasticity values which is entirely driven by the terms of trade effect. Notice that the terms of trade deterioration which takes place in the base case makes this type of investment promotion welfare reducing in the long-run, despite the sizable expansionary effect.[35]

Focusing on the introduction of tariffs on investment, Keuschnigg (1993) notes the possibility of an overshooting adjustment path of financial wealth due to the transitory life-cycle savings motive which is characteristic of Blanchard-type overlapping generations models. In the present case, such a motive only arises in the high elasticity case, since the base case has an almost stationary behavior of disposable wage income, apart from an anticipation effect. And for high elasticity values the transitory motive is towards dissavings, rather than savings, since we look at tariff cuts. Hence, households run down their financial wealth well below its new steady state value. The overshooting adjustment of financial wealth is taking place in an even more pronounced way in its foreign component, as evidenced in figure 13. Figure 12 reveals that overshooting also occurs, though to a much lesser extent, in the trade balance. The important thing to notice here is that all these overshooting phenomena do not require anticipation or gradualism in the way the tariff cut is implemented. They even arise for a simple once-and-for-all policy which takes agents by surprise.

5 Conclusion

What have we learned from applying our intertemporal CGE model to trade liberalization scenarios? We were able to address, in a quantitative way, a number of important issues that necessarily escape attention of static models. In addition to the familiar static efficiency effect, tariff liberalization generates incentives for increased investment, spurring economic growth in the medium-run, and leading to a higher long run capital stock. Whether or not such a medium term growth bonus also entails a welfare bonus is uncler

[35]It also reduces welfare for old generations and generations born during the transition. More details can be obtained upon request.

a priori. Duly taking into account that investment implies forgone consumption, and emphasizing overlapping generations on the household side, we find that trade liberalization tends to involve redistribution between different generations, mostly favoring future generations and partly also old generations who gain from windfall profits on their equity holdings at the time of policy change. As expected, the effects of liberalization very much depend on whether or not it is reciprocated by our trading partners. Multilateral liberalization avoids unfavorable terms of trade effects which we have observed for unilateral tariff cuts and, therefore, delivers a clear welfare gain for all generations, despite the intergenerational redistribution just mentioned. It also implies a markedly different dynamic adjustment, with much less intertemporal substitution than in the case of unilateral tariff cuts, if such cuts are anticipated and phased in gradually.

Dynamic models are particularly well suited to address issues of temporary protection which play an important role in policy debates. We find that such temporary policies imply relatively sharp intergenerational redistribution. Moreover, the intersectoral effect of targeting an individual industry for temporary protection are dominated in magnitude by intertemporal effects which are largely similar for all sectors. We have seen that periods of high temporary protection are mainly characterized by falling capital stocks, as firms try to evade high acquisition costs of capital. Temporary protection may entail positive welfare effects due to terms of trade improvements, but these very quickly vanish if the price elasticity of export demand is increased. Indeed, our results generally reveal that this elasticity is a crucial parameter, not only for welfare as one would expect from static theory, but also for the details of dynamic adjustment. This is most conspicuous for the case of a tariff cut which is selectively applied to investment demand only. Even absent any anticipation effects, adjustment of financial assets turns out to be highly non-monotonic if the price elasticity of export demand is very high.

A very important potential of our model which we have not mentioned so far is that it allows to consider alternative budgetary policies to accommodate the revenue consequences of commercial policies, including debt financing. Available space did not permit any detailed analysis in this chapter, so all we can do is simply point out here that our modeling experience suggests that budgetary policies are absolutely crucial for many effects. More details may be found in Keuschnigg and Kohler (1994b).

We close our chapter by returning to an important aspect that we have briefly mentioned at the outset: the role of commercial policy in a world of endogenous growth. Neither did we allow for the type of externalities that the recent literature on the convergence debate has emphasized, nor did we incoporate endogenous growth channels of the neo-Schumpeterian tradition which emphasizes elements of market power. Neo-Schumpeterian growth models, in particular, point to several entirely new dimensions along which commercial policy may importantly influence the evolution of the world economy [see Grossman and Helpman (1991)]. As yet, these dimensions still await empirical quantification on the basis of general equilibrium models. In the meantime, developing models like the one presented above, and applying these in various contexts may generate a stock of experience and tools of analysis, which will later on prove of significant value for quantification of endogenous growth aspects.

References

[1] Baldwin, Richard, 1989, "The Growth Effects of 1992", *Economic Policy,* 9, pp. 248-281.

[2] Baldwin, Richard, 1992, "Measurable Dynamic Gains From Trade", *Journal of Political Economy,* 100, 1, pp. 162-174.

[3] Baldwin, Richard, 1993, "On the Measurement of Dynamic Effects of Integration", *Empirica,* 20, pp. 129-146.

[4] Blachard, Olivier J., 1985, "Debt, Deficits, and Finite Horizons", *Journal of Political Economy,* 21, pp. 223-247.

[5] Blanchard, Olivier J. and Fischer, Stanley, 1989, *Lectures on Macroeconomics*, Cambridge/Mass.: MIT Press.

[6] Bovenberg, Lans A. and Goulder, Lawrence H., 1991, "Introducing Intertemporal and open Economy Features in Applied General Equilibrium Models", *De Economist,* 139, pp. 186-203.

[7] Brown, Drusilla K., 1992, "The Impact of a North American Free Trade Area: Applied General Equilibrium Models", *Discussion Paper, Research Forum on International Economics,* 311, Ann Arbor: Inst. of Public Policy Studies, Univ. of Michigan.

[8] Buiter, Willem H., 1988, "Death, Birth, Productivity Growth and Debt Neutrality", *Economic Journal,* 98, pp. 279-293.

[9] Deardorff, Alan V. and Stern, Robert M., 1986, *The Michigan Model of World Production and Trade*, Cambridge, Mass.: MIT Press.

[10] Eaton, Jonathan, 1989, "Monopoly Wealth and International Debt", *International Economic Review,* 30, pp. 33-48.

[11] Eichengreen, Barry and Goulder, Lawrence, 1991, "The Impact of Permanent and Temporary Import Surcharges on the U.S. Trade Deficit", in: Baldwin, Robert E. (ed.) *Empirical Studies of Commercial Policy,* Chicago: The University of Chicago Press, pp. 245-285.

[12] Engel, Charles and Kletzer, Kenneth, 1990, "Tariffs and Saving in a Model with New Generations", *Journal of International Economics,* 28, pp. 71–91.

[13] Francois Joseph F. et al., 1992, *Economy-Wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Canada and Mexico, USITC Publication 2516,* Washington D.C.: U.S. International Trade Commission.

[14] Francois, Joseph F. et al. (eds.), 1992, *Economy-Wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Canada and Mexico, USITC Publication 2508,* Washington D.C.: U.S. International Trade Commission.

[15] Francois, Joseph F. and Shiells, Clinton R., 1993, *The Dynamic Effects of Trade Liberalization: A Survey, USITC Publication 2608,* Washington, D.C.: U.S. International Trade Commission.

[16] Frenkel Jacob A. and Razin, Assaf, 1987, *Fiskal Policies and the World Economy,* Cambridge/Mass.: MIT Press.

[17] Gavin, Michael, 1990, "Structural Adjustment to a Terms of Trade Disturbance: The Role of Relative Prices", *Journal of International Economics,* 28, pp. 217–243.

[18] Gavin, Michael, 1991, "Tariffs and the Current Account. On the Macroeconomics of Commercial Policy", *Journal of Economic Dynamics and Control,* 15, pp. 27–52.

[19] Goulder, Lawrence and Eichengreen, Barry, 1989, "Savings Promotion, Investment Promotion, and International Competitiveness", in: R. Feenstra (ed.) *Trade Policies for International Competitiveness,* Chicago: University of Chicago Press, pp. 5–44.

[20] Goulder, Lawrence and Eichengreen, Barry, 1992, "Trade Liberalization in General Equilibrium: Intertemporal and Inter–Industry Effects", *Canadian Journal of Economics,* 25, pp. 253-280.

[21] Grossman, Gene M. and Helpman, Elhanan, 1991, *Innovation and Growth in the Global Economy*, Cambridge/Mass.: MIT Press.

