

# The FTAP2 Model: Theory and Data

Research  
Memorandum

Cat No: MC 61

*George Verikios  
Xiao-guang Zhang*

October 2001

**This is an Internal  
Working Document.  
Research Memoranda do  
not necessarily reflect the  
views of the Productivity  
Commission and are not  
for quotation.**

© Commonwealth of Australia 2001

## **ISBN**

This work is subject to copyright. Apart from any use as permitted under the *Copyright Act 1968*, the work may be reproduced in whole or in part for study or training purposes, subject to the inclusion of an acknowledgment of the source. Reproduction for commercial use or sale requires prior written permission from Info Products. Requests and inquiries concerning reproduction and rights should be addressed to the Manager, Legislative Services, Info Products, Department of Finance and Administration, GPO Box 1920, Canberra, ACT, 2601.

### **Publications Inquiries:**

Media and Publications  
Productivity Commission  
Locked Bag 2 Collins Street East  
Melbourne VIC 8003

Tel: (03) 9653 2244  
Fax: (03) 9653 2303  
Email: [maps@pc.gov.au](mailto:maps@pc.gov.au)

### **General Inquiries:**

Tel: (03) 9653 2100 or (02) 6240 3200

### **An appropriate citation for this paper is:**

<include here, refer examples in style manual and over>

#### **The Productivity Commission**

The Productivity Commission, an independent Commonwealth agency, is the Government's principal review and advisory body on microeconomic policy and regulation. It conducts public inquiries and research into a broad range of economic and social issues affecting the welfare of Australians.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Information on the Productivity Commission, its publications and its current work program can be found on the World Wide Web at [www.pc.gov.au](http://www.pc.gov.au) or by contacting Media and Publications on (03) 9653 2244.

---

# Contents

<b>Contents</b>	<b>I</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Modifications to the theory of FTAP</b>	<b>3</b>
2.1 Introducing perfect capital mobility between all firms owned by a region	4
2.2 Removing wealth accumulation and ‘turning off’ the bond market	12
2.3 Substitution of imported services with domestically-produced services	13
2.4 Miscellaneous changes to the FTAP equation system	14
2.5 Closing FTAP2	15
<b>3 FDI stocks and rentals matrix</b>	<b>20</b>
3.1 Introduction	20
3.2 Creating a 3D FDI stocks matrix using RAS procedures: an outline	22
3.3 Creating 3D FDI stocks and rentals matrices: detailed procedures	24
3.4 Collating the 23 sector FDI stock matrices and calculating FDI rentals	30
<b>4 Incorporating impediments in the post-UR database using ALTERTAX</b>	<b>35</b>
4.1 Adjusting regional bond income data in GTAPICM	35
4.2 Splitting out telecommunications and banking services in the post-UR database	37
4.3 Applying impediment rates using ALTERTAX	43
<b>5 Splitting the post-UR, post-ALTERTAX database between domestic and foreign constituents</b>	<b>46</b>
5.1 Splitting domestic and foreign capital impediments	46
5.2 Splitting domestic and foreign firms’ production	48

---

5.3	Splitting domestic and foreign firm's exports and imports	51
	<b>References</b>	<b>57</b>

---

# Abbreviations and explanations

## Abbreviations

IAC	Industries Assistance Commission
IC	Industry Commission
PC	Productivity Commission

## Explanations

Billion	The convention used for a billion is a thousand million (10 <sup>9</sup> ).
Findings	<i>Findings in the body of the report are paragraphs highlighted using italics, as this is.</i>
Recommendations	<b><i>Recommendations in the body of the report are highlighted using bold italics with an outside border, as this is.</i></b>
Requests for further information	<i>Information requests are paragraphs highlighted using italics, as this is.</i>

---

# 1 Introduction

The FTAP2 model is a variant of the FTAP model (Hanslow, Phamduc and Verikios 2000), which is a comparative static, computable general equilibrium (CGE) model of the world economy with bilateral foreign direct investment (FDI). This research memorandum documents the modifications undertaken to FTAP to create FTAP2. It assumes the reader is familiar with Hanslow, Phamduc and Verikios (2000), Hanslow et al. (2000) and Verikios and Zhang (2001). The memorandum is organised as follows.

Chapter 2 describes the theoretical modifications to the FTAP equation system. Differences in both theory and data exist between FTAP and FTAP2. The main theoretical difference is that FTAP2 assumes greater flexibility in the movement of capital between regions and sectors. FTAP2 also assumes that certain imported services delivered via cross-border supply, telecommunications and financial services, are not substitutable with their domestically produced equivalents. In addition, the international bond market is eliminated as a source of additional borrowing or lending in policy simulations.

The FTAP2 database consists of 19 regions and eight commodities. It has the same regional detail as FTAP, but greater commodity detail for services (see table 1.1 for a concordance between FTAP and FTAP2 sectors and regions). Where FTAP has three highly aggregated sectors (primary, secondary and tertiary), FTAP2 also has a primary and secondary sector, but *six* services sectors, five of which are traded between regions. The procedure followed in constructing the FTAP2 database largely tracks that used in constructing the FTAP database. An important element of the modified database is the construction of FDI stocks and rentals data. The sources and construction of FDI data is described in chapter 3. As with the FTAP database, once the FDI data has been constructed, the impediments to services trade data must be incorporated into the post-Uruguay Round (UR) of multilateral trade negotiations database provided by the work of Verikios and Hanslow (1999). The impediments data are incorporated using the ALTERTAX procedure documented in Malcolm (1998). This procedure is described in chapter 4. Chapter 5 explains how the industries in the post-ALTERTAX database are split between foreign and domestic constituents.

---

**Table 1.1      Concordance between FTAP and FTAP2 sectors and regions**

---

<i>FTAP/FTAP2 region with abbreviation</i>	<i>FTAP sector with abbreviation</i>	<i>FTAP2 sector with abbreviation</i>
1. Australia (AUS)	1. Primary (pri)	1. Primary (pri)
2. New Zealand (NZL)	2. Secondary (sec)	2. Secondary (sec)
3. Japan (JPN)	3. Tertiary (ter)	3. Construction (con)
4. Korea (KOR)	3. Tertiary (ter)	4. Trade and transport (tt_)
5. Indonesia (IDN)	3. Tertiary (ter)	5. Telecommunications (cmn)
6. Malaysia (MYS)	3. Tertiary (ter)	6. Finance, insurance and business services (fib)
7. Philippines (PHL)	3. Tertiary (ter)	7. Other services (osr)
8. Singapore (SGP)	3. Tertiary (ter)	8. Dwellings (dwe)
9. Thailand (THA)		
10. China (CHN)		
11. Hong Kong (HKG)		
12. Taiwan (TWN)		
13. Canada (CAN)		
14. United States of America (USA)		
15. Mexico (MEX)		
16. Chile (CHL)		
17. Rest of Cairns group (ROC)		
18. European Union (EUN)		
19. Rest of the world (RST)		

---

---

## 2 Modifications to the theory of FTAP

Three major modifications to the theory of FTAP are described in this chapter:

- the introduction of increased capital mobility between regions and sectors;
- fixing regional wealth, regional bond holdings and the world bond rate; and
- the assumption that certain imported services are not substitutable with their domestically-produced equivalents.

In FTAP, physical capital is one of four assets which make up wealth owned by each region, with land, natural resources and net bond holdings (net foreign debt) being the other three. Capital can move between regions via two mechanisms: the direct allocation of capital through commercial presence (FDI) by firms from other regions, or the acquisition of capital from other regions through borrowing. The direct allocation of capital is controlled by a set of nested CET capital supply functions. As such, FTAP assumes that capital assets used by firms in different sectors and regions are different and not perfectly transformable by users.

FTAP2 adopts a different approach to capital supply. Capital is assumed to be homogenous for all firms and foreign affiliates originating from the same region. The capital owner maximises total returns by allocating capital between firms from its home region and located in different sectors or regions. Assuming such rational behaviour ensures that, in equilibrium, the (post-tax) *expected* rates of return to capital used by all firms from the same region are equalised.

The expected rate of return is risk-adjusted. Capital investment involves uncertainty and risk. A high market rate of return may not be achievable because of the potential high risk involved. Therefore, when investors make investment decisions they normally adjust the market rate of return by the probability of not receiving it. The rate of return that the capital owner responds to in FTAP2 is defined as the risk-adjusted or the expected rate of return, rather than the observed market rate of return. This is different from FTAP, which uses *market* rates of return to capital taken directly from Disclosure (1999) and assumes no equalisation of rates of return. By assuming arbitrage of expected rates of return, FTAP2 implies a greater degree of capital mobility than FTAP.

FTAP allows regional capital stocks (and wealth) to accumulate over time, and net foreign debt of each region can adjust to help finance the accumulation of domestic

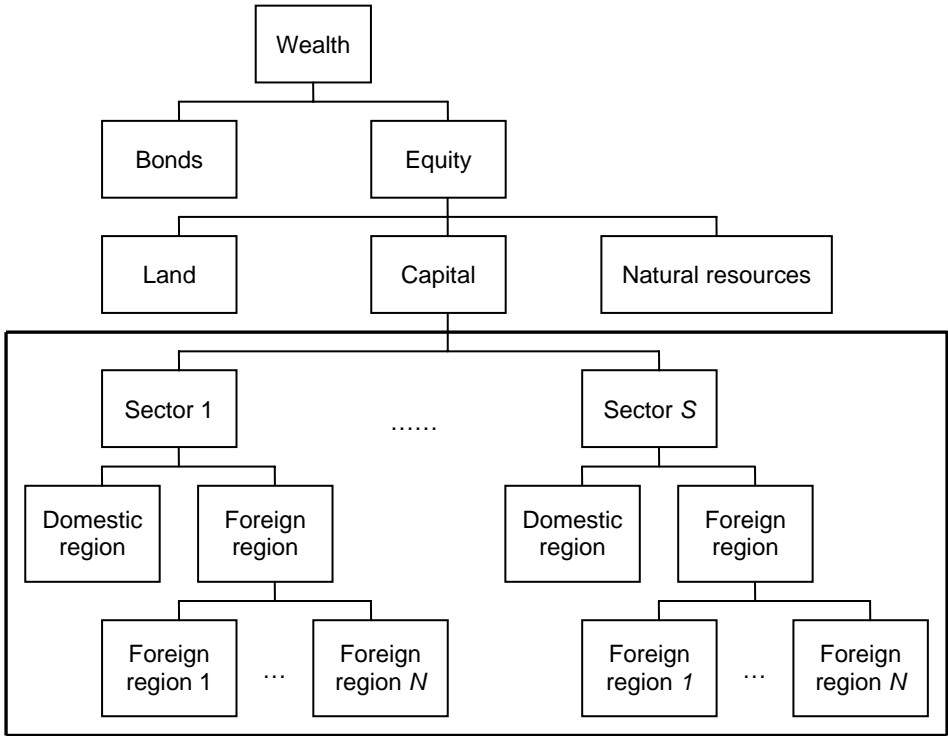


and foreign capital by each region’s investors. FTAP2 fixes regional wealth by removing the wealth accumulation mechanism in FTAP. Regional bond holdings are also held fixed, as is the world bond rate. Physical capital can still move between regions to exploit differences between rates of return in different sectors and regions.

