Suggested Revisions to the SALTER Model

by

Randall Wigle and Carlo Perroni

Wilfrid Laurier University

Waterloo, Ontario

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SALTER working papers document work in progress on the development of the SALTER model of the world economy. They are made available to allow scrutiny of the work undertaken but should not be quoted without the permission of the author(s). Comments on the papers would be most welcome.

INDUSTRY COMMISSION

Professor Thomas W. Hertel
Agricultural Economics Department
563 Krannert Building
PURDUE UNIVERSITY
West Lafayette, IN 47907
U.S.A.

SUBJECT: IMPERFECT COMPETITION PILOT STUDY

Dear Tom

This is mainly to record matters we discussed by phone earlier this week.

The SALTER-II database is now completed and tested. It is based on the same input-output statistics as SALTER-I, except for Australia, New Zealand, and the 'rest of the world'. The source for the Australian input-output statistics is the 1986-87 ORANI database. For New Zealand, the source is the New Zealand Department of Statistics, *Inter-Industry Study of the New Zealand Economy, 1986-87*. The rest-of-the-world input-output table is based on national accounts statistics for selected representative countries, and averaged input-output statistics from the other SALTER regions.

I am sending the full multi-country database on diskette, under separate cover. The diskette is IBM-formatted, and database is written as a header array file (ST0237.HAR). Also on the diskette is a file containing a three-sector aggregation of the database. This database contains some trade imbalances, but otherwise appears satisfactory (ST0203.HAR). Trade imbalances arise in aggregation because the database does not provide for destination-specific export taxes.

As discussed the other day, we should either make sure that the pilot study will be delivered by 30 June this year, or make arrangements, in good time, for a partial carry-over of funds. I understand that you will send me about 6 April a document indicating progress to date and the future outlook.

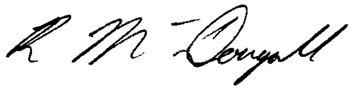
I have circulated Gehlhar, Binkley and Hertel, *Estimation of Trade Margins for Food Products*, among senior members of the SALTER team, where it has been well received. We would be interested in using similar estimates for non-food products in the SALTER-III database. For this purpose we would need them by the start of May. As discussed the other day, we would be willing to consider letting a contract. I understand that you will advise me of your views about 6 April.

Finally, I am enclosing some bound copies of SALTER Working Papers Nos 8 and 9

[redacted]
Benjamin Offices, Chan Street,
Belconnen ACT 2616
PO Box 80, Belconnen ACT 2616
Telephone: 06 264 1144
Facsimile: 06 253 1662

(Hertel, *An Independent Assessment of the SALTER General Equilibrium Model of the World Economy*, and Wigle and Perroni, *Suggested Revisions to the SALTER Model*).

Yours sincerely



R.A. McDougall
(3 April 1992)

Aggregation of the SALTER II database

NEW SECTORS No.	NEW SECTORS Description	OLD SECTORS No.	OLD SECTORS Description
1	Agriculture and food products	1	Paddy rice
		2	Wheat
		3	Grains, other than rice and wheat
		4	Non-grain crops
		5	Wool
		6	Other livestock
		13	Meat products
		14	Milk products
		15	Processed rice
		17	Other food products
2	Primary products and manufacturing nec	7	Forestry
		8	Fishing
		9	Coal
		10	Oil
		11	Gas
		12	Other minerals
		16	Beverages and tobacco
		18	Textiles
		19	Wearing apparel
		20	Leather etc.
		21	Lumber and wood
		22	Pulp, paper, etc.
		23	Petroleum and coal products
		24	Chemicals, rubber and plastics
		25	Non-metallic mineral products
		26	Primary ferrous metals
		27	Non-ferrous metals
		28	Fabricated metal products nec
		29	Transport industries
		30	Machinery and equipment
		31	Other manufacturing
3	Services	32	Electricity, water and gas
		33	Trade and transport
		34	Other services (ownership of dwellings)
		35	Other services (private)
		36	Other services (government)
		37	Construction

Header arrays in the aggregated SALTER II database

Header designation	Description
DIO1	Domestic intermediate usage
DIO2	Imported intermediate usage
DI03	Domestic investment usage
DI04	Imported investment usage
DI05	Domestic consumption usage
DI06	Imported consumption usage
DI07	Domestic government usage
DI08	Imported government usage
DI11	Exports
DI12	Industry taxes
DI13	Usage of labour
DI14	Usage of capital
DI15	Usage of land
DI16	Commodity taxes on domestic intermediate usage
DI17	Commodity taxes on imported intermediate usage
DI18	Commodity taxes on domestic consumption usage
DI19	Commodity taxes on imported consumption usage
DI20	Commodity taxes on domestic investment usage
DI21	Commodity taxes on imported investment usage
DI22	Commodity taxes on domestic government usage
DI23	Commodity taxes on imported government usage
DI24	Commodity taxes on exports
DI27	Duty
DI28	Income tax
DI29	Transfer payments
DI31	Freight
DP07	Depreciation

The authors would like to acknowledge comments suggestions and advice from numerous sources. In alphabetical order, we wish to thank Stephen Brown, Kevin Hanslow, Mark Horridge, Patrick Jomini, Michael Malakellis, Robert McDougall, Alan Powell and John Zeitsch for advice and comments while in Australia. Particular thanks are reserved for Ken Pearson, who tutored Randy in some of the fundamentals of "linearised" terminology and approach. Tom Hertel from Purdue University also deserves mention for encouraging us to undertake the task.

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Outline

Chapters 1–3 of this report describe three proposed changes to the SALTER model of the World Economy. These changes relate to:

- the modeling of international freight flows
- the theoretical formulation of the rest of the world (ROW) block
- the modeling of international investment

The report concludes with a brief discussion of other issues concerning SALTER. This latter section includes some responses to a number of comments and suggestions made by Hertel in [2].

Chapter 1

Modeling the Rest of World

This section will discuss two alternative representations of the Rest of World (ROW) in rather general terms. The first option would be to treat the rest of world schematically via a set of offer curves or with a reduced-form representation of the region's technology (as via a PPF). The second option would be to use exactly the same structure for the ROW as that used for all of the other regions. We'll refer to the former as the "schematic" approach, and the latter as the "symmetric" approach. The alternatives will be briefly discussed, although our strong preference is to adopt the symmetric approach.

The major appeal of the schematic approach is usually that the data requirements for the ROW are more modest than for the other regions. In this sense the schematic approach can be seen as economical (in the narrow sense).

The main argument against modeling the ROW region fully is usually that the data available is incomplete, or unreliable. We feel that the adoption of a "schematic" representation of the ROW may be false economy for a number of reasons:

- All those working with the model must learn new concepts and terminology for one region.

- While there is more data to assemble for the symmetric representation, it is the same type of data assembled for the other regions, so that the problems which arise will largely have been confronted before.

From our point of view, there are many arguments in favour of treating the ROW symmetrically with the other regions.

- Transparency of the Model — A lot of work has gone into developing a reasonable, consistent structure for the other regions. This structure is readily understood by economists, but most of the alternatives won't be so easily understood. It will also be easier to compare the model results for this (large and important!) region to the effects elsewhere.

- Data Collection — The data required for the ROW are the same as those needed for the other regions, so that the lessons learned in preparing the other country sets is applicable to the ROW.