[22] Grossman, Gene M. and Helpman, Elhanan, 1994, "Endogenous Innovation in the Theory of Growth", *Journal of Economic Perspectives,* 8, pp. 23-54.

[23] Hayashi, Fumio, 1982, "Tobin's Marginal q and Average q: A Neoclassical Interpretation", *Econometrica,* 50, pp. 213-224.

[24] Jorgensen, Dale W. and Ho, Mun S., 1993, "Trade Policy and U.S. Economic Growth", *Harvard Institute of Economic Research, Discussion Paper No. 1634.*

[25] Jorgensen, Dale W. and Wilcoxen, Peter J., 1990, "Intertemporal General Equilibrium Modeling of U.S. Environmental Regulation", *Journal of Policy Modeling,* 12, pp. 715–744.

[26] Kehoe, Timothy J., 1992, "Modeling the Dynamic Impact of North American Free Trade", in: Francois Joseph F. et al. (eds.) *Economy Wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Canada and Mexico,* Washington D.C.: U.S. International Trade Commission, pp. 249-276.

[27] Keuschnigg, Ch., 1991, "How to Compute Perfect Foresight Equilibria", *University of Bonn, Discussion Paper,* Bonn: Sonderforschungsbereich 303.

[28] Keuschnigg, Christian, 1994, "Overshooting Adjustment to Tariff Protection", *Research Memorandum No. 321,* Vienna: Institute for Advanced Studies.

[29] Keuschnigg, Christian and Kohler, Wilhelm, 1994a, "Modeling Intertemporal General Equilibrium: An Application to Austrian Commercial Policy", *Empirical Economics,* 19, pp. 131-164.

[30] Keuschnigg, Christian and Kohler, Wilhelm, 1994b, "Dynamic Effects of Tariff Liberalization: An Intertemporal CGE Approach", *Review of International Economics, forthcoming.*

[31] Krugman, Paul, 1982, "The Macroeconomics of Protection with a Floating Exchange Rate", *Carnegie–Rochester Conference Series on Public Policy,* 16, Amsterdam: North–Holland, pp. 141–182.

[32] Levy, Santiago and van Wijnbergen, Sweder, 1992, "Transition Problems in Economic Reform: Agriculture in the Mexico-U.S. Free Trade Agreement", in: Francois Joseph F. et al. (eds.) *Economy Wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Canada and Mexico,* Washington D.C.: U.S. International Trade Commission, pp. 299-357.

[33] Matsuyama, Kiminori, 1988, "Terms–of–Trade, Factor Intensities and the Current Account in a Life–Cycle Model", *The Review of Economics Studies,* 55, pp. 247–262.

[34] McCleery, Robert K., 1992, "An Intertemporal, Linked Macroeconomic CGE Model of the United States and Mexico Focussing on Demographic Change and Factor Flows", in: Francois, Joseph F. et al. (eds.) *Economy Wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Canada and Mexico,* Washington D.C.: U.S. International Trade Commission, pp. 369-441.

[35] Mercenier, Jean and Akitoby, Bernardin, 1993, "On Intertemporal General Equilibrium Reallocation Effects of Europe's Move to a Single Market", *Federal Reserve Bank of Minneapolis, Discussion Paper 87.*

[36] Pack, Howard, 1994, "Endogenous Growth Theory: Intellectual Appeal and Empirical Shortcomings", *Journal of Economic Perspectives,* 8, pp. 55-72.

[37] Romer, Paul, 1994, "The Origins of Endogenous Growth", *Journal of Economic Perspectives,* 8, pp. 3-22.

[38] Sen, Partha and Turnovsky, Stephen J., 1989, "Tariffs, Capital Accumulation, and the Current Account in a Small Open Economy", *International Economic Review,* 30, pp. 811–831.

[39] Solow, Robert M., 1994, "Perspectives on Growth Theory", *Journal of Economic Perspectives,* 8, pp. 45-54.

[40] Weil, Philippe, 1989, "Overlapping Families of Infinitely-Lived Agents", *Journal of Public Economics,* 38, pp. 183-198.

[41] Whalley, John and Yeung, Bernard, 1984, "External Sector 'Closing' Rules in Applied General Equilibrium Models", *Journal of International Economics,* 16, pp. 123–138.

[42] Wilcoxen, Peter J., 1989, "A Fast Algorithm for Solving Rational Expectations Models", *University of Melbourne, Impact Research Centre.*

[43] Young, Leslie and Romero, Jose, 1992, "Steady Growth and Transition in a Dynamic Dual Model of the North American Free Trade Agreement", in: Francois, Joseph F. et al. (eds.) *Economy Wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Canada and Mexico,* Washington D.C.: U.S. International Trade Commission, pp. 675-691.

Table 1: Basic Parameters

x	productivity growth rate	0.025
n	population growth rate	0.010
θ	probability of death	0.060
ρ	**subjective rate of time preference**	0.006
γ	intertemporal elast. of substitution	0.800
α	**share of commodity cons. in v**	0.722
r	world interest rate	0.055
δ	depreciation rate	0.150
ψ	adjustment cost parameter	10.000
t_y	marginal income tax rate	0.200
e_i	**investment expensing rate**	0.400

Legend: Bold faced parameters have been calibrated, the rest was taken from extraneous sources (see text and appendix).

Table 2: Sectoral Features of Benchmark Data Set and Parameters

	Sector		VA	TAR	TAR*	Imports	Exports	σ
1	Agriculture & Forestry	Agr/For	10.579	6.758	1.743	3.120	1.156	1.413
2	Mining	Min/Quar	1.211	1.280	0.501	1.886	0.691	0.551
3	Foodstuff	Food	6.769	5.384	5.856	2.858	2.361	0.797
4	Textiles & Clothing	Tex/Clot	5.238	4.922	3.774	7.131	5.892	1.581
5	Wood & Wood Processing	Wood	4.349	2.648	2.128	1.812	3.684	0.969
6	Paper & Paper Processing	Paper	4.210	3.316	3.622	2.378	3.224	1.905
7	Chemicals (excl. Petroleum)	Chemic	5.708	2.261	5.141	8.296	5.952	1.065
8	Petroleum	Petrol	0.939	1.751	3.282	5.221	0.557	1.046
9	Non-ferrous Minerals	Nonferr	3.916	2.911	3.218	1.409	1.176	1.596
10	Basic Metals	MetProd	5.428	1.720	2.111	4.226	5.604	2.012
11	Metal Processing	MetProc	21.403	2.536	3.972	23.858	18.305	1.712
12	Energy & Water Supply	Energy	6.461	0.000	0.000	0.150	0.660	0.440
13	Construction	Constr	18.145	0.000	0.000	0.000	0.218	1.100
14	Commerce	Trade	27.581	0.000	0.000	1.072	3.864	0.100
15	Hotels & Restaurants	Hot/Cat	5.504	0.000	0.000	0.195	7.837	0.100
16	Transport & Communication	Trans	10.452	0.000	0.000	0.758	2.844	0.100
17	Banking, Insur. & Real Est.	RealEst	17.606	0.000	0.000	0.487	0.902	0.100
18	Other Services	OthSer	11.060	0.000	0.000	1.049	0.520	0.100
19	Public Services	Public	28.152	0.000	0.000	0.000	0.016	0.100

Legend: All flow magnitudes have been scaled down so as to yield a total labor supply of 100. VA is value added, TAR denotes average domestic tariff rates, while TAR* denotes average foreign tariff rates. σ denotes the elasticity of substitution between home goods and imports, taken from extraneous econometric sources (see appendix).