## 2.1 Introducing perfect capital mobility between all firms owned by a region

The capital (and wealth) supply structure in FTAP is shown in figure 2.1. This structure is composed of a set of CET functions representing the supply of capital at the different sectoral and regional levels. To minimise the required changes to the structure of the FTAP model, the nested capital supply structure is retained and the CET function at each level of the capital supply nest is replaced with an arbitrage condition.

Figure 2.1 Allocation of wealth and capital by a home region in FTAP



Source: Modified from figure 2.3 of Hanslow, Phamduc and Verikios (2000).

FTAP uses five levels of CET functions to specify the allocation of a region’s wealth, which includes the allocation of capital across sectors and regions. From the top level down, the five levels are:

- 
- the allocation of wealth between bonds and equity in productive assets (CET level 1);
  - the allocation of equity (in productive assets) between capital, land and natural resources within a region (CET level 2);
  - the allocation of capital between sectors (CET level 3);
  - the allocation of capital within each sector between domestic and foreign regions (CET level 4); and
  - the allocation of outward FDI within each sector between different foreign regions (CET level 5).

The adoption of CET capital supply functions in FTAP assumes that capital is a firm-specific asset and imperfectly transformable between different sectors and regions. The responsiveness of capital supply to any change in its price and the prices of other capital assets, therefore, is determined by the adopted values of the elasticity of transformation. Moreover, the price of capital is defined as the reciprocal of the market rate of return to capital. This imposes very deterministic capital supply behaviour. As such, a fall in the impediment-inclusive rate of return (due to the removal of a barrier to FDI) will prompt the price and supply of capital to rise exactly to a level, at which the post-simulation value of rentals fully compensate for the rentals lost due to the fall in the impediment-inclusive rate of return.

The main task in modifying this capital allocation structure is to replace each CET function by an arbitrage condition. The CET function defines the ‘Petri’ value of a capital asset as a function of its own price and the prices of the assets which it is imperfectly transformable with.<sup>1</sup> The arbitrage condition, on the other hand, defines the rates of return to all capital assets owned by a region as equal with each other. This implies that the capital owned by a region is perfectly mobile among the region’s domestic firms and their overseas affiliates in all sectors.

For convenience, the CET functions are replaced one level at a time from the bottom level up. These changes are presented below in TABLO code (Harrison and Pearson 1996), and the original and modified code is presented from the FTAP2 TABLO input file to aid in describing the changes made. Deleted equations are presented in shaded boxes and new equations are presented in unshaded boxes.

---

<sup>1</sup> Petri asset values are described and discussed in detail in appendix C of Hanslow, Phamduc and Verikios (2000).

---

## CET Level 5: Imperfect transformation of outward FDI in each sector between different foreign regions

Two steps are required to convert the CET function to an arbitrage condition at this level. First, the existing CET equation  $E\_k\_hhi$  for the variable  $k\_hhi(i,s,d)$ , which defines the supply of outward FDI stocks by region  $s$  in industry  $i$  in region  $d$ , is deleted

```
EQUATION E_k_hhi (All,i,TRAD_COMM)(All,s,home)(All,d,host)
  k_hhi(i,s,d)-kf_h_i(i,s)=
KTRA_HHI(i,s,d)*[-r_rr_hhi(i,s,d)-c_rrf_h_i(i,s)]
```

and is replaced by the arbitrage condition in the new equation  $E\_c\_rr\_hhi2$ , which equalises the percentage changes in the rates of return to capital used in each sector by the foreign affiliates of home-region firms.

```
EQUATION E_c_rr_hhi2 (All,i,TRAD_COMM)(All,s,home)(All,d,host)
  IF[VFDI_HHI(i,s,d) NE 0, C_c_rr_hhi(i,s,d)*c_rr_hhi(i,s,d)-
C_c_rrf_h_i(i,s)*c_rrf_h_i(i,s)]=
IF[VFDI_HHI(i,s,d)=0,k_hhi(i,s,d)];
```

As the rates of return on capital in industry  $i$  in region  $d$  owned by region  $s$ ,  $c\_rr\_hhi(i,s,d)$ , and foreign capital in industry  $i$  owned by region  $s$ ,  $c\_rrf\_h\_i(i,s)$ , are absolute change variables, they are multiplied by the reciprocal of (or divided by) their coefficient equivalents,  $C\_c\_rr\_hhi(i,s,d)$  and  $C\_c\_rrf\_h\_i(i,s)$ , respectively. This expresses the arbitrage condition in percentage change form.  $C\_c\_rr\_hhi(i,s,d)$  and  $C\_c\_rrf\_h\_i(i,s)$  are new coefficients defined below.

```
FORMULA (All,i,TRAD_COMM)(All,s,home)(All,d,host)
  C_c_rr_hhi(i,s,d)=
IF[EVIFMS(i,s,d) NE 0, VFDI_HHI(i,s,d)/EVIFMS(i,s,d)];
FORMULA (All,i,TRAD_COMM)(All,d,home)
  C_c_rrf_h_i(i,d)=
IF[sum(s,HOST,EVIFMS(i,d,s)) NE 0,
VFDI_H_I(i,d)/sum(s,HOST,EVIFMS(i,d,s))];
```

As not all home regions invest in every sector of each host region, many elements of the variable  $c\_rr\_hhi(i,s,d)$  are zero. As a result, a conditional expression is used in equation  $E\_c\_rr\_hhi2$ , and in various places throughout the TABLO code, to avoid calculation of undefined variables.

The second step required to convert the CET function to an arbitrage condition at this level is the deletion of equation E\_c\_rrf\_h\_i for the variable defining the Petri asset weighted sum of outward FDI,  $kf\_h\_i(i,s)$ ,

```
EQUATION E_c_rrf_h_i (All,i,TRAD_COMM)(All,s,home)
  IF{VKF_H_I(i,s) NE 0, sum(d,dest,VK_HHI(i,s,d)*[k_hhi(i,s,d)-
kf_h_i(i,s)])}=IF{VKF_H_I(i,s)=0,c_rrf_h_i(i,s)}
```

$kf\_h\_i(i,s)$  is redefined as the normal asset weighted sum of outward FDI in equation E\_kf\_h\_i2

```
EQUATION E_kf_h_i2 (All,i,TRAD_COMM)(All,s,home)
  IF{VFDI_H_I(i,s) NE 0, sum(d,dest,VFDI_HHI(i,s,d)*[k_hhi(i,s,d)-
kf_h_i(i,s)])}=IF{VFDI_H_I(i,s)=0,c_rrf_h_i(i,s)}
```

#### **CET Level 4: Imperfect transformation of capital between domestic and foreign regions within a sector**

Three changes are required to convert the two CET functions at this level to arbitrage conditions, which equalise the expected rates of return to capital for domestic firms and their foreign affiliates in each sector. First, the CET equation E\_kd\_h\_i for the variable defining the supply of domestic capital by region  $s$  in industry  $i$ ,  $kd\_h\_i(i,s)$ , is deleted.

```
EQUATION E_kd_h_i (All,i,TRAD_COMM)(All,s,home)
  kd_h_i(i,s)-k_h_i(i,s)=
KTRAD_H_I(i,s)*[-r_rrd_h_i(i,s)-c_rr_h_i(i,s)]
```

It is replaced by the equation E\_c\_rrd\_h\_i2, which equates the percentage change in the rate of return to domestic capital owned by region  $s$  in industry  $i$ ,  $c\_rrd\_h\_i(i,s)$ , with the percentage change in the rate of return to total capital owned by region  $s$  in industry  $i$ ,  $c\_rr\_h\_i(i,s)$ ,

```
EQUATION E_c_rrd_h_i2 (All,i,TRAD_COMM)(All,s,home)
  IF[VKD(i,s) NE 0,
C_c_rrd_h_i(i,s)*c_rrd_h_i(i,s)-C_c_rr_h_i(i,s)*c_rr_h_i(i,s)]=
IF[VKD(i,s)=0,kd_h_i(i,s)];
```

Where  $C\_c\_rrd\_h\_i(i,s)$  is a coefficient defining the reciprocal of the rate of return on domestic capital owned by region  $s$  in industry  $i$ , and  $C\_c\_rr\_h\_i(i,s)$  is a coefficient defining the reciprocal of the rate of return on total capital owned by region  $s$  in industry  $i$ , both defined below

---

```

FORMULA (All,i,TRAD_COMM)(All,d,host)
  C_c_rrd_h_i(i,d)=VKD(i,d)/EVDFM(i,d);
FORMULA (All,i,TRAD_COMM)(All,d,host)
  C_c_rr_h_i(i,d)=
  [VKDI(i,d)+VFDI_H_I(i,d)]/[EVDFM(i,d)+sum(s,HOST,EVIFMS(i,d,s))];

```

The second change required at this level is the deletion of the CET equation  $E_{kf\_h\_i}$  which determines the variable for total outward FDI owned by region  $s$  in industry  $i$ ,  $kf\_h\_i(i,s)$

```

EQUATION E_kf_h_i (All,i,TRAD_COMM)(All,s,home)
  kf_h_i(i,s)-k_h_i(i,s)=
  KTRAF_H_I(i,s)*[c_rrf_h_i(i,s)-c_rr_h_i(i,s)]

```

This equation is replaced by the arbitrage condition in equation  $E_{c\_rrf\_h\_i2}$ , which equates the percentage change in the rate of return to FDI owned by region  $s$  in industry  $i$ ,  $c\_rrf\_h\_i(i,s)$ , with the percentage change of the rate of return to total capital owned by region  $s$  in industry  $i$ ,  $c\_rr\_h\_i(i,s)$ ,

```

EQUATION E_c_rrf_h_i2 (All,i,TRAD_COMM)(All,s,home)
  IF[VFDI_H_I(i,s) NE 0,
  C_c_rrf_h_i(i,s)*c_rrf_h_i(i,s)-C_c_rr_h_i(i,s)*c_rr_h_i(i,s)]=
  IF[VFDI_H_I(i,s)=0,kf_h_i(i,s)];

```

Where  $C_{c\_rrf\_h\_i}(i,s)$  is a coefficient defining the reciprocal of the rate of return on outward FDI in industry  $i$  owned by region  $s$ , defined below

```

FORMULA (All,i,TRAD_COMM)(All,d,home)
  C_c_rrf_h_i(i,d)=IF[sum(s,HOST,EVIFMS(i,d,s)) NE 0,
  VFDI_H_I(i,d)/sum(s,HOST,EVIFMS(i,d,s))];