- Data Transparency — There seems to be the widely-held view that the specification of the ROW region doesn't matter, and therefore it is best kept simplified and in the background. The problem is that for some issues of possible interest, the ROW may be very important (TRIPS, textiles and clothing, as well as TRIMS). At the same time, it's clear what the data in the ROW corresponds to. An advantage which we see is that debates about the quality of data in the ROW are encouraged by having them out in the open.

By putting the data in a black box (PPF or some other summary function) one hides the fact that the data is weak. It doesn't reduce the possibility that the weakness of the data will be a problem, it only serves to make it harder to discern if that is the case.

On the positive side, some of the data needed is already available once the data for the model's explicit regions are assembled. A first approximation of the ROW's trade and international transactions are merely the negative of those residuals from the other countries. (The IMF direction of trade statistics may also be helpful here.) Intermediate transactions tables and the composition of final demand will be unavailable for all of the countries in the ROW, but one can think of two approaches to this:

1. Choose a "representative" country (or set of countries) for which reasonably good data is available, and model the region on that economy's productive structure. (You will need to RAS of course, but that won't be unique.) If a representative set of countries are used, the starting point for RAS would be an appropriately weighted combination of the tables for the chosen countries.

2. Use an input-output structure equal to some combination of those in the fully-specified regions. John Whalley has implicitly used this approach before in some work on Canadian regional issues. (The US was

ten times Canada.) This approach could serve as a stop-gap measure while other data is developed.

We feel strongly that the investment in the existing model structure should not be wasted by designing what may be a poor substitute. This is doubly true if (as we suspect) workable data for the ROW region would not be impractical to obtain. The appendix flags a possible problem with the PPF representation of technology.

Chapter 2

Reconciliation of Trade-Related Service Flows

This section discusses the previous treatment of freight in SALTER, and discusses the changes necessary to make the model internally consistent in terms of the supply and use of trade-related freight and insurance services. Appendix A discusses the previous model treatment of freight.

First, we note that there really is a counterpart of distance in SALTER, in that apparel produced in Canada is more costly in Australia than Canada even before duties are paid.

The landed price equation embodies a fixed share of "world" freight costs in the landed price of imports. These share parameters can differ by source, destination and commodity.

The freight price equation specifies a common price of world freight, implying identical proportions of the regional transportation services in world freight for all goods and all source–destination pairs. It would appear that the share parameters S_{Fiz}^{Wz} are all zero (i.e. when the source equals the destination), although this is not clear from equation 6.24. If this is the case, one most really think of the transportation services as being the "extra" transportation services needed for delivering goods to a given foreign destination.

The question arises whether we believe that the shares of both freight in landed prices and those of each region's transportation services in international freight are constant. We can consider each in turn.

It seems most likely that the requirements of freight per-unit of imports are almost fixed in real terms, leading to a very low elasticity of substitution[1] (in intermediate or final demand) between freight and imports. The previous SALTER treatment seems entirely appropriate.

By contrast, the elasticity of substitution between freight services from different sources could be higher, and the shares of regional transportation services in international freight might differ by source-destination pair in particular. In terms of the substitution possibilities, they could be almost infinite where purchasers of freight are in unregulated markets. More typically, regulations which are hard to capture may lead to restricted substitution possibilities. The idea of fixed shares of regional transportation services in international freight does not seem reasonable.

The modifications necessary fall in two categories:

1. Introduce a range of substitution possibilities between transportation services from various sources in the production of international freight.

2. Account carefully for the supply of transportation services used in the realization of international trade.

2.1 Previous SALTER Implementation

Implicit in equation 6.24 are fixed per-unit (of trade) requirements of trade-related services which vary by source, destination and commodity. These are essentially the trade margins discussed in pages 34–35 of [4].

In the same way, there are per-unit (of world freight) requirements of regional trade-related services implicit in equation 6.25.

2.2 Implementation of Proposed Change

The following equations embody the proposed changes to SALTER. What is referred to as p^s_{EJ} in SALTER equation 6.25 (the export price of region s freight) is here called p^s_{EF} for clarity. Otherwise, our equation 2.1 is the same as equation 6.25. Equation 2.2 describes the determination of total demand for transportation services from region s, while equation 2.3 describes the determination of total demand for international freight. Equation 2.4 replaces SALTER equation 4.10 for $i = F$ (transportation services). This equation serves to increment total exports by the amount of freight exports,

[1] Much closer to 0 than 1.

(so that balance of payments conditions are correct), but will not affect the normal reporting of bilateral trade flows, which will ignore freight as is usual.

We elected to have index F refer to the index of transportation services, and T (as in SALTER) refer to international freight. This transposition is rather unfortunate, but is probably easier to understand, given that T is already used in many of SALTER's equations.

$$p_T = \sum_{s=1}^{S+1} S_{Fs}(p_{EF}^s - e^s) \tag{2.1}$$

$$f_z = f^W + \beta_T (p_T - (p_{EF}^z - e^z)) \tag{2.2}$$

$$f^W = \sum_s \sum_i \sum_z S_{Fsi}^z exp_{si}^z \tag{2.3}$$

$$exp_F^z = \sum_{s=1}^{S+1} S_{EsF}^z exp_{sF}^z + S_E^{Tz} f_z \tag{2.4}$$

New variables defined are presented in Table 2.1. The resulting formulation implies that imports require fixed proportions of international freight, but that international freight (which is common to all regions) is composed of a CES aggregate of transportation services from each region.

Table 2.1: New Symbols for International Freight

Symbol	Variable or Parameter	Equation
f_z	Trade-related demand for region z freight	2.3
f^W	Total trade-related demand for freight	2.3
β_T	Elasticity of substitution between freight sources	2.3
S_{Fsi}^z	Share of total trade-related demand for freight attributable to exports of good i from region s to destination z	2.1
S_{Es}^{Tz}	Share of exports of freight in total exports of region z trade and transportation services	2.4

It is important to realize that all variables referring to imports are *exclusive* of trade in international freight. This means that the trade balance will still be correct, but changes in imports of trade and transport services will refer to changes in imports for intermediate or final demand in the usual sense, but will exclude trade in the services associated with international trade.

2.3 Other Remarks

The transportation margins presented in both Table 3.10 of [4] and Tables 2.10 and 2.11 of [3] seem extremely high. The simple average of the margins over all commodities (from Table 3.10 of [4]) is almost 17%, which seems awfully high compared to Australian data in particular.

To illustrate, the following Table lists data available for Australia from the ABS, and the corresponding data from SALTER.

Table 2.2: Trade Margins in SALTER

SALTER Data for 1988 ($US)	Trade	Freight	Percentage
Exports (fob)	47,081	2,740	5.8%
Imports (cif)	49,052	3,299	6.7%
ABS Data for 1986–7 ($A)	**Trade**	**Freight**	**Percentage**
Exports (fob)	25,423	4,452	12.6%
Imports (cif)	37,159	2,471	6.6%

The data suggest that the SALTER data are in line with the ABS data, but that the margins in the SALTER documents mentioned are inappropriately high. One interpretation which seems reasonable from the data is that the trade margins should be interpreted as follows:

Margin on finished capital goods	5.1%
Margin on Canada–Japan trade	20.1%
Margin for Canada-Japan finished capital goods	1.0%

If we interpret the margins as multiplicative in this way, the puzzle is seemingly resolved, although our preference would be to make it clearer what the margins data represent.