Table 3: Long Run Macro Effects

Variables, changes in %		UNIL	TOKYO	MULTILAT. BASE	MULTILAT. HIGH	INVESTMENT BASE	INVESTMENT HIGH
p^v	full price index	-2.437	-0.049	0.076	2.126	-0.404	-0.045
p^c	consumption p.i.	-2.506	-0.156	-0.467	1.190	-0.410	-0.118
p^I	investment p.i.	-2.163	0.009	-0.059	1.652	-0.855	-0.556
$\bar{p}$	terms of trade	-2.090	0.066	0.332	2.310	-0.435	-0.091
z	gov. transfers	-6.035	-0.378	-1.577	1.457	-0.921	-0.216
w	wage rate	-2.258	0.228	1.504	4.601	-0.390	0.144
y	disp. wage income	-3.152	0.072	0.706	3.723	-0.514	0.051
C	commodity cons.	-0.662	0.228	1.179	2.504	-0.105	0.169
L^s	labor supply	0.610	0.103	0.524	0.559	0.083	0.062
K	Capital Stock	0.373	0.213	1.438	1.882	0.425	0.639
EV	welfare change	-0.732	0.122	0.629	1.564	-0.110	0.096
A	financial wealth	-3.152	0.072	0.706	3.723	-0.514	0.051
V	firm values	-1.538	0.209	1.318	3.307	-0.326	0.132
D^G	government debt	0.000	0.000	0.000	0.000	0.000	0.000
D^F	net foreign assets	-1.613	-0.137	-0.612	0.416	-0.189	-0.081

Legend: Lower part of table reports changes of variables in percent of initial financial wealth. $\bar{p}$: Terms of Trade variable defined as a weighted average of domestic producer price changes with sectoral export shares serving as weights. EV: Equivalent wealth variation. UNIL: Unilateral removal of all tariff rates. TOKYO: Tokyo-round tariff cuts. MULTILAT.: Multilateral removal of all tariff rates. INVESTMENT: Investment promotion through selsective removal of tariffs on investment demand. BASE: Base case elasticities of export demand. HIGH: Base case export price elasticities scaled up by factor of 5.

Table 4: Long Run Industrial Effects: Multilateral Tariff Removal

	Sector	p^d	$\tilde{p}$	V	K	L	C^d	C^m	I^d	I^m	E
1	Agr/For	0.120	0.152	0.400	0.416	-0.522	-0.260	10.235	0.919	13.884	3.122
2	Min/Quar	0.816	1.200	1.762	1.560	0.790	1.796	5.862	0.559	0.000	-0.049
3	Food	0.179	1.073	1.786	1.611	0.417	0.640	5.957	1.197	0.000	3.904
4	Tex/Clot	-0.103	1.233	3.509	3.297	1.764	-0.497	8.477	1.320	11.171	5.614
5	Wood	0.357	1.076	2.579	2.401	1.082	0.381	3.349	1.022	4.769	2.918
6	Paper	0.190	1.113	2.381	2.196	0.855	-0.700	4.022	1.186	0.000	4.161
7	Chemic	0.165	0.996	6.998	6.831	5.491	0.388	4.904	1.206	6.814	14.190
8	Petrol	-0.075	1.017	1.183	1.020	0.252	0.726	9.021	1.401	11.811	0.252
9	Nonferr	0.599	0.974	1.700	1.545	0.018	-1.357	7.647	0.767	8.491	3.724
10	MetProd	0.411	1.196	3.371	3.167	1.469	-0.524	1.992	-0.240	7.012	4.067
11	MetProc	.0.306	1.036	3.011	2.841	1.934	-0.845	4.501	-0.078	4.612	5.536
12	Energy	0.416	0.603	1.200	1.122	0.565	0.293	0.476	0.959	0.000	-0.141
13	Constr	0.567	0.914	1.182	1.040	0.541	0.138	0.000	0.807	0.000	-0.845
14	Trade	0.623	0.752	1.338	1.229	-0.264	0.082	0.000	0.751	0.000	-0.927
15	Hot/Cat	0.451	0.733	0.580	0.476	-1.006	0.253	0.000	0.923	0.000	-0.673
16	Trans	0.879	1.257	1.790	1.576	0.089	-0.172	0.000	0.495	0.000	-1.305
17	RealEst	0.514	0.455	1.087	1.040	-0.457	0.191	0.000	0.000	0.000	-0.766
18	OthSer	0.740	0.942	1.351	1.203	-0.285	-0.030	0.043	0.719	0.793	-1.099
19	Public	1.199	1.199	1.465	1.263	-0.220	-0.487	0.000	0.178	0.000	-1.771

Legend: p^d: Domestic prices. $\tilde{p}$: Value added prices. V: Firm values. K: Sectoral capital stock. L: Labor demand. C^d: Consumption demand domestic goods. C^m: Consumption demand for imported goods I^d: Investment demand for domestic goods. I^m: Investment demand for imported goods. E: Exports.