```

The third change required is to delete equation  $E_{c\_rr\_h\_i}$  defining the variable for the Petri asset weighted sum of domestic capital and outward FDI owned by region  $s$  in industry  $i$ ,  $k\_h\_i(i,s)$ ,

```

EQUATION E_c_rr_h_i (All,i,TRAD_COMM)(All,s,home)
  IF{VK_H_I(i,s) NE 0,
  VKD_H_I(i,s)*kd_h_i(i,s)+VKF_H_I(i,s)*kf_h_i(i,s)-
  VK_H_I(i,s)*k_h_i(i,s)}=IF{VK_H_I(i,s)=0,c_rr_h_i(i,s)};

```

which is redefined as the normal asset weighted sum of domestic capital and outward FDI in equation  $E_{k\_h\_i2}$

---

```

EQUATION E_k_h_i2 (All,i,TRAD_COMM)(All,s,home)
  IF{VKTI(i,s) NE 0,
VKD(i,s)*kd_h_i(i,s)+VFDI_H_I(i,s)*kf_h_i(i,s)-
VKTI(i,s)*k_h_i(i,s)}=IF{VKTI(i,s)=0,c_rr_h_i(i,s)}

```

### CET Level 3: Imperfect transformation of capital owned by a region between different sectors

Two changes are required at this level of the CET nest. First, the CET equation  $E_{k\_h\_i}$  defining the variable for total capital owned by region  $s$  in industry  $i$ ,  $k_{h\_i}(i,s)$ , is deleted

```

EQUATION E_k_h_i (All,i,TRAD_COMM)(All,s,home)
  k_h_i(i,s)-k_h__(s)=KTRA_H_I(i,s)*[c_rr_h_i(i,s)-c_rr_h__(s)]

```

and is replaced by the new equation  $E_{c\_rr\_h\_i}$ , which defines the percentage change in the rate of return to capital owned by region  $s$  to be equal in all industries

```

EQUATION E_c_rr_h_i (All,i,TRAD_COMM)(All,s,home)
  IF{VKTI(i,s) NE 0, C_c_rr_h_i(i,s)*c_rr_h_i(i,s)-
C_c_rr_h__(s)*c_rr_h__(s)}=IF{VKTI(i,s)=0,k_h_i(i,s)};

```

In this new equation, the three new coefficients are the reciprocal of the rate of return on capital owned by region  $s$  in industry  $i$ ,  $C_{c\_rr\_h\_i}(i,s)$ , the reciprocal of the rate of return on total capital owned by region  $s$ ,  $C_{c\_rr\_h\_}(s)$ , and the asset value of capital in industry  $i$  owned by region  $s$ ,  $VKTI(i,s)$ , all defined below

```

FORMULA (All,i,TRAD_COMM)(All,d,host)
  C_c_rr_h_i(i,d)=
[VKD(i,d)+VFDI_H_I(i,d)]/[EVDFM(i,d)+sum(s,HOST,EVIFMS(i,d,s))];
FORMULA (All,d,host)
  C_c_rr_h__(d)=sum(i,TRAD_COMM,(VKD(i,d)+VFDI_H_I(i,d)))/
sum(i,TRAD_COMM,(EVDFM(i,d)+sum(s,HOST,EVIFMS(i,d,s))));
FORMULA (All,i,TRAD_COMM)(All,s,HOME)
  VKTI(i,s)=VFDI_H_I(i,s)+VKD(i,s);

```

where  $VFDI\_H\_I(i,s)$  is a new coefficient defining the asset value of FDI stock in each industry owned by region  $s$ ,

```

FORMULA (All,i,TRAD_COMM)(All,s,home)
  VFDI_H_I(i,s)= sum(d,HOST,VFDI_HHI(i,s,d));

```

The second change at this level is the deletion of equation  $E\_c\_rr\_h\_$  determining the variable defining the Petri asset weighted sum of capital owned by region  $s$ ,  $k\_h\_ (s)$ ,

```
EQUATION E_c_rr_h_ (All,s,home)
  IF{VK_H_(s) NE 0, sum(i,TRAD_COMM,VK_H_I(i,s)*[k_h_i(i,s)-
k_h_(s)])}= IF{VK_H_(s)=0,c_rr_h_(s)}
```

and  $k\_h\_ (s)$  is redefined as the normal asset weighted sum of capital in equation  $E\_c\_rr\_h\_$ ,

```
EQUATION E_c_rr_h_ (All,s,home)
  IF{VKT(s) NE 0, sum(i,TRAD_COMM, VKTI(i,s)*[k_h_i(i,s)-
k_h_(s)])}=IF{VKT(s)=0,k_h_(s)}
```

## CET Level 2: Imperfect transformation of equity between capital, land and natural resources owned by a region

It should be noted that at this level there is no transformation of equity between capital and other productive assets in FTAP, as land and natural resources are fixed at the sectoral level in all regions. As a result, the CET equations for land and natural resources are replaced by the original GTAPICM equations determining the purchase price of these two factors. The CET equation for capital is replaced by an arbitrage condition between capital and bonds. This requires that the CET function for the variable defining the aggregate supply of capital by home region  $s$ ,  $k\_h\_ (s)$ , in equation  $E\_k\_h\_$ , be deleted

```
EQUATION E_k_h_ (All,s,home)
  k_h_(s)-qer(s)=KTRA_H_(s)*[c_rr_h_(s)-rer(s)];
```

It is replaced by the following arbitrage condition, which equates the percentage change in the rate of return to capital owned by region  $s$  with the bond rate in region  $s$ ,  $rbr(s)$ ,

```
EQUATION E_k_h_ (All,s,home)
  C_rbr(s)*c_rr_h_(s)=C_rbr(s)*rbr(s)+frbr(s);
```

where  $C\_rbr(s)$  is a new coefficient defining the reciprocal of the rate of return on bonds in region  $s$ , and  $frbr(s)$  is a new slack variable used for swapping with the absolute change in the bond-income ratio in region  $s$ ,  $qybr(s)$ , to ‘switch off’ equation  $E\_k\_h\_$ ,

---

**FORMULA** (All, d, host)

$$C\_rbr(d) = 1 / RTBDR(d);$$

The second change at this level is the deletion of the two CET equations  $E\_pnr$  and  $E\_pnrr$  for land and natural resources, defining the purchase price of land,  $pnr(r)$ , and the purchase price of natural resources,  $pnrr$ , respectively.

**EQUATION**  $E\_pnr$  (All, r, REG)

$$mt(r) - qer(r) = KTRA\_H\_\_(r) * [-r\_rr\_land(r) - rer(r)];$$

**EQUATION**  $E\_pnrr$  (All, r, REG)

$$nru(r) - qer(r) = KTRA\_H\_\_(r) * [-r\_rr\_natres(r) - rer(r)];$$

Two GTAPICM equations are then restored for the purchase price of land and natural resources,  $pnr(r)$  and  $pnrr(r)$ , respectively

**EQUATION**  $E\_pnr$  (All, r, REG)

$$c\_rr\_h\_\_(r) = RTBD * (rm(r) - pnr(r));$$

**EQUATION**  $E\_pnrr$  (All, r, REG)

$$c\_rr\_h\_\_(r) = RTBD * (nrp(r) - pnrr(r));$$

## CET Level 1: Imperfect transformation of private wealth between equity and bonds owned by a region

The first change at this level is the deletion of the CET equation  $E\_qbr$  determining the variable for the supply of bonds by region  $s$ ,  $qbr(s)$

**EQUATION**  $E\_qbr$  (All, s, home)

$$qhr(s) - qbr(s) = KTRA\_H\_\_(s) * [rhr(s) + CRED\_DEBT(s) * r\_rbr(s)];$$

Which is now replaced by an equation determining the variable for the absolute change in the rate of return on private wealth owned by region  $s$ ,  $rhr(s)$

**EQUATION**  $E\_qbr$  (All, s, home)

$$rhr(s) = \{ [VKTR(s) + MTT(s) + NTT(s) + YCHHITR(s)] / [VKT(s) + ASLNR(s) + ASLNRR(s) + ASHHBDR(s)] \} * [rphr(s) - ipahr(s)];$$

in which a new variable,  $rphr(r)$ , the rental price of private wealth owned by region  $r$ , is defined as

**EQUATION**  $E\_rphr$  (All, r, HOME)

$$[VKTR(r) + MTT(r) + NTT(r) + YCHHITR(r)] * rphr(r) = VKTR(r) * rpk\_h\_\_(r) + MTT(r) * rm(r) + NTT(r) * nrp(r) + YCHHITR(r) * prentb(r)$$



The second change at this level is the removal of the CET equation  $E_{qer}$  for the supply of total equity in productive assets by region  $s$ ,  $qer(s)$

$$\text{EQUATION } E_{qer} \text{ (All, s, home)} \\ qhr(s) - qer(s) = KTRA\_H\_\_(s) * [rhr(s) - rer(s)];$$

Which is replaced by an equation determining the absolute change in the rate of return to equity owned by region  $s$ ,  $rer(s)$

$$\text{EQUATION } E_{rer} \text{ (All, s, home)} \\ rer(s) = \{ [VKTR(s) + MTT(s) + NTT(s)] / [VKT(s) + ASLNR(s) + ASLNRR(s)] \} \\ * [rper(s) - iper(s)];$$

in which  $rper(r)$ , the rental price of equity owned by region  $r$ , is a new variable, defined as

$$\text{EQUATION } E_{rper} \text{ (All, r, HOME)} \\ [VKTR(r) + MTT(r) + NTT(r)] * rper(r) = \\ VKTR(r) * rp_k\_h\_\_(r) + MTT(r) * rm(r) + NTT(r) * nrp(r);$$

where  $rp_k\_h\_\_(r)$ , the rental price of capital owned by region  $r$ , is a new variable, defined as

$$\text{EQUATION } E_{rp_k\_h\_\_} \text{ (All, r, HOME)} \\ \text{sum}[i, \text{TRAD\_COMM}, \text{EVDFM}(i, r) + \\ \text{sum}[d, \text{HOST}, \text{EVIFMS}(i, r, d)]] * rp_k\_h\_\_(r) = \\ \text{sum}[i, \text{TRAD\_COMM}, \text{EVDFM}(i, r) * rpd(i, r)] + \\ \text{sum}[i, \text{TRAD\_COMM}, \text{sum}[d, \text{HOST}, \text{EVIFMS}(i, r, d) * rps(i, r, d)]];$$

The third change made at this level is the removal of equation  $E_{rer}$  for the Petri asset value of equity owned by region  $s$ ,  $qer(s)$

$$\text{EQUATION } E_{rer} \text{ (All, s, home)} \\ VKT(s) * k\_h\_\_(s) + VLAND(s) * mt(s) + VNATRES(s) * nru(s) = \\ [VK\_H\_\_(s) + VLAND(s) + VNATRES(s)] * qer(s);$$

which is redefined as the normal asset value weighted sum of land, natural resources and capital in equation  $E_{qer}$

$$\text{EQUATION } E_{qer} \text{ (All, s, home)} \\ [VKT(s) + ASLNR(s) + ASLNRR(s)] * qer(s) = \\ VKT(s) * k\_h\_\_(s) + ASLNR(s) * mt(s) + ASLNRR(s) * nru(s);$$