2.4 Trade Margins as Insurance and Freight

Normally the wedge between landed and *cif* prices is accounted for by insurance and freight. Typically, the ratio of freight costs to insurance costs will be very high for primary commodities (coal or iron ore) while it tends to be low for goods with a high value to weight ratio (computers or jewelry). The existing specification attributes all of this differential to freight, whereas there should be some insurance, with the ratio of insurance to freight rising ratios as the value per tonne of the commodity rises.

It is very convenient that the services provided would be primarily in sector 31 (Trade and transport), although part (insurance) is likely included in sector 32 (Other services private). For simplicity it may be most appropriate to assume that the services are entirely provided by sector 31. (Although the developed economies clearly have a comparative advantage in providing the insurance versus transportation services.)

Chapter 3

International Investment Flows

3.1 Introduction

This chapter briefly outlines the "conceptual" approach used to represent international capital mobility in a CGE model, noting the appeal and drawback of the recommended implementation. Section 3.4 discusses the determination of investment by destination country. Section 5 discusses a number of added details which must be resolved for the long-run. SALTER will not be truly intertemporal once the recommended changes are completed, but the suggested interim step of using a sequence of static equilibria to reflect simple accumulation relations seems an appropriate first step along this road.

A number of other issues related to implementing international investment in SALTER are discussed in section 4. A later section includes other possible extensions of the sequenced approach.

3.2 Shoven-Whalley (GEMTAP) Approach for Closed Economy

Briefly, the GEMTAP (see [1]) approach is to use a two-period setting, where the domestic consumers maximize current and future consumption, as:

$$U = U(C_0, C_1) \tag{3.1}$$

Simplifying assumptions are that:

1. Depreciation=0.
2. No explicit period 1 market (C_0 is an aggregate of period 0 consumption goods).
3. Myopic expectations, so the future rental price of capital as well as future consumption prices are assumed to equal the current (post-counterfactual) prices.

The budget constraint can then be written:

$$P_0C_0 + \frac{P_0}{1+i}C_1 = P_0V_0 \tag{3.2}$$

where V_0 equals the value of the initial endowments of primary factors, and i (the rate of return on investment) equals the ratio of the rental price of capital (R) to the purchase price of currently produced investment (P_I) and is assumed to be independent of the level of investment. There is no explicit period one optimization once the quantity of investment in period zero is chosen (i.e. $C_1 = (1+i)I_0P_0/P_I$.)

3.2.1 Limitations

The main limitation to this approach for the closed economy is that the assumption of myopic expectations about the future rental price of capital (and hence i) is rather strong. This problem is amplified because it is clear that the expectations are likely to be wrong in circumstances where investment is very high or very low. Most policy changes which have a dramatic effect on investment are likely to have an impact on the return to capital in the period when the investment is installed.

The other limitation to this approach is that there is nothing in the model to reflect the common idea that investment opportunities are scarce. Depending on the terminology, this can be thought of as:

- decreasing Marginal Efficiency of Investment (MEI)
- decreasing Marginal Product of Capital (MP_K)
- increasing Marginal Cost of Investment (MC_I)

The only thing which makes the agent reluctant to invest more is the decreasing marginal rate of substitution between C_0 and C_1. If it is possible to alter the intertemporal utility function to reflect this, some (rather indirect) adjustment can be made for the problem.

3.3 Extension to International Capital Mobility

When extending the analysis to cover international investment, an added challenge exists, in that investors seem to do an inordinate share of their investing in the domestic economy. The treatment adopted can be described in terms of the answer to the following two questions:

- How is investment in the home region modeled relative to investment in "foreign" regions from the demand side?
- Should investment reflect the idea that the MEI curve is downward-sloping? If so, should there be decreasing MEI in each region, or merely for the world as a whole?

We turn now to a schematic look at a number of options that could be used to deal with these challenges.

3.3.1 Mechanical Implementation of GEMTAP Formulation

The most direct application of the GEMTAP approach to international capital mobility would be to have homogeneous investment produced by all countries, and to have no reflection in any of the economies of the presence of downward-sloping MEI's. In this way, investment would take place where the ratio of the rental price of capital to the price of investment goods is the highest. The limitations to this approach include the following:

1. There is no decline in the (national) return to investment attributable to the scarcity of opportunities.
2. With the normal technology[1], minor changes in tariffs, or any other policy parameters can lead to the complete shut-down of investment activity in one or more of the regions. This seems unrealistic.
3. There is no portfolio dimension, (i.e. it would not reproduce the fact that investment seems to be disproportionately done in the domestic market.) Depending on the experiment considered or the policy issues at hand, this may be of secondary importance.
4. The assumption of myopic expectations about the rate of return is likely to be weak, particularly since, with complete homogeneity, some countries could have no new investment, while others could be absorbing huge sums of investment.

[1]That is technology using primary factors which are inter-sectorally mobile.

3.4 Investment with Decreasing MEI by Region

Here, we treat investment in all regions as a perfect substitute in demand, but the investment production sectors have decreasing returns to scale. One might think of the decreasing returns being induced by a sector-specific factor called "investment opportunities." Decreasing returns merely reflect the fact that over investment in any region is likely to stretch the profitability of investments in the region.

The SALTER implementation would focus on a non-homogeneous price index for investment. In SALTER, there really isn't a sector producing investment. Rather, there is a bundle of goods which are sold as "investment," with an associated price index.

3.4.1 Decreasing returns to investment

If R is the rental price of capital, the optimization problem can be written:

$$\max_{I} \quad U[C_0, (\tfrac{P_I}{P_1} I + \tfrac{R}{P_1} Q(I))] \tag{3.3}$$
$$\text{subject to:} \quad P_0 C_0 + P_I I = P_0 V_0$$

where $Q(I)$ represents the amount of capital services obtained from I units of capital stock, P_0 and P_1 equal consumption prices in the respective periods, P_I equals the purchase price of investment (machines), and V_0 equals the initial real endowment of primary factors.

Optimizing behaviour implies that the agent's own rate of interest Γ^W (i.e., the marginal rate of time preference) should be equated to the rate of return to investment, and the resulting optimality condition can be written:

$$\Gamma^W = \frac{R}{P_I}\frac{dQ(I)}{dI} \tag{3.4}$$

One particularly interesting case is if $Q(I)$ can be written:

$$Q(I) = \phi I^{\alpha} \tag{3.5}$$

Where ϕ is a positive scalar and $0 < \alpha < 1$.[2] It is interesting because it yields a (negative) constant elasticity of the rate of return to investment with respect to the investment level equal, in absolute value, to $(1 - \alpha)$.

[2]Do not confuse the parameter ϕ with the SALTER terms φ.

3.4.2 Implementation with internationally homogeneous investment

We can re-write this in terms of the SALTER definitions. All lower-case symbols represent the proportionate change of the corresponding level. Upper case symbols represent the *levels* of the corresponding share parameters. The original SALTER definitions, as well as a few new ones are presented in Table 3.1.