Multilateral versus Unilateral Tariff Liberalization

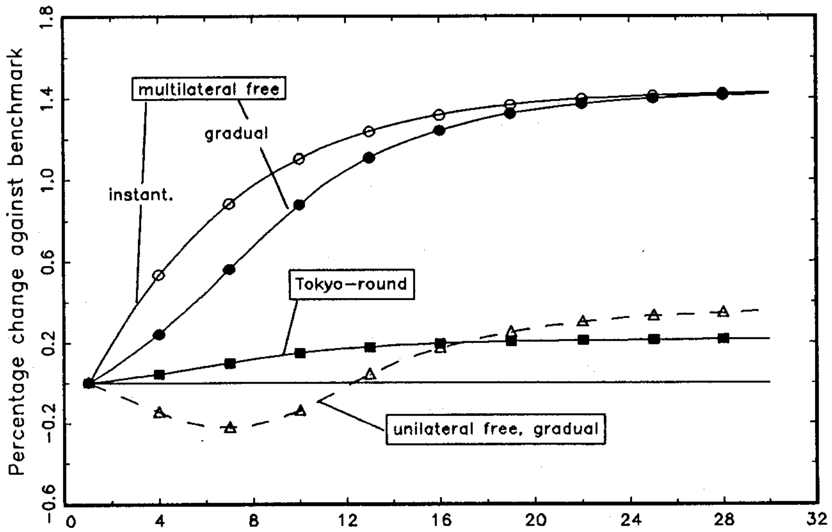


Figure 1: Aggregate Capital Stock

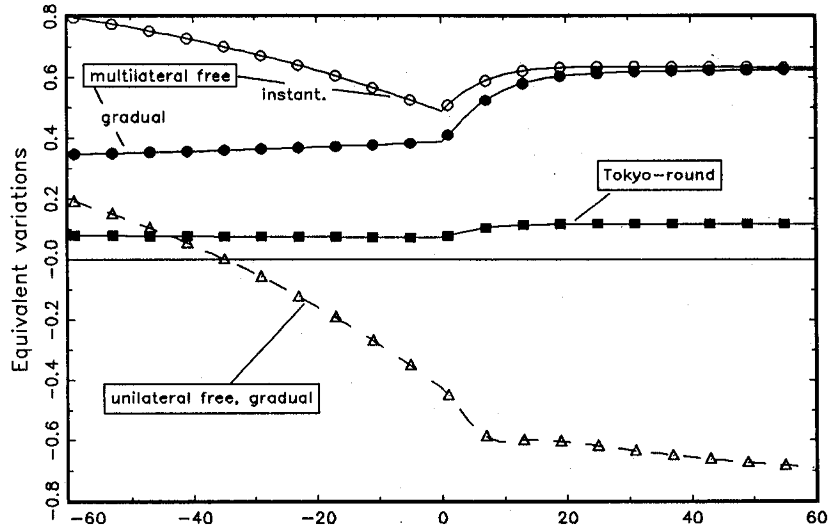


Figure 2: Generational Welfare Accounting

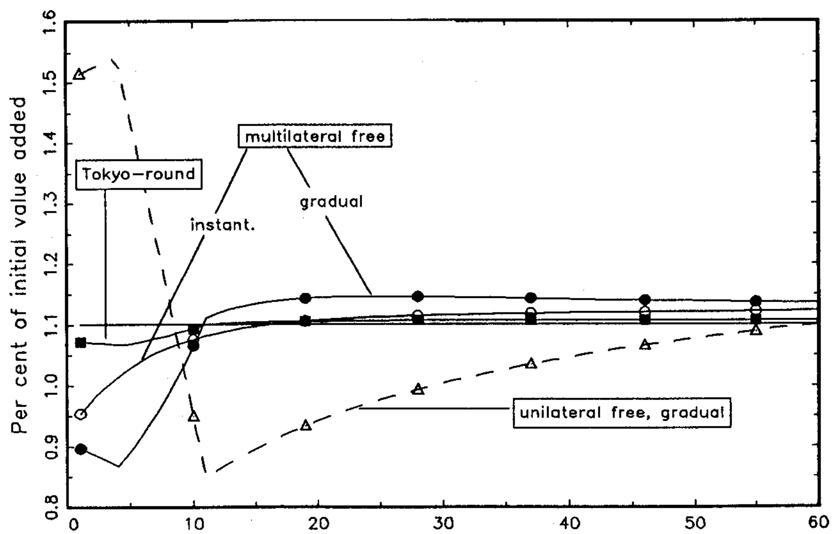


Figure 3: Trade Balance

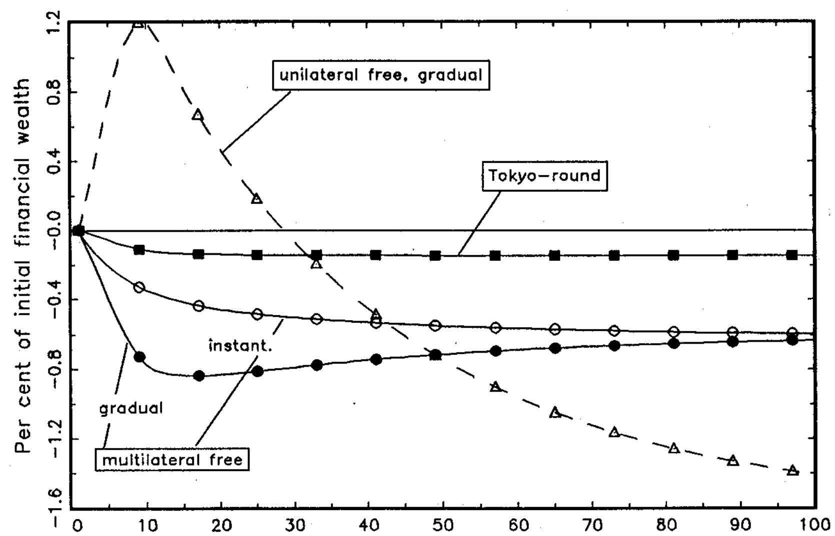
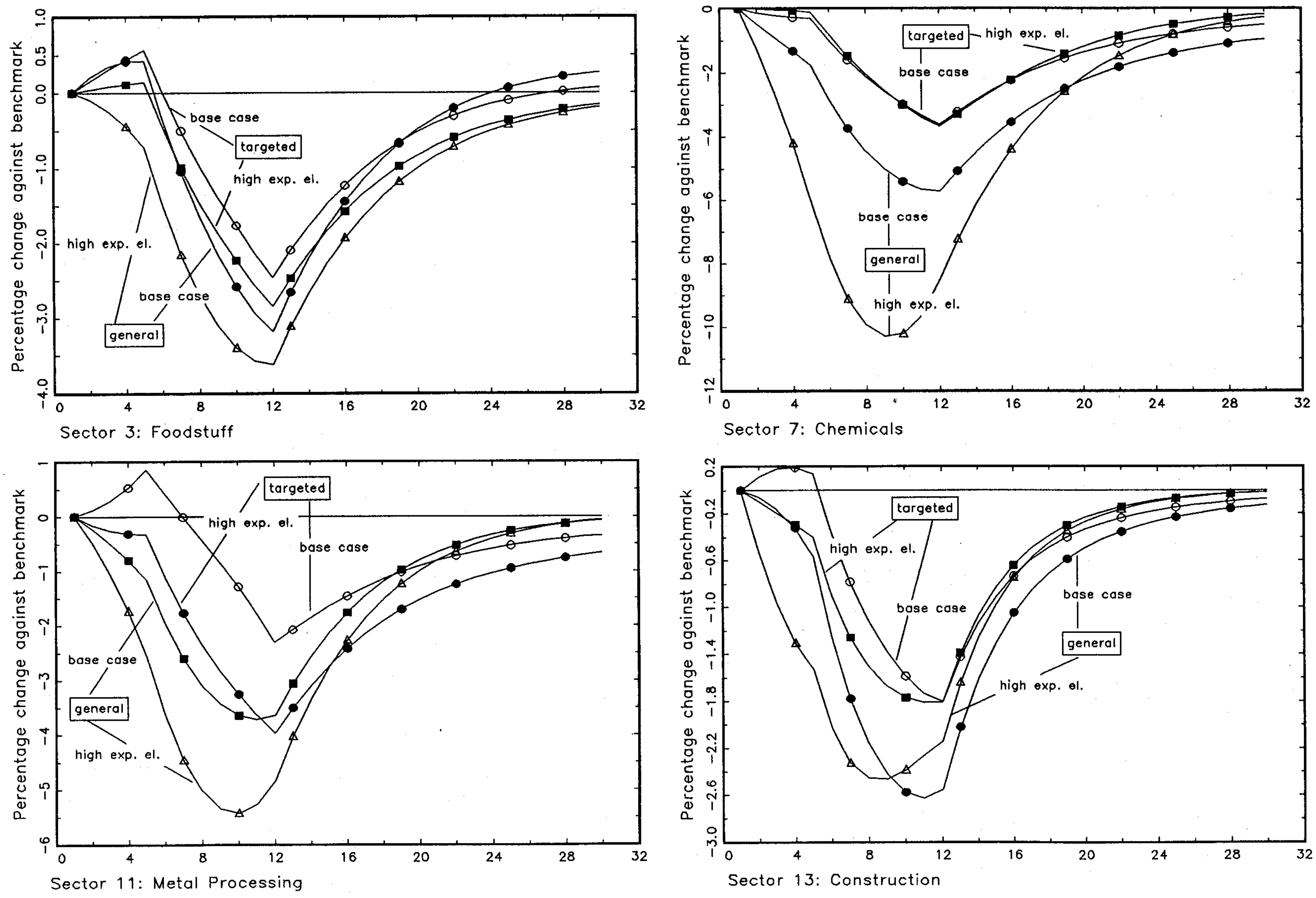