The fourth change at this level is the deletion of equation  $E\_rhr$  for the Petri asset value of private wealth,  $qhr(s)$

$$\begin{aligned} \text{EQUATION } E\_rhr \text{ (All, s, home)} \\ [VK\_H\_ (s) + VLAND(s) + VNATRES(s) + VBR(s)] * qhr(s) = \\ [VK\_H\_ (s) + VLAND(s) + VNATRES(s)] * qer(s) + VBR(s) * qbr(s); \end{aligned}$$

which is redefined as the normal asset value weighted sum of capital and bonds in equation  $E\_rhr$

$$\begin{aligned} \text{EQUATION } E\_rhr \text{ (All, s, home)} \\ [VKT(s) + ASLNR(s) + ASLNRR(s) + ASHHBDR(s)] * qhr(s) = \\ [VKT(s) + ASLNR(s) + ASLNRR(s)] * qer(s) + ASHHBDR(s) * qbr(s); \end{aligned}$$

A new variable is created to aggregate total outward FDI owned by a region,  $kf\_h\_ (s)$ , and is determined by the equation  $E\_kf\_h\_$

$$\begin{aligned} \text{EQUATION } E\_kf\_h\_ \text{ (All, s, home)} \\ VFDI\_H\_ (s) * kf\_h\_ (s) = \text{sum}(i, \text{TRAD\_COMM}, VFDI\_H\_I(i, s) * kf\_h\_i(i, s)) \end{aligned}$$

where  $VFDI\_H\_ (s)$  is a new coefficient representing the asset value of FDI stocks owned by region  $s$ ,

$$\begin{aligned} \text{FORMULA (All, s, home)} \\ VFDI\_H\_ (s) = \text{sum}(i, \text{TRAD\_COMM}, VFDI\_H\_I(i, s)); \end{aligned}$$

## 2.2 Removing wealth accumulation and ‘turning off’ the bond market

FTAP2 assumes that regional real wealth is given. This is done to minimise the effects of inter-regional borrowing and lending on the rest of the model.<sup>2</sup> To implement this change, the wealth accumulation equations for the private household and government sector need to be removed.

<sup>2</sup> The values of regional net bond holdings in FTAP2 are not based on the original data in the updated GTAPICM database. They are the residual of regional bond holdings in GTAPICM after regional outward FDI stocks have been subtracted in the process of generating the FTAP2 database (which is described in the following chapters). The use of the term ‘bond’ is also misleading because there is no repayment of principal by borrowing regions. As a result, inter-regional borrowing and lending is much higher than it otherwise would be in FTAP policy simulations.

To fix private household wealth in each region the equation HHOLD\_WEALTH\_ACCN determining household wealth accumulation is deleted,

```

EQUATION HHOLD_WEALTH_ACCN (all,r,REG)
  ASHHR(r)*ahr(r)=
  (ASHHR(r)-CEACWTHH01R(r)*SVT(r)*LGPRSM)*ipahr(r)
  +CEACWTHH01R(r)*YCHHDPR(r)*LGPRSM*qyhsr(r)
  +CEACWTHH01R(r)*SVT(r)*LGPRSM*ppriv(r)
  +CEACWTHH02R(r)*SVT(r)*LGPRSM*(yhdr(r)-ppriv(r));

```

and the variable for real household wealth,  $q_{hr}(r)$ , is set as exogenous.

To fix real government wealth in each region the equation GOVT\_WEALTH\_ACCN determining the variable defining the absolute change in the government bond-income ratio,  $q_{rgbr}(r)$ , is deleted,

```

EQUATION GOVT_WEALTH_ACCN (all,r,REG)
  RCGVR(r)*qrgbr(r)+ASGVR(r)*rgr(r)=
  (ASGVR(r)-CEACWTGV01R(r)*SPGVR(r)*LGPRSM)*(pbr(r)!+er(r)!)
  +CEACWTGV01R(r)*RCGVR(r)*LGPRSM*qrgsr(r)
  +CEACWTGV01R(r)*SPGVR(r)*LGPRSM*pgov(r)
  +CEACWTGV02R(r)*SPGVR(r)*LGPRSM*(rgr(r)-pgov(r));

```

and  $q_{rgbr}(r)$  is then set as exogenous. During policy simulations, the absolute change in the regional bond-income ratio,  $q_{ybr}(r)$ , and the absolute change in the global bond rate,  $r_b$ , are also set as exogenous to avoid unrestricted borrowing and lending, while all components of  $f_{rbr}(r)$  are made endogenous.<sup>3</sup> The underlying assumption is that the net foreign debt position of each region, measured as a share of income in the database, is a long-run equilibrium position and will not be altered by policy changes.<sup>4</sup>

## 2.3 Substitution of imported services with domestically-produced services

FTAP2 assumes that imported telecommunications and financial services delivered via cross-border supply are not substitutable for their domestically produced

<sup>3</sup> One region's bond-income ratio (Japan) is selected to be endogenous to allow for the bond rate to be exogenous and to avoid over-determining the model, as the world net ownership of bonds,  $q_{yb}$ , is also fixed.

<sup>4</sup> A proper treatment of foreign debt in a dynamic setting would allow for the repayment of principal as well as interest, unlike the interest-only bond payments in FTAP.

counterparts. This is done to reflect the fact that cross-border services of this kind are inputs to international transactions and cannot be directly consumed by domestic users. Thus, in order to avoid composite cross-border services being substituted for their domestically-produced equivalents, the elasticity parameter  $ESUBD(i)$  is set to 0.1 for telecommunications and financial services. Further, to avoid cross-border services from different regions being substituted for each other, the elasticity parameter  $ESUBM(i)$  is set to 0.2 for telecommunications and financial services.

## 2.4 Miscellaneous changes to the FTAP equation system

There are two FTAP coefficients which determine the share of tax revenue that is genuine and the share that are impediment rents created by barriers to trade in services. They are  $SHPTAX(i,r)$  and  $SHXTAXD(i,s,d)$ , which represent the share of output rent which is tax revenue and the share of export restriction rent which is tax revenue, respectively. These coefficients are determined by the following formulas,

```

FORMULA (Initial) & EQUATION (Levels) E_c_SHPTAX
(All,i,PROD_COMM)(All,r,REG)
    SHPTAX(i,r)=1-!0*!IF[$POS(i,PROD_COMM)=3,1];
FORMULA (Initial) (All,i,TRAD_COMM)(All,s,SOURCE)(All,d,DEST)
    SHXTAXD(i,s,d)=1-IF[$POS(i,TRAD_COMM)=3,1-TYPR_L(s)];

```

It is obvious that these formulas set  $SHPTAX(i,r)$  and  $SHXTAXD(i,s,d)$  constant at one for all commodities except commodity three, which is constant at zero. This suits the three commodity aggregation in FTAP where all output rents from the tertiary sector are due to impediments to ongoing operations, and where all export rents from the tertiary sector are due to impediments to cross-border trade. In FTAP2, however, the sectors for which impediments data are applied are in positions five (telecommunications) and six (finance, insurance and business services) (see table 1.1). Thus, the two formulas determining these coefficients are modified as follows,

```

FORMULA (Initial) & EQUATION (Levels) E_c_SHPTAX
(All,i,PROD_COMM)(All,r,REG)
    SHPTAX(i,r)=1-!0*!IF[$POS(i,PROD_COMM)=5,1]-
    IF[$POS(i,PROD_COMM)=6,1];
FORMULA (Initial) (All,i,TRAD_COMM)(All,s,SOURCE)(All,d,DEST)
    SHXTAXD(i,s,d)=1-IF[$POS(i,TRAD_COMM)=5,1-TYPR_L(s)]-
    IF[$POS(i,TRAD_COMM)=6,1-TYPR_L(s)];

```

---

This change also needs to be made to all TABLO generated programs used in splitting the post-ALERTAX database between domestic and foreign constituents (see chapter 5).

In initial simulations of the removal of barriers to trade in telecommunications, the substitution of capital for labour in certain regions was so great that the use of capital increased hundreds of per cent. To avoid such unrealistic results, the elasticity of substitution between capital and labour in the production of value-added, the coefficient  $ESUBVA(j)$ , for telecommunications was reduced from around 1.68 to around one. The original value of  $ESUBVA(j)$  for telecommunications was equal to the value for the more aggregated trade, transport and communications sector. This change is consistent with the view that the use of capital and labour in telecommunications is determined more by technology than relative factor prices, compared with the trade, transport sector.

Initial simulations also indicated that the removal of barriers to trade in certain regions and service sectors would lead to negative values for domestic capital, as demand shifted from domestically-produced services to those produced by foreign affiliates in the same region. This problem seemed to be the result of increased capital mobility in FTAP2, compared with the very restrictive CET capital supply function in FTAP. The use of a CET capital supply function necessitates a high value for the demand elasticity of substitution between commodities produced by domestic and FDI firms, that is, 10. However, such a value is inconsistent with a more flexible capital supply mechanism. Thus, in FTAP2 the demand elasticity of substitution between commodities produced by domestic and FDI firms is reduced from 10 to 7.5. This necessitates the creation of a new coefficient,  $ESUBMO(i)$ , which replaces the coefficient  $ESUBM(i)$  in the equations  $E_{qdd}$ ,  $E_{qdh}$ ,  $E_{qxdd}$  and  $E_{qxhd}$ .

## 2.5 Closing FTAP2

The closure used for FTAP2 appears in the file TER.CMF, which is reproduced below. The FTAP2 closure is developed from the FTAP closure via three changes.

The first change to the FTAP closure is that the variable  $to\_shk(i,r)$  is swapped with  $tod(i,r)$  on the list of exogenous variables. This allows non-FDI industries to be shocked directly via the variable  $tod(i,r)$ . This closure change is necessary for instances when impediments have been applied to industries in regions which have no foreign firms present. In these instances, shocking via  $to\_shk(i,r)$  will not lead to the removal of output impediments in domestic non-FDI industries. Only impediments on domestic firms in FDI industries will be removed.

---

The next change is endogenising all components of  $frbr(s)$ , and exogenising  $rb$ , and all but one component of  $qybr(r)$ . These changes have three effects: substitution between bonds and capital is turned off for each region, bond-income ratios in all but one region are fixed at initial levels, and the world bond rate is also fixed at its initial level. Collectively, these changes (i) eliminate the bond market as a significant influence on physical capital allocation among regions, and (ii) eliminate initial bond holdings as significant source of welfare effects.