Table 3.1: Definitions for Decreasing Returns to Investment

Symbol	Variable or Parameter	SALTER Equation
sv^z	Private savings supply (nominal)	2.5
inv_N^z	Nominal investment in region z	4.1
inv_R^z	Real investment in region z	4.1
w_K^z	Basic rental price of capital in region z (w_2^z)	6.30
pci^z	Purchase price of region z capital	6.20
Symbol	**Variable or Parameter**	**New Equation**
ρ^W	World-wide rate of return to investment	3.7
iv_R^z	Real investment by z residents	3.8
$\overline{pci^z}$	Efficiency-adjusted price of region z capital	3.6
S_I^{Wz}	Share of country z assets in world portfolio	3.8
S_I^{zW}	Share of world portfolio owned by country z's residents	3.8

Having defined a new variable $\overline{pci^z}$ as the efficiency-adjusted price of region z capital, we can write it as follows given the function "Q" from above.

$$\overline{pci^z} = pci^z + (1 - \alpha^z)inv_R^z \qquad (3.6)$$

This merely means that the price of enough capital to yield one unit's return in period one depends (positively) on both the price of machines, and the number of machines to be purchased for investment. Thus the calculation of real investment (as in equation 4.1) is unaffected, since we usually think of it in terms of "machines" installed, rather than the return to those machines (as reflected in $\overline{pci^z}$).

Equilibrium in the world capital market is then described by the following conditions:

$$w_K^z - \overline{pci^z} = \rho^W, \forall z \in \{1, \ldots S\} \tag{3.7}$$

$$\sum_z S_I^{Wz} inv_N^z = \sum_z S_I^{zW} iv_N^z \tag{3.8}$$

Equations 3.6, 3.7 and 3.8 would constitute a modification to SALTER to model capital mobility when the efficiency units of investment are international homogeneous.

One can think of w_K^z as the rental price of capital (albeit from the owners point of view). In the benchmark equilibrium ϕ can be chosen so that $\Gamma^W = W_K^Z$.

3.4.3 Evaluation

There are a number of drawbacks and advantages to this approach. First a brief discussion of some drawbacks:

1. The elasticity of the returns to capital with respect to new investment may not be known.

2. It won't overcome the "portfolio" problem discussed above.

The formulation has a number of advantages, however:

1. The problem of minor policy changes generating huge impact effects on investment is avoided. This effectively eliminates problem of perfect specialization in the investment of one region discussed earlier.

2. The assumption of myopic expectations for the rental price of capital is mitigated by the fact that agents correctly forecast the effect of investment levels on "physical" returns.

3. The formulation is relatively transparent. While I realize that this can be an overused word, the modifications to the standard model are minimal, and the interpretation of the modifications and α are relatively straightforward. The change deals directly with a well-defined problem.

3.4.4 Closures

In the short-run, the capital employed in each industry will be fixed, while in the medium-run, the national capital stock will be fixed, but capital would be allowed to move between industries. In the long-run of course, investment will increase the stock of capital by country. It is assumed that the sector-specific returns to capital and land remain constant in all experiments, just as before in SALTER.

Chapter 4

Financial Flows

A number of changes to SALTER to complement international investment, as well as deal with international government borrowing are summarized in this chapter. With the introduction of international investment in SALTER, a number of closely linked financial flows deserve more attention. In particular, international flows of factor service payments should be related to changes in market prices of capital services, and national incomes should reflect patterns of ownership of domestic and foreign capital. In a similar way, international borrowing and debt-service are discussed. This covers only the changes required to the "static" (i.e. one-period) version of the model. Chapter 5 discusses incrementing various "state variables" in the model (such as the stock of capital and holdings of various assets).

To complete the international financial linkages to accompany international investment and financial flows, we deal in turn with the following points:

1. factor service income
2. government borrowing and debt service
3. calculation of income
4. the allocation of private savings to financial instruments
5. trade balance and the balance of payments

4.1 Factor Service Income

Factor service receipts by different countries will be affected by changes in the holdings of foreign capital, as well as changes in the returns, as follows:

$$\mathcal{FS}_s^z = \rho^W + f_{EK_s}^z \tag{4.1}$$

Where $\mathcal{FS}_s^z$ equals the proportionate change in factor service payments from region s to region z, and $f_{EK_s}^z$ is the proportionate change in region z holdings of region z capital. In the normal static case, the terms $f_{EK_s}^z$ would all be zero.

4.2 Government Borrowing

In the previous SALTER implementation, government deficits were implicitly funded through domestic borrowing, and debt service interest was effectively included in transfers. International financial transactions were implicitly assumed to be zero. In the previous implementation of SALTER, there is no direct linkage between government borrowing and the supply of "savings" more generally.[1]

To introduce an international market for government bonds, we suggest a *very* simple solution. If investors at home and abroad are to be convinced to hold a country's debt, they must be rewarded with a competitive return. The returns must be competitive not only with the returns on other government bonds, but also on equity capital (investment as discussed in Chapter 3).

In the case of investment we argued that excessive investment in any economy would lead to some decreasing returns to investment as opportunities were scarce. Similarly, one might think that investors' evaluations of the security of government bonds from different countries might also depend on things such as the financial history of the country and the size of that government's debt (perhaps as a proportion of GNP, for example). In this case, we could argue, that there are fixed risk-related premia under/over the world rate of return to investment in equity (Γ^W) attributable to the size and other characteristics of each countries debt. For stable governments with modest national debts, γ might well be less than unity, whereas for

[1]The terms public debt and government bonds are used interchangeably in what follows. The term national debt is used to refer to the outstanding stock of a region's government bonds.

debt-ridden governments, it could easily exceed unity. The following equation in levels would arise:

$$\mathcal{R}_{\mathcal{B}}^{z} = \gamma^{z}\Gamma^{W} \tag{4.2}$$

Where $\mathcal{R}_{\mathcal{B}}^{z}$ is the rate of return paid to consuls[2] and γ^{z} is the fixed relation of returns on country z bonds to the world rate of return on equity. In percentage change terms leads to:

$$r_{\mathcal{B}}^{z} = \rho^{W} \tag{4.3}$$

In other words, governments must match all changes in returns to equity.

4.3 Debt Service and Issuance

Completing the introduction of (international) government debt in SALTER requires two more pieces, first, that private savings be allocated to investment (domestic and foreign) or government bonds (domestic or foreign). Second, we need to maintain a linkage between the income of those who hold the debt (the private sector), and the debt service payments made by the respective governments. In an intertemporal setting, one must also maintain the connection between purchases of bonds and both holdings by the private sector and debt of the public sector.

Equations to assure that debt issue equals purchases of debt are as follows:

$$B_{N}^{z} = \sum_{s=1}^{S} S_{s}^{Bz}\mathcal{BP}_{s}^{z} \tag{4.4}$$

where B_{N}^{z} is the rate of change of bond issues by region z, S_{s}^{Bz} is the share of bond sales to region s in region z bond issue and $\mathcal{BP}^{z}$ is the proportionate change in bond purchases by region s from region z. The equilibrating mechanism to equate supply and demand for bonds are the variables $\mathcal{BP}_{s}^{z}$. The purchases adjust to equate total demand and supply, *given* that the bonds earn the same relative returns as equity.

Debt service receipts by different countries will be affected by the volume of bonds outstanding, as well as changes in the returns, as follows:

$$\mathcal{DS}_{s}^{z} = \rho^{W} + f_{Bs}^{z} \tag{4.5}$$

[2]The (now imaginary) assets discussed by Keynes. They have an infinite lifetime and fixed nominal payout. Risk neutrality means that if they are freely traded, the rate of return to them will always equal the economy-wide rate of return.