Figure 4: Change in Net Foreign Assets

Fig. 5: Sectoral Capital Stocks and Temporary Protection



Dynamics of Temporary Protection

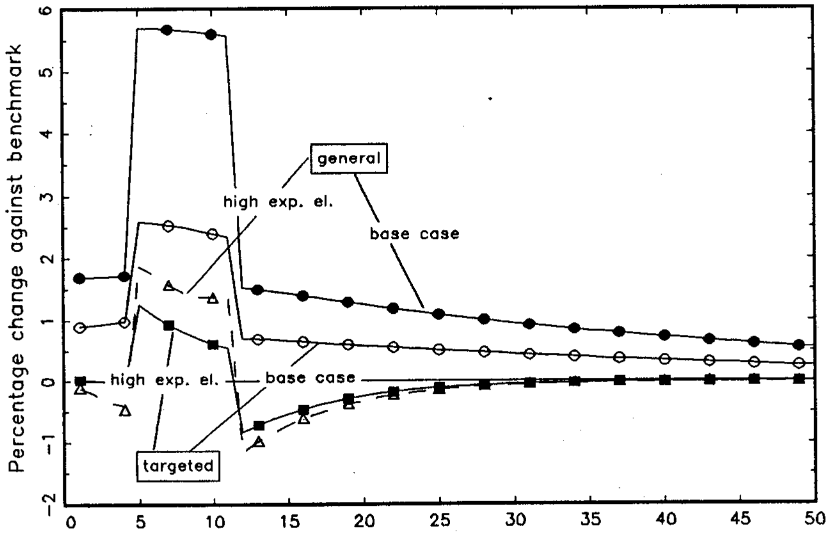


Figure 6: Disposable Wage Income

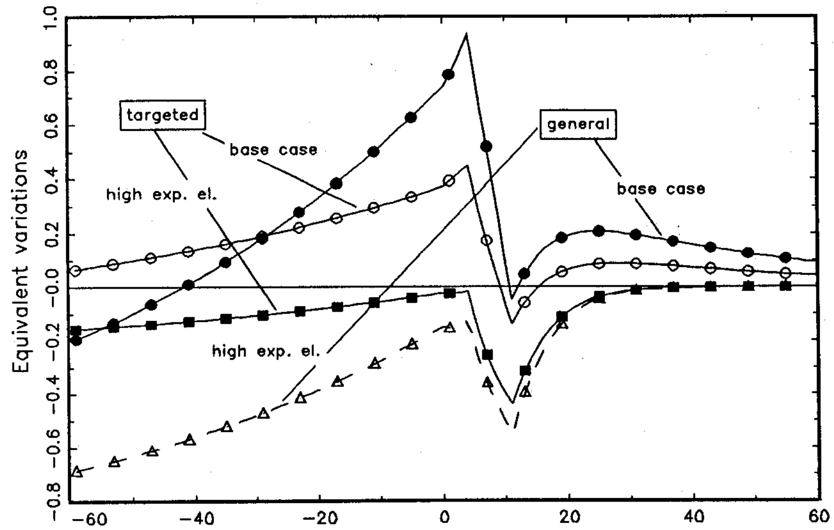


Figure 7: Generational Welfare Accounting

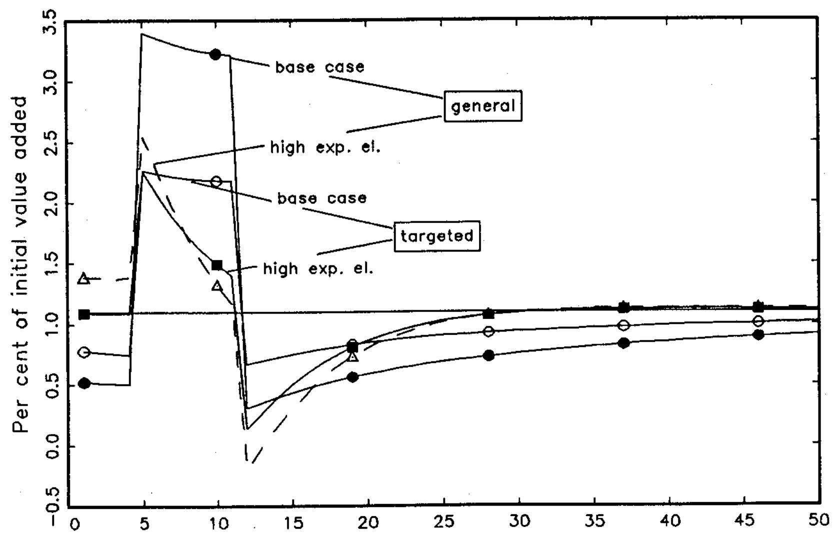


Figure 8: Trade Balance

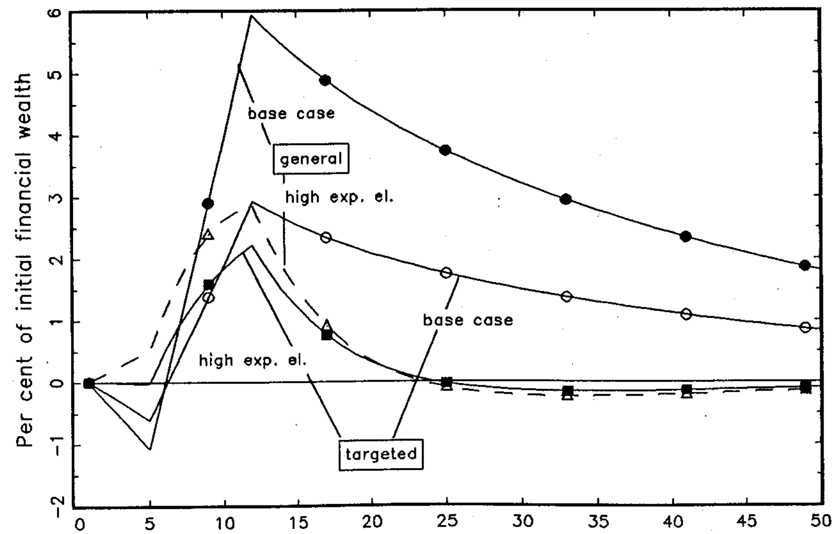


Figure 9: Change in Net Foreign Assets

Tariff Cuts on Investment Demand

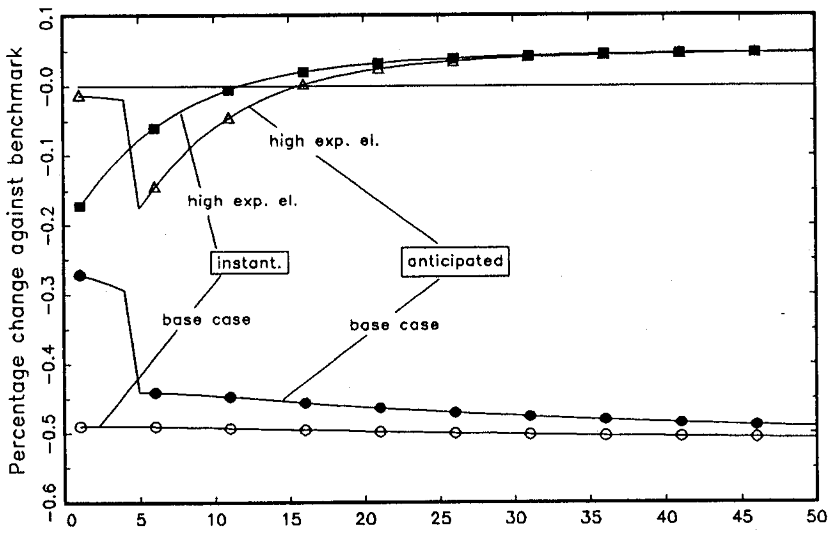


Figure 10: Disposable Wage Income

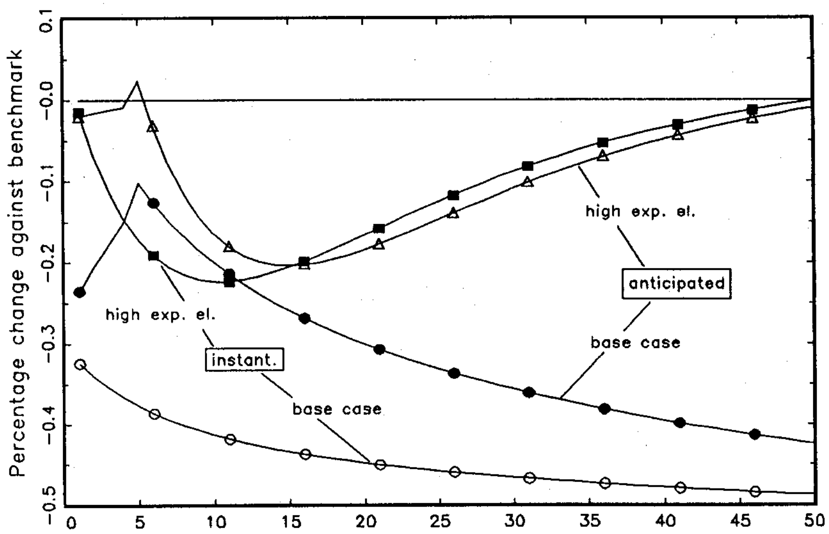


Figure 11: Financial Wealth

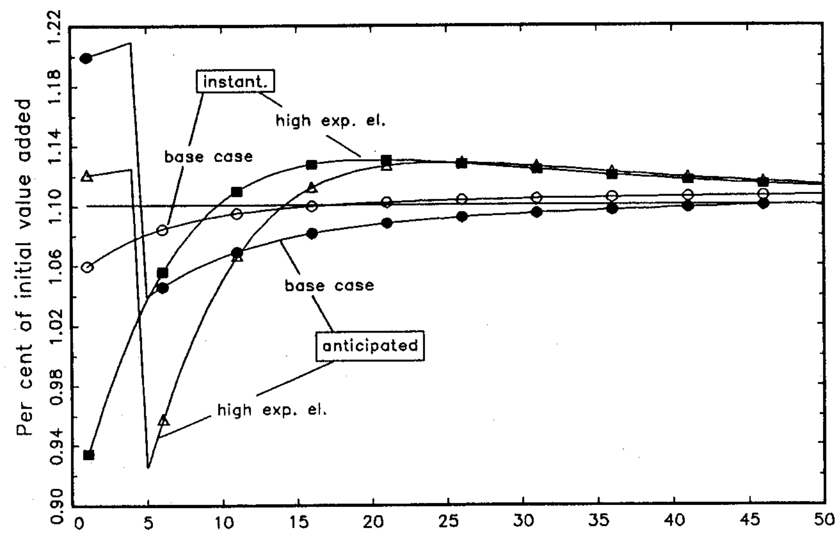


Figure 12: Trade Balance

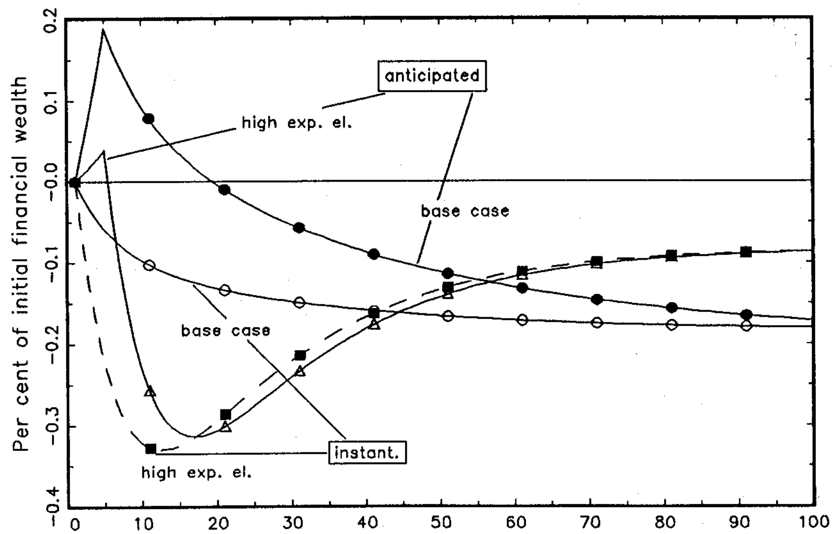


Figure 13: Change in Net Foreign Assets

Publikationen des Instituts für Höhere Studien

Publications of the Institute for Advanced Studies

Herausgeber, Verleger und Eigentümer / Corporate Editor, Publisher:
Institut für Höhere Studien / Institute for Advanced Studies
Stumpergasse 56, A-1060 Wien, Tel.: +43-1-599 91-0, Fax: +43-1-597 06 35

Bestellungen / Order:
Institut für Höhere Studien, Bibliothek
Stumpergasse 56, A-1060 Wien, Tel.: +43-1-599 91-0, Fax: +43-1-597 06 35,
e-mail: nessler@ihssv.wsr.ac.at

Individuals: ATS 80
Institutions: ATS 250
Subscription of 10 Papers
Individuals: ATS 550
Institutions: ATS 1700

Bankverbindung / Bank:
Creditanstalt Bankverein, Konto-Nummer: 23-74247
Bank Austria, Konto-Nummer: 236-102-694/00

PUBLICATIONS OF THE INSTITUTE FOR ADVANCED STUDIES

A. Forschungsberichte/Research Memoranda (no longer published).

B. Reihe Ökonomie/Economics Series

C. Reihe Osteuropa/East European Series

D. Reihe Politikwissenschaft/Political Science Series

E. Reihe Soziologie/Sociological Series

F. Sonderdrucke/Reprints

Reprints will be sent free of charge.

G. Sonderpublikationen/Special Studies Series (no longer published).

H. Workshop-Proceedings

I. Institutsarbeiten - Economic Forecasts

Inquiries should be sent to the director's office of the Institute for Advanced Studies.

J. Journal - Empirical Economics

A Quarterly Journal of the Institute for Advanced Studies, published by Physica Verlag.

Forschungsberichte/Research Memoranda

No. 312	URL, Thomas	Do Austria And Germany Form An Optimum Currency Area? January 1993.
No. 313	SCHMEIKAL, Bernd	Space-Time Sociology. January 1993.
No. 314	SCHIENSTOCK, Gerd TRAXLER, Franz	Economic Transformation and Institutional Change. A Cross-national Study in the Conversion of Union Structures and Politics in Eastern Europe. February 1993.
No. 315	KEUSCHNIGG, Christian KOHLER, Wilhelm	Dynamic Effects of Tariff Liberalization: An Intertemporal CGE Approach. February 1993.
No. 316	RAZIN, Assaf SADKA, Efraim	Interactions between International Migration and International Trade: Positive and Normative Aspects. February 1993.