The third and final change to the FTAP closure is the addition of the variables  $qrgbr(r)$  and  $qhr(r)$  to the list of exogenous variables. This fixes nominal government and real private household wealth, respectively.

```

! _____start of ter.cmf_____
! This GEMPACK command file specifies the complete removal of all
! impediments on foreign and domestic producers of cmn & fib services,
! using automatic accuracy.
!
! Changes from 19x3 FTAP closure:
! (i) Swapping tod with to_shk on endogenous list, and
! (ii) Shocking domestic non-FDI industries directly via tod.
!
! Using Armingtons of 0.1 and 0.2 for cmn & fib, ETECH=0.0714,
! ESUBVA(cmn)=0.999 & ESUBMO(TRAD_COMM)=7.5
!
! Using owned capital mobility model (FMOBG2) with fixed qhr, rb,
! qybr(REG-JPN), qrgbr and zero govt bonds.
! _____
!
Auxiliary files = FMOBG2;
File GTAPSETS = sets.har;
File GTAPPARM = 0esubdm.dat;
File GTAPDATA = fdata.har;
File fdi_file = fdi.har;
FILE KDATA = kdata.har;
FILE fdi_ind_dat = fdi_ind.har;
!
Identifier = FMOBG2.tab condensed using FMOBG2.sti;
!
!Closure
!
!Begin with GTAPICM closure
Exogenous   pfactwld pop psaveslack incomeslack endwslack govslack

```

---

```

privslack to(PROD_COMM,REG) txs tms qo(ENDW_COMM, REG)
cgdslack 14 ercfrer saveslack1 qrgrs ftypr ftylr fughr qyb
rer d_ughr frer qybr 1-18;

!
Endogenous qo(ENDWC_COMM,REG) frer 1-18;
!
!
!The following GTAPICM variables have been omitted to reduce the size
!of the model:
!
!profitslack ava tx tm tf tpm tpd tgm tgd tfm tfd rari
!
!The following GTAPICM variables were previously omitted & are now
!exogenous
Exogenous tradslack ao af afe atr;
!
!End of GTAPICM closure
!
!
!FTAP closure changes
!
!Restriction on sourcing overseas saving no longer required
Endogenous qybr 1-18;
Exogenous frer 1-18;
!
!Turn off GTAP equation MKTCLTRD
Endogenous tradslack
!
!Endogenise input, endowments & intl. freight tech change
af afe atr
!
!Endogenise all new FDI variables
f_qva(FDI_COMM,FDI_DEST)
f_pf( TRAD_COMM, FDI_COMM, FDI_DEST)
f_qf( TRAD_COMM, FDI_COMM, FDI_DEST)
f_qfd( TRAD_COMM, FDI_COMM, FDI_DEST)
f_qfm( TRAD_COMM, FDI_COMM, FDI_DEST)
f_qfel( LABOR, FDI_COMM, FDI_DEST)
f_qfek( ENDWC_COMM, FDI_COMM, FDI_DEST)
f_qfen( LAND, FDI_COMM, FDI_DEST)
f_qfenr( NATRES, FDI_COMM, FDI_DEST)
!
!Endogenise rer as now measures average regional rate of return

```

---

```

! on productive assets
      rer;
!
!Introduce new FDI output impediment shock variables
Exogenous  remotaxd remotaxf
!
!Introduce new tech change variables
      alprim altot
!
!Introduce new capital tax and output tax shock variables
      toad toai to_shk tfda tfsa
!
!Introduce new slack variables
      f_pfek(CGDS_COMM,REG) f_tof f_pltot;
!
!FTAP variables omitted to reduce size of the model:
      !f_afe tfia toas
!
!Introduce imperfect arbitrage between regional rates of return
Endogenous frer;
Exogenous  f_kb;
!
!to, txs & tms replaced with new tax variables
Endogenous to(TRAD_COMM,FDI_DEST) txs tms;
Exogenous  toa txsd tmsd;
!
!Turn on endogenous tech change for output of local industries
Endogenous ao(TRAD_COMM,REG);
Exogenous  f_ao;
!
!Turn on endogenous tech change for output of FDI industries
Endogenous altot;
Exogenous  f_altot;
!
Rest endogenous;
!
!Swap
Endogenous to_shk;
Exogenous  tod;
!
!Corrections 7 August 2000
exogenous pb; ! f_pb for homogeneity test

```



```

!
Exogenous frbr;
!
Endogenous frbr; ! 1-13,15-19; ! USA
Exogenous qybr 1-2,4-19; ! USA
Exogenous rb;
!
Exogenous qrgbr qhr;
!
! Shock
!Shock pfactwld = 1;
XSET FIB(fib);
XSUBSET FIB IS SUBSET OF TRAD_COMM;
XSET CMN(cmn);
XSUBSET CMN IS SUBSET OF TRAD_COMM;
!Shock txsd(FIB,SOURCE,DEST) = select from file txsd_fib.txt;
!Shock txsd(CMN,SOURCE,DEST) = select from file txsd_cmn.txt;
Shock tfda(FIB,REG) = select from file tfda_fib.txt;
Shock tfda(CMN,REG) = select from file tfda_cmn.txt;
Shock tfsa(FIB,HOME,HOST) = select from file tfsa_fib.txt;
Shock tfsa(CMN,HOME,HOST) = select from file tfsa_cmn.txt;
XSET ImpedTer (cmn,fib);
XSUBSET ImpedTer IS SUBSET OF TRAD_COMM;
Shock remotaxf(ImpedTer,HOME,DEST) = uniform 100;
Shock remotaxd(ImpedTer,REG) = uniform 100;
Shock tod(FIB,REG) = select from file to_fib.txt;
Shock tod(CMN,REG) = select from file to_cmn.txt;
!
!Solution method
!Method = johansen;
!Steps = 2 4 6;
Automatic accuracy = yes;
Accuracy percent = 99;
Subintervals = 6;!Minimum number of subintervals required to
!achieve specified accuracy
!
Verbal Description =
+++++
+                               Model FMOBG2                               +
+                               Solution Method: automatic accuracy         +
+                               Sim: Removing all Ter impeds                +
+++++

```

---

```
!  
! Output File Specification (they are experiment dependent)  
!  
Solution File = <cmf>;  
!  
! Updated (i.e. post-simulation) data files  
!  
Updated file GTAPDATA = fdata.upd;  
Updated file fdi_file = fdi.upd;  
Updated file KDATA = kdata.upd;  
!  
DISPLAY FILE = <cmf>.dis;  
!  
! Options  
!  
CPU = yes; !Report simulation time  
!NDS = yes; ! Do no displays.  
Start with MMNZ = 16000000;  
!Check-on-read all = no; !Don't check coefficient information  
NRP = yes; !Don't reuse pivots  
Log file = <cmf>.log; !Generate log file  
set elements read style = flexible ;  
!Equations file = <cmf>;  
!_____end of file_____
```

---

## 3 FDI stocks and rentals matrix

This chapter describes the procedures used to produce three-dimensional (3D) matrices of FDI stocks and rentals, used in FTAP2. These matrices detail the allocation of FDI stocks across home and host regions, and sectors. Such data is unique for CGE models such as FTAP2. The available data on foreign capital stocks are too limited and too inconsistent to construct such a matrix without many empty cells. Thus it is necessary to employ mathematical techniques to fill in cells on which no data is available.

The resulting FDI stocks matrix is adjusted for consistency with the impediments data used in FTAP2 (Kalirajan et al. 1999 and Warren 2000), so that a mild, but discernible, inverse relationship exists between the estimated barriers and the FDI stock *shares*. Further, zero FDI stocks for non-zero FDI impediment rates are adjusted to be non-zero. The rentals associated with the FDI stocks are calculated by using the pre-tax rates of return from the post-UR database generated by the work of Verikios and Hanslow (1999). It is assumed that these rates of return are exclusive of the impediment rates.

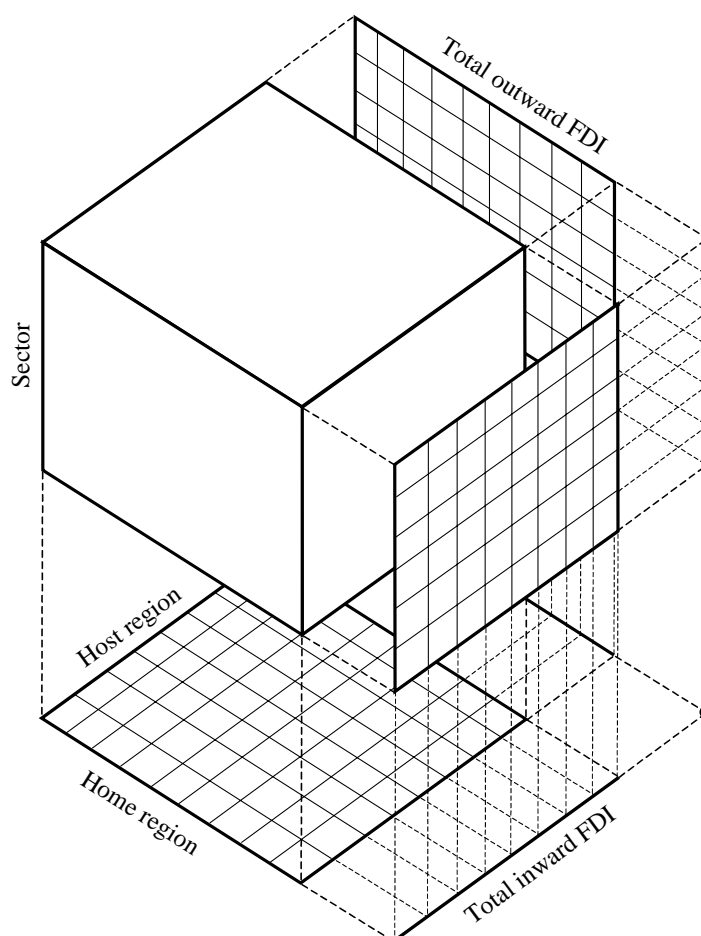
### 3.1 Introduction

One of the unique features of the FTAP2 database, compared to traditional CGE databases, is a 3D matrix which contains detailed information on the allocation of FDI stocks across regions and sectors. Each cell of the matrix indicates the source (home) region, the destination (host) region and sector of a particular FDI stock. A diagrammatic representation of a 3D FDI stocks matrix is presented in figure 3.1. Unfortunately, the available data on foreign capital stocks are too limited and too inconsistent to construct such a matrix without many empty cells. As such, it is necessary to employ mathematical techniques to fill in all cells on which no data is available. The procedure adopted in compiling the FDI stocks matrix involves the use of RAS methods (Stone 1961).

---

Figure 3.1    **Creating a 3D FDI stocks matrix using RAS**

---



---

The minimum data requirements for using RAS methods are three two-dimensional matrices of aggregate FDI stocks, consisting of a home-host FDI stocks matrix, a sector-host (inward) FDI stocks matrix and a sector-home (outward) FDI stocks matrix. Each of the three two-dimensional FDI stock matrices can be seen as a 3D FDI stocks matrix summed over one dimension. As such, they can be used as target totals in a series of RAS procedures to create a complete 3D FDI stocks matrix. Furthermore, to ensure that the matrix is consistent with the three-sector FTAP database, that is, primary, secondary and tertiary, the RAS procedures are conducted separately for each of these broad sector groups. Original data must be gathered to build these initial matrices.