Where $\mathcal{DS}_s^z$ equals the proportionate change in debt service payments from region s to region z, and $f_{B_s}^z$ is the proportionate change in region z holdings of region z debt. In the normal static case, the terms $f_{B_s}^z$ would all be zero. It is important to understand the distinction between $\mathcal{BP}_s^z$, which is the proportionate change in (new) purchases of region s bonds by region z and $f_{B_s}^z$, which is the corresponding proportionate change in ownership. The former concerns the flow of purchases, the latter, the stock of holdings.

4.4 Budget Deficit

The government budget deficit will also need to reflect changes in debt-service payments arising from changes in the rate of return to investment. This implies that governments must match changes in the real returns to equity with bond yields:

$$bd^z = R_G^z r_G^z - \left(Z_g^z z_G^z + T_G^z t_G^z + T_{DS}^z \rho^W \right) \tag{4.6}$$

The only new term in this equation is the last term, which corresponds to the share of debt-service payments in the government deficit (T_{DS}^z) times the proportionate change in the real rate of return to equity investment (ρ^W).

This new calculation of the budget deficit also determines the proportionate change in issues of government debt as follows:

$$B_N^z = bd^z \tag{4.7}$$

4.5 Income Determination

In the presence of factor service and debt interest income, the income determination equation (replacing 8.1) will be changed to include:

1. returns to labour
2. returns to domestic and foreign capital
3. returns to land
4. returns (interest) on domestic and foreign government bonds

The "Aggregate net primary factor income" (equation 8.1 from Working Paper 4) can be written as follows:

$$\begin{aligned} y_F^z &= S_{YL}^z(w_L^z + f_{SL}^z) \\ &+ S_{YK}^z \sum_{s=1}^{S} S_{K_s}^z(w_K^S + f_{EK_s}^z) \\ &+ S_{YR}^z(w_R^z + f_{SR}^z) \\ &+ S_{YB}^z \sum_{s=1}^{S} S_{B_s}^z(\rho^W + f_{B_s}^z) \\ &- S_{YD}^z dep^z \end{aligned} \tag{4.8}$$

Some new variables are defined in Table 4.1, below. The indices L, K and R stand for labour, capital and land respectively, replacing the indices 1...3 used in SALTER. Equation 4.8 also adds new variables corresponding to the accumulation of domestic *and foreign* capital ($f_{EK_s}^z$) and the accumulation (by the private sector) of domestic and foreign government bonds ($f_{B_s}^z$). As before, these variables would normally be set exogenously to zero in the static model.

A host of new share parameters are also introduced, which are defined in Table 4.1.

4.6 Allocation of Savings

The allocation of total public savings between alternative investment instruments must also be changed as follows, since private investors can now hold domestic or foreign equity or government bonds (again foreign or domestic).

$$\sum_z S_I^{zW} iv_N^z = S_S^I \sum_z S_I^{Wz} inv_N^z + S_S^B \sum_z S_B^{Wz} B_N^z \tag{4.9}$$

4.7 The Balance of Payments

With international (equity) investment, government debt, and international factor services flows, the existing trade balance is insufficient to represent international equilibrium.[3] The calculation of the trade balances in equations 9.10 and 9.11 has *not* been changed since they still reflect the (normal) balance on merchandise and non-factor service trade.

[3]See also Appendix B.

Table 4.1: Definitions

Symbol	Description	Equation
f^z_{SL}	% change in domestic labour supply	(4.8)
f^z_{SR}	% change in domestic "land"	(4.8)
$f^z_{EK_s}$	% change in region z holdings of region s capital	(4.8)
$f^z_{B}s$	% change in region z holdings of region s government bonds	(4.8)
S^z_{YL}	Labour's share in region z net primary factor income	(4.8)
S^z_{YK}	Total capital income's share in region z net primary factor income	(4.8)
$S^z_{K_s}$	Share of capital income from region s in region z total capital income	(4.8)
S^z_{YR}	Land's share in region z net primary factor income	(4.8)
S^z_{YB}	Bond income's share in region z net primary factor income	(4.8)
$S^z_{B_s}$	Share of bond interest income from region s in region z total bond interest income	(4.8)
ρ^W	% change in rate of return to equity investment	(4.8)

Since trade in factor services (and implicitly service on government bonds) is no longer zero, the balance of payments condition implicit in the existing formulation of SALTER is no longer sufficient. In words, the balance of payments condition to be satisfied is that the merchandise trade balance plus the factor service balance plus the net capital flow must equal zero. In percentage change terms this can be written:

$$tb^z = -(H^z_{FS} f^z_{FS} + H^z_{KF} f^z_{KF}) \tag{4.10}$$

This merely says that the proportionate *increase* in the trade balance is equal to the proportionate *decrease* in the factor-service balance and the capital account balance. (Definitions for the symbols in equation 4.10 can be found in Table 4.3).

Table 4.2: Definitions

Symbol	Description	Equation
S_I^{zW}	Share of world savings done by country z	4.9
S_S^I	Share of world-wide investment in total world savings	4.9
S_I^{Wz}	Share of investment in region z in world investment	4.9
S_S^B	Share of total issues of government bonds in total world savings	4.9
S_B^{Wz}	Share of region z government bond issues in total world savings	4.9
B_N^z	% change in issues of government bonds by region z	4.7, 4.9

The following equation links nominal foreign investment on a bilateral basis to the real investment decisions described in Chapter 3.

$$\mathcal{KP}_s^z = inv_N^z S_I^{Ws} \tag{4.11}$$

Where $\mathcal{KP}_s^z$ is the proportional change in region z purchases of region s investment.

We also need equations for the respective balances (the balance on factor services, denoted FS, and the balance on capital flows, denoted KF).

$$\begin{aligned} f_{FS}^z &= S_{PUB}^z \left[\sum_{s=1}^{S} (S_{SR_s}^z \mathcal{DS}_s^z) - \sum_{j=1}^{S} \left(S_{SPj}^z \mathcal{DS}_z^j \right) \right] \\ &+ S_{PRI}^z \left[\sum_{s=1}^{S} (S_{FR_s}^z \mathcal{FS}_s^z) - \sum_{j=1}^{S} \left(S_{FPj}^z \mathcal{FS}_z^j \right) \right] \end{aligned} \tag{4.12}$$

$$\begin{aligned} f_{KF}^z &= S_{GB}^z \left[\sum_{s=1}^{S} (S_{BP_s}^z \mathcal{BP}_s^z) - \sum_{j=1}^{S} \left(S_{BSj}^z \mathcal{BP}_z^j \right) \right] \\ &+ S_{PK}^z \left[\sum_{s=1}^{S} (S_{KS_s}^z \mathcal{KP}_s^z) - \sum_{j=1}^{S} \left(S_{KPj}^z \mathcal{KP}_z^j \right) \right] \end{aligned} \tag{4.13}$$