No. 317	PICHELMANN, Karl RIEDEL, Monika	Unemployment Duration and the Relative Change in Individual Earnings: Evidence from Austrian Panel Data. March 1993.
No. 318	BANERJEE, Abhijit WEIBULL, Jörgen W.	Evolutionary Selection with Discriminating Players. March 1993.
No. 319	STARK, Oded	Nonmarket Transfers and Altruism. April 1993.
No. 320	BERGSTROM, Theodore C. STARK, Oded	How Altruism Can Prevail in an Evolutionary Environment. April 1993.
No. 321	KEUSCHNIGG, Christian	Overshooting Adjustment to Tariff Protection. May 1993.
No. 322	HAUSER, MICHAEL A. KUNST, Robert M.	Fractionally Integrated Models With ARCH Errors. May 1993.
No. 323	HOFER, Helmut WÖRGÖTTER, Andreas	Regional Convergence in Austria. May 1993.
No. 324	RITZBERGER, Klaus WEIBULL, Jörgen W.	Evolutionary Selection in Normal Form Games. June 1993.
No. 325	FLECKER, Jörg SCHIENSTOCK, Gerd	Globalisierung, Konzernstrukturen und Konvergenz der Arbeitsorganisation. Juni 1993.
No. 326	KEUSCHNIGG, Christian	The Vanishing Savings Motive. June 1993.
No. 327	RÜNSTLER, Gerhard	An Analysis of Austrian Output Growth at a Sectoral Level. July 1993.

No. 328	GALOR, Oded STARK, Oded	Life Expectancy, Human Capital Formation, and Per-Capita Income. July 1993.
No. 329	PICHELMANN, Karl	Hysteresis in Unemployment: A Quick Refresher Note. July 1993.
No. 330	HSU, Chien-Te	Stock Markets Efficiency and Volatility Tests: A Survey. July 1993.
No. 331	HOFER, Helmut RÜNSTLER, Gerhard URL, Thomas	The Dynamic Effects of Aggregate Demand and Supply Disturbances: Further Evidence. July 1993.
No. 332	MÜLLER, Karl H. STEINER, Josef S. TOBIL, Friedrich TSCHARE, Georg	Wissenschaft als System. Von der Black Box zum Black Hole - und retour ... ? Juli 1993.
No. 333	ALT, Raimund	A Sequential Variance Ratio Test Based on the Closure Test Principle. September 1993.
No. 334	HELMENSTEIN, Christian YEGOROV, Yury	The Dynamics of Migration in the Presence of Chains. September 1993.
No. 335	KUNST, Robert M.	Fourth-Moment Structures in Financial Time Series. October 1993.
No. 336	NATTER, Martin BUCHTA, Christian	Measuring Demand Interdependencies by Neural Networks. November 1993.
No. 337	HELMENSTEIN, Christian	Anbieterkonzentration auf dem Markt für Jahresabschlußprüfungen. Januar 1994.
No. 338	STARK, Oded	The Dynamics of Labor Migration When Workers Differ in Their Skills and Information is Asymmetric. January 1994.
No. 339	ALT, Raimund	Zur Beziehung zwischen Barwertmodell, Fair Game Modell und Martingalmodell. Eine Übersicht. Jänner 1994.
No. 340	HEIJDRA, Ben J. VAN DER PLOEG, Frederick	Keynesian Multipliers and the Cost of Public Funds Under Monopolistic Competition. February 1994.
No. 341	THALMANN, Philippe GOULDER, Lawrence H. DELORME, Francois	Assessing the International Spillover Effects of Capital Income Taxation. April 1994.
No. 342	RITZBERGER, Klaus	A Note on Games under Expected Utility with Rank Dependent Probabilities. April 1994.