The data used in compiling the home-host FDI stocks matrix are taken mainly from APEC (1995). Data used in compiling the sector-home FDI stocks matrix are drawn from UNCTAD (1999). The data used in compiling the sector-host FDI stocks matrix are collected from a wide range of publications (UNCTAD 1992, 1998;

OECD 1995, 1997a, 1997b). All of these original data are collected for 23 sectors and 19 countries or country groups, which are listed in table 3.1.

**Table 3.1 FDI stocks data: listing of sectors and countries or country groups**

<i>Sectors and abbreviation</i>	<i>Country or country groups, and abbreviation</i>
1. Agriculture (agr)	1. Australia (AUS)
2. Mining (min)	2. New Zealand (NZL)
3. Oil (oil)	3. Japan (JPN)
4. Food, beverages and tobacco (fbt)	4. Korea (KOR)
5. Textiles, leather and clothing (tlc)	5. Indonesia (IDN)
6. Paper and printing (p_p)	6. Malaysia (MYS)
7. Chemicals (che)	7. Philippines (PHL)
8. Coal and petroleum (c_p)	8. Singapore (SGP)
9. Non-metallic (nmm)	9. Thailand (THA)
10. Metal (met)	10. China (CHN)
11. Mechanical equipment (meq)	11. Hong Kong (HKG)
12. Electric and electronic equipment (eee)	12. Taiwan (TWN)
13. Motor vehicles (mvh)	13. Canada (CAN)
14. Other transport equipment (ote)	14. United States of America (USA)
15. Other manufacturing (omn)	15. Mexico (MEX)
16. Construction (con)	16. Chile (CHL)
17. Wholesale and retail trade (wrt)	17. Rest of Cairns Group (ROC) <sup>a</sup>
18. Transport (tra)	18. European Union (EUN)
19. Finance, insurance and business (fib)	19. Rest of the world (ROW)
20. Communications (cmn)	
21. Other services (osr)	
22. Real estate (res)	
23. Other commodities (oth)	

<sup>a</sup> This group consists of Brazil, Argentina, Uruguay and Colombia.

## **3.2 Creating a 3D FDI stocks matrix using RAS procedures: an outline**

This section describes the data sources and outlines the procedures used in creating the 3D FDI stocks matrix.

### **Inward and outward FDI stock vectors**

The original data for the 19 region inward and outward FDI stock vectors are taken from UNCTAD (1996), and are for 1995. The grand total of these two vectors are not equal. The mid-point of the two grand totals is used to re-scale the two vectors

---

to make their grand totals equal. The resultant vectors are used as the target totals in a RAS procedure to produce a 19 region home-host FDI stocks matrix.

### **Home-host FDI stocks matrix**

The home-host FDI stocks matrix is generated using

- two share matrices of 19 region inward and outward FDI stocks for 1992, and
- consistent 19 region inward and outward FDI stock vectors for 1995.

The original data used to construct the two share matrices are taken from APEC (1995).

Preliminary inward and outward FDI stock matrices are constructed by applying the inward and outward share matrices, to the inward and outward FDI stock vectors. A preliminary home-host matrix is constructed by taking the mid-point of the corresponding cell values of the preliminary inward and outward matrices. This preliminary home-host matrix is used, together with the inward and outward stock vectors, in a RAS procedure to produce the home-host FDI stocks matrix.

### **Host-sector FDI stocks matrix**

Original data on FDI stocks by sector in host regions is sourced from OECD (1995, 1997a and 1997b) and UNCTAD (1992). The data cover all regions listed in table 3.1 except Chile, the rest of Cairns group and the rest of the world. For these regions it is assumed that the sectoral shares of inward FDI stocks are the same as the average share of inward FDI stocks in all other countries and country groups. These average shares are used in conjunction with the inward FDI stocks vector to assign values to all sectors for Chile, the rest of Cairns group and the rest of the world. The result is the host-sector FDI stocks matrix.

### **Home-sector FDI stocks matrix**

The original data on sectoral shares of outward FDI cover only seven home countries or regions. The data on Australia, Japan, Canada, the United States (US) and the European Union (EU) are taken from UNCTAD (1999). The data on China are taken from Wall (1997), tables 5 and 8. The data on Taiwan are taken from Trade and Investment (1991), table 3. The outward FDI stocks vector and the host-sector FDI stocks matrix summed over all sectors, are used as target column and row totals, respectively, in a RAS procedure. A home-sector share matrix is constructed by applying the average sectoral shares for all regions for which data is

---

available, to each region for which data is not available. A preliminary home-sector matrix is created by applying the values from the outward FDI stock vector to the complete home-sector share matrix. A RAS procedure is then used to generate a final home-sector FDI stocks matrix, whose row totals equal those of the host-sector FDI stocks matrix and whose column totals equal those of the outward FDI stocks vector.

### **Home-host-sector FDI stock matrix**

The home-host, host-sector and home-sector matrices only represent the allocation of aggregate FDI stocks across countries and sectors. To generate a more detailed allocation of FDI stocks from home regions to host regions in all individual sectors, that is, a detailed 3D matrix, a RAS procedure is again applied. The three matrices already generated are used as target totals for the 3D matrix. A preliminary 3D matrix is created by assuming that the home-host matrix represents the allocation of FDI stocks in each sector, so that the home-host matrix was identical for each sector. A RAS procedure is sequentially applied to each dimension of the preliminary 3D matrix, until a balanced home-host-sector matrix is produced, which is consistent with the home-host, host-sector and home-sector matrices.

### **3.3 Creating 3D FDI stocks and rentals matrices: detailed procedures**

All original FDI data collected from original sources is contained in the file `h:\epb05\projects\ftap2\ras\stockmt.xls`.

It was decided early in the construction of the eight-sector FTAP2 database that it should mirror the broad three-sector FTAP database, in terms of FDI stocks aggregated to the three broad FTAP sectors. To achieve this consistency, the 23 sector data described in section 3.2 were grouped into the three broad sectors in FTAP, that is, primary, secondary and tertiary industries. A concordance between the 23 sectors for which data was collected and the broad industry groups in FTAP, is presented in table 3.2. An identical RAS procedure was conducted for each of the three broad sectors to ensure the results were consistent with three-sector FTAP database.

**Table 3.2 Concordance between FDI stocks data and FTAP commodities**

<i>FDI stocks sector and abbreviation</i>	<i>FTAP commodity and abbreviation</i>
1. Agriculture (agr)	Primary (pri)
2. Mining (min)	Primary (pri)
3. Oil (oil)	Primary (pri)
4. Food, beverages and tobacco (fbt)	Primary (pri)
5. Textiles, leather and clothing (tlc)	Secondary (sec)
6. Paper and printing (p_p)	Secondary (sec)
7. Chemicals (che)	Secondary (sec)
8. Coal and petroleum (c_p)	Secondary (sec)
9. Non-metallic (nmm)	Secondary (sec)
10. Metal (met)	Secondary (sec)
11. Mechanical equipment (meq)	Secondary (sec)
12. Electric and electronic equipment (eee)	Secondary (sec)
13. Motor vehicles (mvh)	Secondary (sec)
14. Other transport equipment (ote)	Secondary (sec)
15. Other manufacturing (omn)	Secondary (sec)
16. Construction (con)	Tertiary (ter)
17. Wholesale and retail trade (wrt)	Tertiary (ter)
18. Transport (tra)	Tertiary (ter)
19. Finance, insurance and business (fib)	Tertiary (ter)
20. Communications (cmn)	Tertiary (ter)
21. Other services (osr)	Tertiary (ter)
22. Real estate (res)	Tertiary (ter)
23. Other commodities (oth)	Tertiary (ter)

### **The primary sector matrices**

All files referred to in this section are located in h:\epb05\projects\ftap2\ras1\pri. The DOS bat file PRI\_RAS is used to run a number of TABLO-generated programs which create the four primary sector FDI stock matrices. Table 3.3 lists the command line in PRI\_RAS and the program which it invokes, any input data files used by the program, and any output data files created by the program.



**Table 3.3 Steps in creating the primary sector FDI stock matrices using the DOS bat file PRI\_RAS**

<i>Command</i>	<i>Input data files</i>	<i>Output data file(s)</i>
1. RASSPLIT -sti RASSPLIT.STI >>log	PRI_FDI.HAR; PRI_SEC.HAR	RASSPLIT.DIS; PRI_OUT.HAR
2. OUT_RAS -sti OUT_RAS.STI >>log	PRI_FDI.HAR; PRI_SEC.HAR; PRI_OUT.HAR	OUT_RAS.DIS; W1.HAR
3. OUT_RAS1 -sti OUT_RAS1.STI >>log	PRI_FDI.HAR; PRI_SEC.HAR; PRI_OUT.HAR; W1.HAR;	PRI_RAS.DIS; W1.UPD
4. CHEK_OUT -cmf CHEK_OUT.CMF >>log	PRI_FDI.HAR; PRI_OUT.HAR; W1.UPD	W2.HAR
5. RASSEC -sti RASSEC.STI >>log	PRI_FDI.HAR; PRI_OUT.HAR; W1.UPD	RASSEC.DIS; PRI_OUT.UPD
6. CHEKSEC -sti CHEKSEC.STI >>log	PRI_FDI.HAR; PRI_OUT.UPD; W1.UPD	CHEKSEC.DIS

Line one of PRI\_RAS invokes the program RASSPLIT using input from the file RASSPLIT.STI, and writes all screen output to the end of the file LOG. RASSPLIT takes inward and outward stock vectors from PRI\_FDI.HAR, host-sector and home-sector share matrices from PRI\_SEC.HAR, and combines them to create preliminary home-host matrices for each of the four primary sectors. RASSPLIT also calculates inward and outward world average FDI sectoral shares for use by the next program. All output matrices are written to PRI\_OUT.HAR.

Line two invokes the program OUT\_RAS using input from the file OUT\_RAS.STI, and writes all screen output to the end of the file LOG. OUT\_RAS uses the inward and outward stock vectors from PRI\_FDI.HAR, the home-sector share matrix from PRI\_SEC.HAR, the outward world average sectoral shares from PRI\_OUT.HAR, and assigns the outward world average shares to countries for which data is not available. The resulting preliminary home-sector stocks matrix is written to the file W1.HAR.

The program OUT\_RAS1 conducts a RAS procedure on the preliminary home-sector stocks matrix in the file W1.HAR, to create a balanced home-sector stocks matrix.

As its name suggests, the program CHEK\_OUT checks the balanced home-sector stocks matrix created by OUT\_RAS1 for consistency with the preliminary host-sector matrix and the final home-host matrix for each primary sector, both created by RASSPLIT. Where inconsistencies exist, they are flagged in the header array

---

W2 in the output data file W2.HAR. Any cell values not equal to 200 indicate an inconsistency, which requires the header array W002 in file PRI\_OUT.HAR to be modified accordingly, and the file PRI\_RAS to be rerun.