Table 4.3: Definitions

Symbol	Description	Equation
H_{FS}^{z}	Share of country z's factor-services balance in the balance on factor services and capital flows	4.10
H_{KF}^{z}	Share of country z's capital flows balance in the balance on factor services and capital flows	4.10
f_{FS}^{z}	% change in country z's factor services balance	4.10
f_{KF}^{z}	% change in country z's capital flows balance	4.10
S_{PUB}^{z}	Share of region z's balance on public debt service in the factor-services balance	4.12
S_{PRI}^{z}	Share of region z's balance on private factor services in the factor-services balance	4.12
$S_{SR_s}^{z}$	Share of region s debt interest payments to country z in region z's balance on public debt service	4.12
$S_{SP_j}^{z}$	Share of region z debt interest payments to country s in region z's balance on public debt service	4.12
$S_{FR_s}^{z}$	Share of region s factor-service payments to country z in region z's balance on private factor services	4.12
$S_{FP_j}^{z}$	Share of region z factor-service payments to country s in region z's balance on private factor services	4.12
S_{GB}^{z}	Share of region z's balance on government bonds in the capital-flows balance	4.13
S_{PK}^{z}	Share of region z's balance on private capital in the capital-flows balance	4.13
$S_{BP_s}^{z}$	Share of region z bond sales to region s in region z's balance on government bonds	4.13
$S_{BS_j}^{z}$	Share of region z bond purchases from region s in region z's balance on government bonds	4.13
$S_{KS_s}^{z}$	Share of region z capital sales to region s in region z's balance on capital flows	4.13
$S_{KP_j}^{z}$	Share of region z capital purchases from region s in region z's balance on capital flows	4.13

If we have written the balance of payments condition properly, it will *imply* that NDP from the disposition side will equal NDP from expenditure side. In those equations, the trade balance must correspond to the sum of the following balances:

1. the balance on merchandise and non-factor service trade

2. the balance on (private) factor services

3. the balance on public debt service

The balance of payments equation should replace the condition whereby the trade deficit is related in a fixed way to NDP (equation 9.11). Under this formulation, the trade balance becomes endogenous and (notably) interacts with savings, which will affect the capital account.

Chapter 5

Long Run Closure with International Investment and Financial Flows

A drawback to the initially proposed implementation was that even in the long run it was a "static" model formulation, in that there was no opportunity for the investment being undertaken to affect capital accumulation in the various economies. This was unacceptable for the long-run solutions of SALTER. In place of this a sequenced static approach (similar to that adopted by BFSW) is described below.

The only other *micro-consistent* approach is the full intertemporal equilibrium approach used in tax analysis and some development models. Some recent examples include Perroni's work on endogenous human capital, as well as Mercenier's work on Brazil. Mark Horridge, Michael Malakellis and Alan Powell at the Impact Centre as well as Peter Wilcoxen are working in the same area. Unfortunately, such a treatment is not yet feasible given the size of the model as normally used.

5.1 Overview: Sequenced Static Solutions

For the case of a long-run solution (10 years) of the effects of 50% trade liberalization to be solved in 10 steps the essence of this implementation would be as follows:

1. The base for comparison in the model first needs to be constructed as follows:

   (a) The $t = 1 \ldots 10$ capital stock for region z is calculated as the period $t-1$ capital stock plus the net investment in region z from period $t-1$.

       Period 0 corresponds to the base data.

   (b) Similarly, the opening ownership of domestic and foreign capital in period t is incremented by the real savings from the previous period.

   (c) Other time-indexed values could also be incremented at this time in a similar way.

   (d) The model is repeatedly solved for new long-run equilibria (presumably at minimal expense) until period $t = 10$. This period's solution database is the basis for comparisons of experiments.

2. The solution of the counterfactual equilibrium proceeds as follows:

   (a) The model is solved for long-run equilibria corresponding to periods $t = 1 \ldots T$ (here $T = 10$) with a policy change of $50\% \frac{t}{T}$), and with the capital stocks, asset ownership and other time-indexed values incremented as in items 1a and 1b above.

   (b) The solution for period 10 obtained in this manner is compared to the solution from item 1d above to calculate the effect of the policy change.

In order for the comparison of the two year 10 solutions to yield a meaningful comparison, it would be necessary to subtract the proportionate changes in the "base" experiment from those in the counterfactual experiment, since effectively this allows the comparison of the terminal year between the two equilibria.

As a part of this approach to the problem, it is necessary to have added equations to govern how "time-dependent" magnitudes will be updated as the solution process goes on. In following sections, we present equations (with some upper case values in terms of *levels*) to describe the motion of the model from one *time* period to another. The following subsections describe equations of motion for the capital stock, asset ownership (wealth) and bond holdings and government indebtedness.

In the discussions of Chapter 4, there was reference to a number of variables whose values would normally be exogenously set to zero in the static form of the model. These included the following:

f^z_{EKs} proportionate change in region z holdings of region s capital (See equation 4.1)

f^z_{Bs} proportionate change in region z holdings of region s government bonds (See equation 4.5)

Subsequent discussions deal in turn with the determination of these variables for the long run.

5.1.1 Capital Stock

First, in levels, the obvious relation is as follows:

$$K^z_t = (1-d)K^z_{t-1} + I^z_{t-1} \tag{5.1}$$

Where I^z_{t-1} is the level of investment in period t in region z, d is the rate of depreciation and K^z_t is the capital stock in region z in period t. The investment by region in the "preceding" period will be determined from the equations described above.

To write this in linear terms we would get:

$$[f^z_{Dk}]_t = \Pi^z_{t-1} - d \tag{5.2}$$

where $[f^z_{Dk}]_t$ equals the proportionate change in the aggregate supply of capital to region z in period t, Π^z_{t-1} is the ratio of gross investment in region z to capital stock in region z in period $t-1$, and d as before is the rate of depreciation.

It's not clear whether the value Π^z_{t-1} is better thought of as a share or a parameter or a variable. The way it will actually get used is not exactly any of these.

5.1.2 International Equity

As the regions progressively save/invest, their holdings of capital (both domestic and foreign) will be rising. This will lead to increases in rental income. The income measures have already been revised to allow the returns from various asset holdings to be reflected in income. Now we define the equations of motion for the various assets.

Table 5.1: Definitions for Asset Accumulation

Symbol	Description
S^z_{YL}	(Own) Labour Income's Share of Factor Income
S^z_{YR}	(Own) Land Income's Share of Factor Income
S^z_{YK}	Capital Income (Domestic and Foreign) Share of Factor Income

Wealth accumulation is governed by the following equation (written in levels).

$$[E^z_s]_t = (1-d)\,[E^z_s]_{t-1} + \left[\frac{\theta^s SV^z}{PCI^s}\right]_{t-1} \tag{5.3}$$

In this equation SV^z is the level of savings, E^z_s is the level of ownership of region s capital by region z, and θ^s is the share of all investment which is undertaken (at the margin) in region s. It is defined in the following equation:

$$\theta^j = \frac{INV^j_N}{\sum_{s=1}^{S} INV^s_N} \tag{5.4}$$

The upper case symbol INV^s_N represents the level of nominal investment in region s. This interpretation assumes that all investors use the same share of investments by region.

Referring back to equation 4.8 on page 24, we see that the proportionate change counterpart of E^z_s is the variable $f^z_{EK_s}$. We could do a transformation as follows:

$$f^z_{EK_s} = \Omega^z_s - d \tag{5.5}$$

Where Ω^z_s is merely the ratio of the previous year's gross investment in region s by region z residents to their holdings of region s equity.

5.1.3 Holdings of Public Debt

In a very similar way to the previous sections, we can derive equations relating holdings of debt to new purchases.

$$f^z_{B_s} = \Omega^z_{B_s} \tag{5.6}$$

In words, the holdings of government bonds depend only on Ω^{z}_{Bs}, the ratio of new purchases to holdings. Once again, this relates to equation 4.8 above.

5.2 Other Time-Related Magnitudes

As well as incrementing the capital stocks, bond-holdings and debt, and asset ownership as mentioned above, one might also consider incrementing other time-related variables. A list of time-dependent things that might be considered at a later time follows. The following are things which do not fit into the usual context of a static model, but might not be out of place in a sequenced setting.