No. 343	DEHEJIA, Vivek H.	Income Distribution and the Limits to Policy Reform. Shock Therapy or Gradualims? May 1994.
No. 344	BOVENBERG, A. Lans de MOOIJ, Ruud A.	Environmental Tax Reform and Endogenous Growth. June 1994.
No. 345	BRANDEL, Franz HOFER, Helmut PICHELMANN, Karl	Verdrängungsprozesse am Arbeitsmarkt. Juni 1994.
No. 346	BÖHM, Bernhard KOMAN, Reinhard RAGACS, Christian	Export-led Growth in the Former CMEA Countries? An Empirical Investigation for Eastern Europe. July 1994.
No. 347	SUMMER, Martin	Principal-Agent Problems from a Game-theoretic Viewpoint. July 1994.
No. 348	HSU, Chien-Te KUGLER, Peter	Nonlinear Dynamics of Spot and Forward Exchange Rates. An Application of a Seminonparametric Estimation Procedure. July 1994.
No. 349	KEUSCHNIGG, Christian KOHLER, Wilhelm	Commercial Policy and Dynamic Adjustment Under Monopolistic Competition. August 1994.
No. 350	KEUSCHNIGG, Christian KOHLER, Wilhelm	Dynamics of Trade Liberalization. August 1994.
No. 351	HÄFKE, Christian HELMENSTEIN, Christian	IPOX - An Initial Public Offerings IndeX. September 1994.
No. 352	FELDERER, Bernhard RIPPIN, Wolfgang	Inflation, Real Estate and Stock Prices: Evidence from West-Germany. December 1994.

Reihe Ökonomie - Economics Series

No. 1	KEUSCHNIGG, Christian NIELSEN, Soren Bo	Housing Markets and Vacant Land. December 1994.
No. 2	HUBER, Peter	Random Walks in Stock Exchange Prices and the Vienna Stock Exchange. January 1995.
No. 3	KESER, Claudia	Voluntary Contributions to a Public Good When Partial Contribution is a Dominant Strategy. January 1995.

The following IAS studies on Eastern Europe and the NIS have been recently published

number of copies

Country Reports:

- ☐ The Slovak Republic*, 19 tables, 5 figures, 36 pp., May 1993
- ☐ Many-faced Russia: The Impact of Transition on the Russian Regions, 5 tables, 3 graphics, 64 pp., September 1993
- ☐ The Czech Republic, More than Prague, 53 tables, 12 figures, 103 pp., January 1994
- ☐ The Slovak Republic: After One Year of Independence, 52 tables, 12 figures, 125 pp., July 1994
- ☐ Romania, 45 tables, 10 figures, 100 pp., September 1994
- ☐ Bulgaria: Recent Economic Development and Prospects, 36 tables, 10 figures, 80 pp., November 1994
- ☐ Slovenia**
- ☐ Kazakhstan**

* Reprint, September 1994
** To be published in fall 1994

ORDER FORM

Please order your copy/copies:

INSTITUTE FOR ADVANCED STUDIES
Department of Economics
Stumpergasse 56, A-1060 Vienna, Austria

Phone: 0043 (1) 59 991 – 154
Fax: 0043 (1) 59 991 – 163
e-mail: isa@ihssv.wsr.ac.at

NAME: ....

INSTITUTION: ....

ADDRESS: ....

....

Price for one copy: US$ 30,– includes postage and packing (orders from Austria AS 250,–).

Advance payment required! Please transfer appropriate amount to the Institute for Advanced Studies account number: 23610269400, **Bank Austria** 12000, Vienna

....
Date   Signature

INSTITUTE
FOR
ADVANCED STUDIES

East European Series

No. 1 Vladimir GLIGOROV
"Gradual Shock Therapy", 22 pp., January 1994

No. 2 Alexander I. YASTREMSKY
"A Simulation of Structural Changes in the Economy of the Regions Affected by the Chernobyl Catastrophe", 22 pp., February 1994

No. 3 Mark DUTZ and James SILBERMAN
"Building Capabilities: A Marshall Plan Type Productivity Enhancement Program for Eastern Europe and the Former Soviet Union", 15 pp., February 1994

No. 4 Theresia THEURL
"Experiences With Monetary Reform in Western European Countries With Differing Levels of Development", 30 pp., April 1994

No. 5 Vladimir TITKOV and Andreas WÖRGÖTTER
"Inflation in the Russian Federation: Dynamics and Causes", 41 pp., April 1994

No. 6 Edmond LEKA
"Power Industry in Albania and its Way Through the Reform to Market Economies", 50 pp., June 1994

No. 7 Larisa LESHCHENKO
"Privatizing Ukraine — Will the Ukrainian People Become Richer?", 12 pp., July 1994

No. 8 Pavol OCHOTNICKÝ and Jana KOHÚTOVÁ
"Regional Unemployment and Employment Policy in Slovakia", 18 pp., July 1994

No. 9 Irina S. SEMENOVA and Andreas WÖRGÖTTER
"Test of the Monetary Model for the Case of Russia, 1992–1993 and Germany 1991–1993", 16 pp., September 1994

No. 10 Andrij HALUSHKA, Sergei SAVLUK, and Andreas WÖRGÖTTER
"Ukrainian Hyperinflation: History, Analysis, Recommendations", 29 pp., September 1994

No. 11 Christof RÜHL and Kenneth SERWIN
"The A, B, C's of Industrial Restructuring in Russia", 22 pp., September 1994

No. 12 Edward E. LEAMER
"Models of Transition in Eastern Europe With Untransferable Eastern Capital", 23 pp., October 1994

No. 13 Martina LUBYOVA and Jan van OURS
"The Matching Process in Labour Markets in Transition", 44 pp., November 1994

No. 14 Andrij A. HALUSHKA
"Presidential Elections and Structure of Industry in Ukraine", 11 pp., December 1994

No. 15 Serguei E. GRIGORIEV, Serguei A. NAGAEV, Andreas WÖRGÖTTER
"Regional Economic Development and Political Attitudes of the Population of Russia: Results for the December 1993 Federal Elections", 55 pp., December 1994

INSTITUTE
FOR
ADVANCED STUDIES

East European Series

No. 16 Andrij A. HALUSHKA and Irina S. SEMENOVA
"Foreign Exchange Markets for Ukrainian Karbovantsi in Russia and for Russian Rubles in Ukraine: Analysis of Development in 1993–1994",
57 pp., January 1995

ORDER FORM

IAS Library, Stumpergasse 56, A-1060 Vienna
Phone: 0043 (1) 59991 – 237 Fax: 0043 (1) 5970635

NAME: ....

INSTITUTION: ....

ADDRESS: ....

....

		number of copy/copies	paper No.
Individual copies:			
Private persons:	AS 80,–	□□	□□
Institutions:	AS 250,–	□□	□□
Subscription of 10 papers:			start with paper No.
Private persons:	AS 550,–		□□
Institutions:	AS 1.700,–		□□

Advance payment required! Please transfer appropriate amount to the Institute for Advanced Studies account number: 23610269400, **Bank Austria** 12000, Vienna

....
Date

....
Signature

Institut
für
Höhere Studien
Reihe Politikwissenschaft

1 **Josef Melchior**
Postmoderne Konflikte um den Konsensus-Begriff
Zum »Widerstreit« zwischen Lyotard und Habermas
Oktober 1992

2 **Andreas Schedler**
Die Funktionsbedingungen konzertierter Politik
Überlegungen zu Lateinamerika
November 1992

3 **Renate Martinsen und Josef Melchior**
»Landnahme«
Eine kritische Evaluation sozialverträglicher Technikgestaltung
in Nordrhein-Westfalen
Dezember 1992

4 **Bernhard Kittel**
Die Selbstbeschreibung der Gesellschaft
Der Begriff der Nation als missing link *der Systemtheorie?*
Januar 1993

5 **Hans Glatz**
Der Industriekomplex »Schienentransportsysteme«
Chancen für eine neue Dynamik in einer »alten« Industrie
Februar 1993