Line five invokes the program RASSEC. This program conducts a RAS procedure on the four primary sector home-host matrices, so that their home and host totals match those in the home-sector and host-sector matrices, respectively.

Line six invokes the program CHEKSEC, which computes the differences between the home and host totals of the four primary sector home-host matrices, and the target home and host totals in the home-sector and host-sector matrices. CHEKSEC also computes the differences between the four primary sector home-host matrices summed over all primary sectors, and the corresponding value in the target home-host matrix for all primary sectors. If satisfactory convergence has not been achieved, this will be indicated in the values of the coefficients GFACTOR\_S, W\_SEC\_FAC and V\_SEC\_FAC reported in the file CHEKSEC.DIS. The further these values are from 1, the less satisfactory convergence has been. If convergence has not been satisfactory, then the preliminary home-sector shares assigned by OUT\_RAS need to be adjusted to aid convergence. Consequently, the PRI\_RAS may need to rerun a number of times.

### **The secondary sector matrices**

All files referred to in this section are located in h:\epb05\projects\ftap2\ras1\sec. The DOS bat file RAS is used to run a number of TABLO-generated programs which create the 11 secondary sector FDI stock matrices. Table 3.4 lists the command line in RAS and the program which it invokes, any input data files used by the program, and any output data files created by the program.

**Table 3.4 Steps in creating the secondary sector FDI stock matrices using the DOS bat file RAS**

<i>Command</i>	<i>Input data files</i>	<i>Output data file(s)</i>
1. RASSPLIT -sti RASSPLIT.STI >>log	SEC_FDI.HAR; SEC_SEC.HAR	RASSPLIT.DIS; SEC_OUT.HAR
2. OUT_RAS -sti OUT_RAS.STI >>log	SEC_FDI.HAR; SEC_SEC.HAR; SEC_OUT.HAR	OUT_RAS.DIS; W1.HAR
3. OUT_RAS1 -sti OUT_RAS1.STI >>log	SEC_FDI.HAR; SEC_SEC.HAR; SEC_OUT.HAR; W1.HAR	SEC_RAS.DIS; W1.UPD
4. CHEK_OUT -cmf CHEK_OUT.CMF >>log	SEC_FDI.HAR; SEC_OUT.HAR; W1.UPD	W2.HAR
5. CHEK_B -cmf CHEK_B.CMF >>log	W1.UPD; SEC_OUT.HAR; SEC_FDI.HAR	ADJ_B.HAR
6. RASSEC -sti RASSEC.STI >>log	SEC_FDI.HAR; SEC_OUT.HAR; W1.UPD; RASSEC.CMF; ADJ_B.HAR	RASSEC.DIS; ADJ_B.UPD
7. CHEKSEC -sti CHEKSEC.STI >>log	SEC_FDI.HAR; SEC_OUT.UPD; W1.UPD	CHEKSEC.DIS
8. B_ALL -cmf B_ALL.CMF >>log	ADJ_B.UPD	B_ALL.HAR
9. RASSEC1 -sti RASSEC1.STI >>log	SEC_FDI.HAR; SEC_OUT.HAR; B_ALL.HAR	E_ALL.HAR
10. CHECK_E -cmf CHECK_E.CMF >>log	E_ALL.HAR; SEC_FDI.HAR; SEC_OUT.HAR; W1.UPD	CHECK_E.HAR

Lines one through to four of RAS runs identical programs and procedures for the secondary sectors, as PRI\_RAS does for the primary sectors. Differences in procedures emerge at line five, where the program CHEK\_B compares the preliminary home-host-sector matrix summed over all secondary sectors, with the final home-host matrix created by RASSPLIT. The header array CHEK on the file ADJ\_B.HAR should only contain values of 0. Non-zero values indicate that the initial inward and outward shares used as input to RASSPLIT must be adjusted for consistency with the final home-host matrix.

The next two lines of RAS are similar to lines five and six in PRI\_RAS. Line eight runs B\_ALL which checks the final home-host matrices for each secondary sector, produced by RASSEC, for convergence. Where convergence has not been satisfactory, then B\_ALL creates a new preliminary home-host matrix for each secondary sector. RASSEC1 then reruns the RAS procedure using the new

preliminary matrices. CHECK\_E checks the new home-host matrices for each secondary sector, for convergence. The header arrays ARAT and VRAT on the output file CHECK\_E.HAR indicate how well the matrices have converged to the home and host totals. The closer these values are to one, the more satisfactory convergence has been.

### The tertiary sector matrices

All files referred to in this section are located in h:\epb05\projects\ftap2\ras1\ter. The procedure for creating the FDI stocks matrices for the tertiary sectors is identical to the procedure used for the secondary sectors. The similarly named file RAS, runs this procedure and all steps, input and output data files are listed in table 3.5.

**Table 3.5 Steps in creating the tertiary sector FDI stock matrices using the DOS bat file RAS**

<i>Command</i>	<i>Input data file(s)</i>	<i>Output data file(s)</i>
1. RASSPLIT -sti RASSPLIT.STI >>log	TER_FDI.HAR; TER_SEC.HAR	RASSPLIT.DIS; TER_OUT.HAR
2. OUT_RAS -sti OUT_RAS.STI >>log	TER_FDI.HAR; TER_SEC.HAR; TER_OUT.HAR	OUT_RAS.DIS; W1.HAR
3. OUT_RAS1 -sti OUT_RAS1.STI >>log	TER_FDI.HAR; TER_SEC.HAR; TER_OUT.HAR; W1.HAR	TER_RAS.DIS; W1.UPD
4. CHEK_OUT -cmf CHEK_OUT.CMF >>log	TER_FDI.HAR; TER_OUT.HAR; W1.UPD	W2.HAR
5. CHEK_B -cmf CHEK_B.CMF >>log	W1.UPD; TER_OUT.HAR	ADJ_B.HAR
6. RASSEC -sti RASSEC.STI >>log	TER_FDI.HAR; TER_OUT.HAR; W1.UPD; ADJ_B.HAR	RASSEC.DIS; ADJ_B.UPD
7. CHEKSEC -sti CHEKSEC.STI >>log	TER_FDI.HAR; TER_OUT.UPD; W1.UPD	CHEKSEC.DIS
8. B_ALL -cmf B_ALL.CMF >>log	ADJ_B.UPD	B_ALL.HAR
9. RASSEC1 -sti RASSEC1.STI >>log	TER_FDI.HAR; TER_OUT.HAR; B_ALL.HAR	E_ALL.HAR
10. CHECK_E -cmf CHECK_E.CMF >>log	E_ALL.HAR; TER_FDI.HAR; TER_OUT.HAR; W1.UPD	CHECK_E.HAR

### 3.4 Collating the 23 sector FDI stock matrices and calculating FDI rentals

All files discussed in this section are located in h:\epb05\projects\ftap2\ras1\all. The DOS bat file B1\_B23 runs a number of programs which collate the primary, secondary and tertiary FDI stocks matrices into a single 3D matrix, before performing a number of other tasks. Table 3.6 lists all procedures, and input and output data files which are run by B1\_B23.

Table 3.6 **Steps in creating the 22 sector FDI stocks and rentals matrices using the DOS bat file B1\_B23**

<i>Command</i>	<i>Input data file(s)</i>	<i>Output data file(s)</i>
1. copy h:\epb05\projects\ftap2\ras1\pri\pri_out.upd >log		
2. copy h:\epb05\projects\ftap2\ras1\sec\check_e.har check_e1.har>>log		
3. copy h:\epb05\projects\ftap2\ras1\ter\check_e.har check_e2.har>>log		
4. copy h:\epb05\projects\ftap2\ror\ror_out.har >>log		
5. copy h:\epb05\projects\ftap2\split_ur\57x57icm.upd >>log		
6. adj_impd -cmf adj_impd.cmf>>log	57X57SET.HAR; 57X57ICM.UPD; 57X57PAR.DAT; COMMAP.HAR; IMPRAT.HAR	ADJ_IMP.D.HAR
7. b1_b23 -cmf b1_b23.cmf>>log	PRI_OUT.UPD; CHECK_E1.HAR; CHECK_E2.HAR; FDI.HAR; ROR_OUT.HAR; 3D_DEPR.HAR; ADJ_IMP.D.HAR	B1_B23.HAR; 3D_DEPR.UPD
8. AGG_22 -cmf AGG_22.CMF>>log	B1_B23.HAR; COMMAP.HAR; IMPRAT.HAR	AGG_22.HAR
9. chkror -cmf chkror.cmf>>log	SETS.HAR; FDI_IND.HAR; KDATA.HAR; FDATA.HAR; FDI.HAR; PARA.DAT	CHKROR.HAR

Line one of B1\_B23 moves the file containing the primary sector FDI stocks matrices to the present working directory, and also creates a new log file to which all screen output is written. Lines two and three do the same for the files containing the secondary and tertiary matrices.

Line four moves the file ROR\_OUT.HAR to the present working directory. This file contains the pre-tax rates of return generated by an updated version of the GTAP 4 database (McDougall, Elbehri and Truong 1998). This database is provided by the work of Verikios and Hanslow (1999) under their assumption of less than

---

perfect capital mobility. This database represents barriers to trade after the complete implementation of the Uruguay Round of multilateral negotiations (UR).

The file 57X57ICM.UPD is moved to the present working directory by line six of B1\_B23. This file is a variant of the updated database from the work of Verikios and Hanslow (1999), and its construction is described in section 4.1 of chapter 4.

All of the files moved to the present working directory by the first six lines of file B1\_B23 are used in the four procedures which follow.

The program ADJ\_IMPDP invoked by line six of B1\_B23 adjusts the domestic and foreign capital impediment rates for telecommunications and banking, taken from PC (1999), by a region- and sector-specific output to capital ratio calculated from 57X57ICM.UPD. This adjustment converts the rates from capital impediments rates as a proportion of output to capital impediment rates as a proportion of capital. The capital and output impediment rates are presented in table 3.7.<sup>1</sup>

The program B1\_B23 firstly collates the primary, secondary and tertiary matrices into a single FDI stocks matrix ranging over the dimensions home, host and sector. A number of small adjustments are made to this matrix. In initial simulations, the resulting 3D stocks matrix gave rise to two major problems. First, certain host regions and sectors with non-zero FDI impediments rates had zero FDI stocks. With an initial stock of zero, the removal of non-zero impediments led to no change in FDI. This is inconsistent with what is generally expected from the removal of a barrier to FDI. Second, a comparison of the measured FDI impediment rates and the sectoral shares of FDI in regional capital stocks indicated a random relationship between the two. For instance, some regions and sectors with no impediments to FDI had zero or very low FDI shares of capital, while other regions with very high impediments to FDI had very high FDI shares of capital. Initial simulations with this database lead to implausibly high percentage increases in sectoral FDI stocks, where the initial FDI were already quite high.