Labour Supply Labour supply (in value terms) is normally growing in an economy in terms of workers, and the skill of the average worker. The secular increase of the labour force may have important independent effects on the economy which could interact with policy measures implemented. It would be rather asymmetric to be indexing the capital stock and not the stock of labour, even if the growth of labour force (i.e. potential labour supply) is rather simplistic. In periods when demographic change is important, or when immigration is being relaxed or tightened, it could be important to both the baseline and counterfactual experiment to take account of growth or contraction of the labour supply.

Technological Change The model has a number of technological shifter parameters which could conceivably also be linked to time. This would probably only be done with particularly long-run simulations where such changes were anticipated to be an important part of the future time path.

5.2.1 An Alternative Solution Concept

It might be possible to think of this solution strategy following time-dependent equilibrium conditions. Using the previous example, periods 1 and 2 could be solved (in *both* the benchmark and counterfactual sequence) under short-run equilibrium conditions, while periods 3–5 could be solved using medium-run equilibrium conditions, with the remainder of the solutions using full long-run equilibrium conditions.

While this approach is probably feasible (as well as rather intuitively attractive), it should not be adopted without careful consideration of the appropriate elasticities to be used in the respective solution periods. The absence of a well-developed literature using this specific approach is another cause for caution.

Chapter 6

Data Balancing

This chapter covers the balancing of data to be consistent with the new model structure. The terms are all in levels, with non-SALTER symbols used throughout.

6.1 National Data

Figure 6.1 shows the structure of a single region's data, noting all of the balancing conditions which must be satisfied. There are two slightly different interpretations of the figure. If inter-industry transactions are evaluated at factor cost, then the intermediate uses of investment are zero, and domestic investment (I_d^f and I_f^d) are gross of depreciation. If inter-industry transactions are evaluated at market prices, then the intermediate uses of investment equals depreciation, and domestic investment (I_d^f and I_f^d) are net of depreciation.

The sum of positive entries in the PRIV (private) column equals national product from the expenditure side, while the sum of the negative entries equals national product from the disposition side. These two are equal as long as the column sum is zero.

The fact that the column sum for the foreign (FOR) sector equals zero corresponds to the fact that the balance of payments as a whole must be must be zero for each region in the data. Thus the trade balance plus the capital account balance, plus the factor services account must add to zero.

The column sum for government equals zero, corresponding to the binding government budget constraint.

Figure 6.1: National Data

	A	M	S	INV	FOR	PRIV	GOV	Row Sum
A					X_A			Σ_A
M		INTERMEDIATE			X_M	C_d	G_d	Σ_M
S		USE			X_S			Σ_S
INV					I_d^f	I_d^d	0	Σ_I
L					0	$-L$	0	0
K		VALUE-ADDED			$-F_d^f$	$-F_d^d$	0	0
TAX					0	$+T_Y$	$-T$	0
A_f		INTERMEDIATE			$-M_A$			0
M_f		USE OF			$-M_M$	C_f	G_f	0
S_f		IMPORTS			$-M_S$			0
INV_f					$-I_f^d$	I_f^d	0	0
K_f					F_f^d	$-F_f^d$	0	0
G BONDS		ALL			B_d^f	B_d^d	$-B_d$	0
SERVICE		ZERO			$-S_d^f$	$-S_d^d$	S_d	0
F BONDS					$-B_f^d$	$+B_f^d$	0	0
SERVICE					S_f^d	$-S_f^d$	0	0
Transfers		ZERO			0	$-Tr$	Tr	0
F. Aid		ZERO			$-FA$	FA^p	FA^g	0
Col Sum	Σ_A	Σ_M	Σ_S	Σ_I	0	0	0	

Table 6.1: Row and Column Headings for National Data

Column Headings	
A	Agricultural industry/good
M	Manufacturing industry/good
S	Service industry/good
INV	Investment
FOR	Foreign sector
PRIV	Private sector
GOV	Government sector
Row Headings	
L	Labour
K	(Domestic) capital
TAX	Indirect and income taxes
A_f	Foreign agriculture
M_f	Foreign manufacturing
S_f	Foreign services
INV_f	Investment abroad
K_f	Foreign capital
G BONDS	Domestic government bonds
SERVICE	Service payments on domestic government debt
F BONDS	Foreign government bonds
SERVICE	Service payments on foreign government debt
Transfers	Transfers from the government to the private sector
F. Aid	Foreign aid and international transfers

6.2 Foreign Transactions

This section merely explains what each of the symbols in the foreign sector column of the national data table stands for.

$X_A \ldots X_S$ Merchandise and non-factor services exports of the three produced commodities at fob prices.

I_j^i Investment by region i investors in region j.

F_j^i Factor income receipts of region i on capital located in region j.

$M_A \ldots M_S$ Merchandise and non-factor services imports of the three produced commodities at landed prices (tariffs will be counted in the TAX row).

B_j^i Purchases by region i residents of region j government bonds.

B_d Total Sales of domestic government bonds.

S_j^i Payments to region i residents of region j (public) debt service.

S_d Total debt service paid on domestic government bonds.

T_r Domestic transfers.

FA Total foreign aid (and transfers). This is actually a balancing entry which corresponds (if you like) of imports of foreign "goodwill."

FA^p Total foreign aid from the private sector

FA^g Total foreign aid from the government.

6.3 Trade Flows Balance with Freight

Although the flows in the national tables need to be consistent with an overall balance in the balance of payments, the data set must be reconciled with the model in one further respect. While the national data on imports is at landed prices, the exports are at *fob* prices, leading to discrepancies between the values attributable to freight and insurance. In SALTER, these differences are counted as international freight, which is composed of trade and transportation services provided by a number of countries. In order for the data set as a whole to be balanced, we need each country to satisfy the balance of payments condition, but we also need the supply and demand for each good to be equal in terms of the *fob* values.

For international trade in trade and transportation services, exports must accommodate both the normal import demands, but also the international (i.e. not bilateral) demand for freight.

$$F = \sum_{i=1}^{S}\sum_{j=1}^{S}\sum_{k=1}^{N} \tau_{ij}^{k} X_{kj}^{i} \tag{6.1}$$

The world-wide demand for freight (F) equals the sum of the insurance and freight requirements for all exports. These requirements are calculated using margins(τ_{ij}^{k}) applicable to *fob* prices.

In turn, the freight must be provided as an export of the trade and transportation services sector.

$$X_T^i = \sum_{j=1}^{S} M_{Tj}^i + \theta_i F \tag{6.2}$$

X_T^i, the total exports of trade and transport services of region i must exceed the normal bilateral imports (M_{Tj}^i) by the amount available for contributing to international freight. The θ_i (country i's share of provision of trade and transportation services for freight) must add to one.

In order for the fully closed version of SALTER to balance, the values τ and θ used for balancing the data will have to correspond to those to be used in the model. Referring to figure 6.2, each row sum should be zero (total exports of each good must equal total imports), and the column sums for Oz, USA and Canada must equal the trade balance on merchandise and non-factor service trade. The amounts T_i equal total freight requirements for region i's imports.

The column sum for "Atlantis" should be zero, since it is merely an international clearing house using trade and transportation services to provide freight.