6 **Agnes Heller**
The Limits to Natural Law
and the Paradox of Evil
April 1993

7 **Andreas Schedler**
Das empirische Profil der »Politikverdrossenheit«
Ein Annäherungsversuch (auf der Grundlage
von Austrian Life Style 1992*)*
April 1993

8 **Rainer Bauböck**
Integration in a Pluralistic Society
Strategies for the Future
Mai 1993

9 **David F.J. Campbell**
Strukturen und Modelle der F&E-Finanzierung
in Deutschland: eine Policy-Analyse
September 1993

10 **Philippe C. Schmitter**
Some Propositions about Civil Society
and the Consolidation of Democracy
September 1993

11 **Rogers Brubaker**
National Minorities, Nationalizing States, and External National Homelands in the New Europe Notes toward a Relational Analysis
Dezember 1993

12 **Kenneth Newton / Augusti Bosch**
The Economic Basis of Attitudes towards the European Community: Familiarity Breeds Content?
April 1994

13 **Georg Aichholzer / Renate Martinsen / Josef Melchior**
Österreichische Technologiepolitik auf dem Prüfstand
Mai 1994

14 **Martin Rein**
Solidarity Between Generations
A Five-Country Study of the Social Process of Aging
September 1994

15 **James Johnson**
The Politics of Possibility
Symbol, Strategy and Power
Oktober 1994

16 **Philip Resnick**
Democractic Savety Valves. The Therapeutic Effects of Antipolitical Referenda
Oktober 1994

17 **Dilek Çinar**
From Aliens to Citizens
A Comparative Analysis of Rules of Transition
November 1994

18 **Rainer Bauböck**
Gibt es ein Recht auf Einwanderung?
November 1994

19 **Claus Offe**
Designing Institutions for East European Transitions
November 1994

20 **Jean Blondel**
Party Government: Myth or Reality?
Dezember 1994

Institut
für
Höhere Studien
Reihe Soziologie

1 Angelika Volst (Hrsg.)
Information und Macht
Preceedings
ad-hoc Gruppe am 13. Österreichischen
Kongreß für Soziologie
25.-27.11.1993 in Klagenfurt
November 1993

2 Lorenz Lassnigg (Hrsg.)
Hochschulreformen in Europa:
Autonomisierung,
Diversifizierung,
Selbstorganisation
Dezember 1993

3 Karl H. Müller
Zement und Gesellschaft
Modernisierungsskizzen
aus dem Geist Karl Polanyis
April 1994

4 Karl H. Müller
**Von den Einheits-Wissenschaften
zu den Wissenschafts-Einheiten**
250 Jahre moderne Wissenschafts-
Synthesen
Juli 1994

5 Andrea Leitner
Rationalität im Alltagshandeln
Über den Erklärungswert der Rational
Choice-Theorie für systematische
Antwortverzerrungen im Interview
September 1994

6 Christoph Hofinger
**Entwurf eines Mastergleichungs-
modells zur Beschreibung der
Dynamiken bei den
österreichischen National-
ratswahlen 1970 bis 1990**
Oktober 1994

Sonderdrucke - Reprints

No. 1 CAMPBELL, David: Der politische Paradigmenbruch. Bürgerinitiativen und Volksabstimmungen als demokratiepolitische Phänomene. September 1991.
Sonderdruck aus: SWS-Rundschau, 31. Jg., Heft 2, 1991, S. 211-222.

No. 2 LASSNIGG, Lorenz: The "New Values" and Consumer Behaviour. Some Empirical Findings From Austria. November 1991.
Reprint from: Klaus G. Grunert and Folke Ölander (Eds.): Understanding Economic Behaviour. Theory and Decision Library. Series A: Philosophy and Methodology of the Social Sciences, Dordrecht, Boston, London, Kluwer Academic Publishers, 1989, pp. 333-345.

No. 3 AICHHOLZER, Georg - FLECKER, Jörg - SCHIENSTOCK, Gerd: Ungewißheit und Politik in betrieblichen Rationalisierungsprozessen. Dezember 1991.
Sonderdruck aus: Georg Aichholzer, Gerd Schienstock (Hg.): Arbeitsbeziehungen im technischen Wandel. Neue Konfliktlinien und Konsensstrukturen, Berlin, Edition SIGMA, 1989, S. 43-69.

No. 4 AICHHOLZER, Georg: Technischer Wandel als kultureller 'Trendsetter'?. Jänner 1992.
Sonderdruck aus: Josef Hochgerner, Arno Bammé (Hg.): Technisierte Kultur, Beiträge zur Soziologie der Technik, Österreichische Zeitschrift für Soziologie, Sonderheft 1, 1989, S. 13-28.

No. 5 LASSNIGG, Lorenz - PECHAR, Hans: Bildung und Strukturwandel. Institutionelle Aspekte im internationalen Vergleich. Juni 1992.
Sonderdruck aus: Josef Schmee, Lorenz Lassnigg, Hans Pechar (Hrsg.), u.a.: Strukturwandel und Bildung. Zusammenhang zwischen technischem Fortschritt und Qualifizierung der Beschäftigten in Verbindung mit dem Einsatz neuer Technologien. Schriftenreihe des Ludwig Boltzmann-Institutes für Wachstumsforschung, Band 14, 1992, S. 224-289.

No. 6 CAMPBELL, David F.J.: Die Dynamik der politischen Links-rechts-Schwingungen in Österreich. Die Ergebnisse einer Expertenbefragung. März 1993.
Sonderdruck aus: Österreichische Zeitschrift für Politikwissenschaft, 21. Jg., Heft 2, 1992, S. 165-179.

No. 7 MARTINSEN, Renate: Theorien politischer Steuerung. Auf der Suche nach dem Dritten Weg. Juli 1993.
Sonderdruck aus: Klaus Grimmer, Jürgen Häusler, Stefan Kuhlmann, u.a. (Hrsg.): Politische Techniksteuerung, Opladen 1992, S. 51-73.

No. 8 GERLICH, Peter: Politikwandel und Politikwissenschaft. Zwölf neuere Beiträge. Februar 1994.

No. 9 EARLE, John S. - WÖRGÖTTER, Andreas: Monopoly Power, Import Competition, and Price Liberalization in the CSFR. July 1994.
Sonderdruck aus: Janos Gacs, Georg Winckler (Eds.): International Trade and Restructuring in Eastern Europe. International Institute for Applied Systems Analysis, Laxenburg, Austria; Physica-Verlag, 1994, pp. 321-341.

No. 10 WÖRGÖTTER, Andreas: Der Wandel des wirtschaftspolitischen Leitbildes in Österreich seit den siebziger Jahren. Juli 1994.
Sonderdruck aus: Günther Chaloupek, Michael Mesch (Hrsg.): Der Wandel des wirtschaftspolitischen Leitbildes seit den siebziger Jahren. Reihe "Wirtschaftswissenschaftliche Tagungen der Arbeiterkammer Wien", Band 1, Verlag Orac, Wien 1993, S. 79-98.

No. 11 ELMESKOV, Jorgen - PICHELMANN, Karl: Interpreting Unemployment: The Role of Labour-Force Participation. October 1994.
Sonderdruck aus: Economic Studies, No. 21/Winter 1993, OECD: Paris, pp. 139-160.

No. 12 RIEDLSPERGER, Alois - WÖRGÖTTER, Andreas: Verarmung im Wohlstand. Oktober 1994.
Sonderdruck aus: Franz Vranitzky (Hrsg.): Themen der Zeit. Renner Institut, Passagen Verlag, Wien, 1994, S. 31-60.

No. 13 CYBA, Eva: Aspekte der Benachteiligung. Drei Beiträge zu einer Theorie geschlechtsspezifischer Ungleichheit. November 1994.

No. 14 PICHELMANN, Karl - WALTERSKIRCHEN, Ewald: East/West Integration and its Impact on Workers: The Austrian Example.
Sonderdruck aus: "Regional Integration and Globalisation: Implications for Human Resources." An International Conference organized jointly by the OECD and the Austrian Federal Government, 24th - 25th January 1994 to be held in Vienna, Austria.