Figure 6.2: Trade Balance with Freight

	Oz	USA	CAN	Atlantis
A_O	EXPORTS	IMPORTS	IMPORTS	0
M_O	TO	FROM	FROM	0
S_O	CAN, USA	OZ	OZ	$-\theta^O F$
A_U	IMPORTS	EXPORTS	IMPORTS	0
M_U	FROM	TO	FROM	0
S_U	USA	OZ, CAN	USA	$-\theta^U F$
A_C	IMPORTS	IMPORTS	EXPORTS	0
M_C	FROM	FROM	TO	0
S_C	CAN	CAN	OZ, USA	$-\theta^C F$
F	$-T_O$	$-T_U$	$-T_C$	F

Chapter 7

Assorted Observations and Queries

This section contains a number of comments about SALTER, including some food for thought. Included in this chapter is a reaction to some suggestions contained in Tom Hertel's assessment of SALTER.

7.1 Specific Remarks on [4]

These remarks are first reactions to a number of features in SALTER working paper Number 4.

On Page 8, we see that a huge size disparity between sectors is possible in SALTER. There are some very small sectors like New Zealand paddy rice to huge ones like United States other private services. In non-linearised models this can occassionally cause huge (percentage) errors to be present in the smallest sectors, or even worse, they can prevent solution of the model. We wonder if it might be better to aggregate some of the smallest sectors, or eliminate them altogether.

It's unclear from the documentation wether trade barriers under the MFA are essentially MFN (same rates applied by Canada to all countries), or wether the protection is bilateral, with MFA countries treated much more harshly than high-cost non-MFA countries, and most low-cost non-MFA countries virtually excluded from developed markets.

7.2 Transportation Again

When freight costs rise, producers may spend more money designing and building lighter (or easier to ship and insure) products. This is an important mechanism whereby freight costs would affect goods producers. By contrast, the effect of transport costs on demanders of products are primarily felt by influencing their choice between goods from different sources.

Implicitly, any non-zero substitution elasticity between imports and freight implies a margin of substitution which in a sense doesn't exist. This is rather a lengthy discussion to argue that the fixed proportions in the landed price equation should not be changed unless there is a mechanism for producers to have some direct substitution between other inputs (perhaps primary factors only) and freight.

7.3 Trade Aggregation

Rob McDougall and John Zeitsch discussed combining the import aggregation as a strategy for simplifying the structure of the model, and perhaps speeding turnaround times. The gist of the simplification would be that each country would have one import aggregator for each good (e.g. finished capital goods), and then each "activity" would consume that aggregate of imported finished capital goods. This contrasts with the current implementation where each country has a different aggregator corresponding to each of 34 industries, plus those for consumption, final demand, government demand and investment demand.

The elimination of the added model complexity would generate some return in reducing the number of parameters to be specified, as well as reducing the computing resources needed for solution. The resulting loss of model flexibility is unlikely to be a major problem, given the state of our knowledge about inter-import substitution by different demand categories. Data collection and preparation would also be greatly simplified. At the same time, the savings in model complexity (in terms of the algebra) is unlikely to be a major consideration, since in most cases the model changes merely amount to reducing the number of subscripts on numerous arrays. Nonetheless, this change seems a worthwhile model modification.

7.4 Price Indeces in SALTER

The practice in SALTER, as in ORANI is to routinely calculate numerous price indeces for such magnitudes as GDP, consumption and investment. The indeces calculated are weighted averages of estimated price changes, using the new weights. The more usual practice in levels models is to base the price indeces on the original weights from a specified period (normally the benchmark). If SALTER is solved in a sequence of solutions as proposed, the interpretation of the price indeces so calculated is a bit unclear, since the base for calculation of the index will be different between the "base" for comparison and the counterfactual run. While this is unlikely to qualitatively affect the results, the situation could arise. If it was possible, an approach to eliminate the problem would be to routinely save the price weights from the original (benchmark) data to permit later calculation of normal Laysperre's price indeces. While this solution is simple in principle, it could be rather time-consuming in practice.

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Appendix A

Previous Model Treatment of Freight

Two of the relevant references to transportation-related services are as follows:

Landed Price Equation Equation 6.24 on page 115 of Working Paper #4 describes the relation between the landed price of imports and (i) the *fob* price, (ii) the price of transportation services:

$$p_{is}^{W_z} = S_{V_{is}}^{W_z}(p_{E_i}^s - e^s) + S_{F_{is}}^{W_z} p_T$$

In this equation, $p_{is}^{W_z}$ is the price (landed in region z) of good i from source region s. p_T is the price of transportation services, and e^s is the exchange rate. The first share parameter ($S_{V_{is}}^{W_z}$) refers to the share of the *fob* value in the imported price, while the second ($S_{F_{is}}$) is the share of freight.

Freight Price Equation Equation 6.25 on page 115 of the same document describes the determination of the price of transportation as a weighted sum of the prices of transportation in the different regions. The equation follows:

$$p_T = \sum_{s=1}^{S+1} S_{Fs}(p_{EJ}^s - e^s)$$

S_{F_s} is the share of region s freight in world-wide freight services. p_{EJ}^s is the price of region s freight.

Appendix B

Notes on the Balance of Payments

These notes briefly outline the relation between the international transactions in SALTER, and the overall balance of payments of a country under floating exchange rates. If properly specified, the normal national income accounts will imply the usual balance of payments conditions.

B.1 National Income Accounting

If we think in terms of the national income accounts for gnp.

B.2 Balance of Payments Accounting

In SALTER, international transactions of three types are present:

1. trade flows
2. factor-income (or factor-service income) flows
3. international investment

If a country is floating, its overall balance of payments equals zero (this is an identity). This can be related to three sub-balances in either of the following ways:

$$(X - M) + (K_d^f - K_a^d) = (F_d^f - F_a^d) \tag{B.1}$$

$$(X - M) + (K_d^f - K_a^d) + (F_a^d - F_d^f) = 0 \tag{B.2}$$

In words, the first says that the (merchandise and non-factor service) trade balance plus the capital account balance equals (minus) the balance on factor-services. In the case of SALTER, we will have endogenous investment flows, endogenous factor-income flows, and the possibility of endogenous trade balance also. We could add another balance equaling the balance on transfers, although there is no counterpart of this in SALTER. The capital account balance would have a different interpretation in a more complete model.

Table B.1: Definition of Symbols

X	Value of merchandise and non-factor services exports at border prices
M	Value of merchandise and non-factor services imports at border prices
K_d^f	Foreign direct investment in Australia
K_a^d	Australian investment abroad
F_a^d	Foreign factor-income payments received by Australians
F_d^f	Factor-income payments paid to foreign nationals

By way of an example, a country running a trade deficit (suppose there are no capital inflows or outflows) would have to run a surplus on factor-service income to maintain the balance of payments.

The point of this exercise is to point out that the trade balance, which is present in the model, but essentially exogenous, and the factor-service balance (which will be endogenous in the long run), and the capital account (which will be endogenous in the long run) are related by a balance of payments condition. Data for the long-run variant of the model should be consistent with condition B.2 or something closely resembling it. In particular, one might prefer a statement like the following:

$$(X - M) + (K_d^f - K_a^d) + (F_a^d - F_d^f) = C \tag{B.3}$$

Where C is some (positive or negative) constant representing parts of the balance of payments which are exogenous to our model (in particular transfers). In any event, in the model, it might be easier to treat some of these data in net (versus) gross flow terms.