These two problems were dealt with by assuming that the estimated barriers to FDI were more accurate and consistent across regions and sectors, than the numerous sources used to source FDI stocks data. As such, the FDI stocks data were adjusted so that a mild, but discernible, inverse relationship existed between the estimated barriers (for telecommunications and banking services) on the one hand, and the FDI stock shares on the other.

---

<sup>1</sup> In initial simulations, the finance, insurance and business services sector in Japan expanded at a rate which was inconsistent with its already large share of the domestic output. To avoid such a result, the banking impediment rates for Japan taken from PC (1999) were reduced to seven-twelfths of their original value.

**Table 3.7 Output and capital impediment rates (per cent)**

Region	Telecommunications sector				Finance, insurance and business sector			
	Output		Capital		Output		Capital	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
Australia	-	-	1.4	1.4	-	2.2	-	43.3
NZ	-	-	1.3	1.3	-	2.2	-	8.5
Japan	-	-	1.8	1.8	5.8	7.7	-	3.0
Korea	2.5	4.9	4.8	9.2	14.9	18.6	-	80.7
Indonesia	41.0	82.1	85.9	163.3	5.3	16.3	-	81.0
Malaysia	5.5	11.0	3.6	15.0	6.7	24.6	41.7	97.4
Philippines	21.4	53.6	-	50.0	3.5	14.1	24.0	109.9
Singapore	0.8	0.8	5.5	8.1	8.0	20.8	-	62.7
Thailand	14.0	28.0	32.7	55.8	-	12.5	-	58.4
China	50.0	100.0	339.4	678.8	14.9	24.7	60.6	140.7
Hong Kong	0.6	0.6	3.2	3.2	2.6	4.9	-	6.4
Taiwan	1.3	2.1	5.8	9.3	8.6	14.7	-	48.8
Canada	0.8	2.3	1.8	6.6	-	2.8	-	13.4
USA	0.2	0.2	-	-	-	2.8	-	8.1
Mexico	5.4	11.0	1.8	7.8	-	2.9	-	21.8
Chile	1.3	1.3	1.0	1.0	7.7	11.3	39.0	57.4
R. Cairns <sup>a</sup>	2.7	6.5	11.8	15.9	0.2	10.1	8.1	33.2
EU	0.3	0.7	3.6	4.6	-	2.8	-	12.3
R. World <sup>b</sup>	16.4	33.0	114.0	215.0	-	12.7	6.4	51.5

<sup>a</sup> The rest of the Cairns group (Brazil, Argentina, Uruguay and Colombia). <sup>b</sup> The rest of the world. \* Nil.

Source: See text.

Where bilateral FDI stocks were adjusted from zero to non-zero values, it was assumed that the 'new' FDI stocks were sourced equally from the three net FDI investing regions in the database, that is, Japan, the US and the EU. FDI stocks were also reduced for Australia and the rest of the world region, the latter consisting mainly of developing countries which engage in little or no FDI.

Another problem encountered with initial simulations was 'arithmetic overflow'<sup>2</sup>, caused by having initial values of FDI which are quite small. Where the initial stock is quite small, any significant change can lead to a enormous percentage change leading arithmetic overflow. This problem was avoided in subsequent simulations by zeroing out all FDI stocks less than \$US10,000.

B1\_B23 then calculates the rentals associated with the final FDI stocks matrix. This is done by multiplying the pre-tax rates of return from the post-UR database, with the final FDI stocks matrix. It is assumed that the rates of return from the post-UR

<sup>2</sup> Arithmetic overflow is a computer error generated when attempting to calculate either very large numbers, or very small numbers.

database are exclusive of impediments to FDI. As such, the impediment-inclusive rates of return are simply the sum of the impediment-exclusive rates of return and the impediments rates themselves. B1\_B23 also assigns the depreciation rates for each home region, host region and sector. These are taken from the post-UR database and are presented in table 3.8, along with the pre-tax rates of return from the post-UR database.

**Table 3.8 Depreciation rates and pre-tax, impediment-exclusive rates of return used in FTAP2 (per cent)**

<i>Region</i>	<i>Depreciation rates by host region</i>	<i>Pre-tax, impediment-exclusive rates of return by home region</i>
Australia	4.44	12.95
New Zealand	2.87	11.10
Japan	5.05	13.16
Korea	3.02	11.19
Indonesia	1.79	10.01
Malaysia	2.36	10.77
Philippines	1.69	10.13
Singapore	3.66	12.10
Thailand	1.93	10.07
China	2.63	10.82
Hong Kong	0.59	8.80
Taiwan	2.25	10.47
Canada	2.98	11.09
United States of America	3.07	11.19
Mexico	1.63	9.71
Chile	1.78	9.93
Rest of Cairns group	2.46	10.61
European Union	5.47	13.56
Rest of the world	4.26	12.44

*Source:* Updated database from Verikios and Hanslow (1999).

As FTAP2 assumes that there is perfect capital mobility between all capital owned by a region, regardless of which sector or host region it is located in, the rates of return taken from the post-UR database are assumed to be the pre-tax, impediment-exclusive rates of return earned by all capital owned by each home region. The depreciation rates taken from the post-UR database are assumed to reflect the rates of return in all sectors in each host region.

Line eight of file B1\_B23 invokes the program AGG\_22, which aggregates all output from the programs ADJ\_IMPD and B1\_B23, from 23 to 22 sectors. The concordance between the two aggregations is presented in table 3.9. Besides the aggregation of existing sectors indicated in table 3.9, a new sector called dwellings is added with zero FDI stocks and rentals data. The final line in B1\_B23 invokes the



program CHKROR which calculates the gross rates of return on domestic capital in the three-sector FTAP database.

**Table 3.9 Concordance between 23 and 22 sector FDI stocks and rentals matrices**

<i>23 sector FDI stocks and rentals matrices, and abbreviation</i>	<i>22 sector FDI stocks and rentals matrices, and abbreviation</i>
1. Agriculture (agr)	1. Agriculture (agr)
2. Mining (min)	2. Mining (min)
3. Oil (oil)	3. Oil (oil)
4. Food, beverages and tobacco (fbt)	4. Food, beverages and tobacco (fbt)
5. Textiles, leather and clothing (tlc)	5. Textiles, leather and clothing (tlc)
6. Paper and printing (p_p)	6. Paper and printing (p_p)
7. Chemicals (che)	7. Chemicals (che)
8. Coal and petroleum (c_p)	8. Coal and petroleum (c_p)
9. Non-metallic minerals (nmm)	9. Non-metallic minerals (nmm)
10. Metals (met)	10. Metals (met)
11. Mechanical equipment (meq)	11. Mechanical equipment (meq)
12. Electric and electronic equipment (eee)	12. Electric and electronic equipment (eee)
13. Motor vehicles (mvh)	13. Motor vehicles (mvh)
14. Other transport equipment (ote)	14. Other transport equipment (ote)
15. Other manufacturing (omn)	15. Other manufacturing (omn)
16. Construction (con)	16. Construction (con)
17. Wholesale and retail trade (wrt)	17. Wholesale and retail trade (wrt)
18. Transport (tra)	18. Transport (tra)
19. Finance, insurance and business (fib)	19. Finance, insurance and business (fib)
20. Communications (cmn)	20. Communications (cmn)
21. Other services (osr)	21. Other services (osr)
22. Real estate (res)	19. Finance, insurance and business (fib)
23. Other commodities (oth)	21. Other services (osr)
	22. Dwellings (dwe)

---

## 4 Incorporating impediments in the post-UR database using ALTERTAX

The database provided by the work of Verikios and Hanslow (1999) is the starting point for the non-FDI data in the FTAP2 database. This database contains estimates of barriers to trade in goods after the complete implementation of the UR. However, it does not contain barriers to trade in services. These must be incorporated into the database separately.

The post-UR database has 19 regions and 50 commodities. The impediments data used in the FTAP2 database are for telecommunications and banking services, but the post-UR database does not distinguish separate telecommunications and banking services sectors. Thus, before the impediments data can be incorporated into the post-UR database, the database must first be disaggregated so that it contains separate telecommunications and banking services sectors. Once this is done, the database must then be aggregated to match the 22 sector FDI stocks and rentals data described in chapter 3. Following this, the impediments data can be accurately incorporated into the post-UR database using the ALTERTAX procedure of Malcolm (1998).

### 4.1 Adjusting regional bond income data in GTAPICM

In initial simulations, the regional welfare results for FTAP2 were dominated by the effect of changes in bond income. For some regions this effect was many times the magnitude of all other effects combined. The dominance of this effect was confirmed by checking the updated FTAP2 database, which indicated that the value of bonds for some regions was almost equal to the value of the capital stock located in that region. This was regarded as undesirable and that welfare results should be largely determined by other ‘real’ effects, and not dominated by initial borrowing and lending positions for each region or growth in these positions over the course of a policy simulation. For this reason, it was decided that the post-UR database, as taken from Verikios and Hanslow (1999), was inappropriate to use in creating the FTAP2 database. It seemed appropriate to adjust the initial bond data used by Verikios and Hanslow (1999), so that the value of bonds was no greater than 10 per cent, in absolute terms, of the value of the capital stock in each region.

All files discussed in this section are located in h:\epb05\projects\ftap2\gtapicm. The bond data used in GTAPICM is described in appendix E, sections E.5 and E.6 of Hanslow, Phamduc and Verikios (2000). Bonds in GTAPICM are made up of private and government bonds. It was decided that government bonds would be set to zero, as the government sector did not own any capital in GTAPICM and should therefore not have the ability to lend or borrow. As such, private bonds were assumed to account for all net capital income from abroad. As net capital income from abroad was originally calculated as a proportion of net factor income from abroad, the adjustments to the initial bond data were made in terms of this proportion. Table 4.1 is similar to table E.4 in Hanslow, Phamduc and Verikios (2000), but contains the adjusted proportion of net factor income from abroad made up by net capital income from abroad. The adjusted bond data is now stored in the file ZRGOVBND.HAR, along with all other initial GTAPICM data which remains unchanged.

Table 4.1 **Net factor income from abroad and net capital income from abroad in GTAPICM**

<i>Region</i>	<i>Net factor income from abroad</i>	<i>Original net capital income from abroad</i>	<i>Adjusted net capital income from abroad</i>
	% of GDP	% of net factor income from abroad	% of net factor income from abroad
Australia	-3.87	100.88	50.44
New Zealand	-3.98	100.00	50.00
Japan	0.94	95.43	95.43
Korea	-0.64	128.33	64.17
Indonesia	-4.68	97.36	48.68
Malaysia	-5.09	98.86	49.43
Philippines	3.04	-57.07	-28.53
Singapore	0.98	100.00	100.00
Thailand	-1.86	98.86	49.43
China	-11.13	97.36	24.34
Hong Kong	1.34	100.00	100.00
Taiwan	0.90	144.08	144.08
Canada	-3.42	0.00	0.00
United States of America	0.26	100.63	100.63
Mexico	-2.72	106.66	53.33
Chile	-5.83	99.12	49.56
Rest of Cairns group	-3.08	98.96	32.99
European Union	-0.83 <sup>a</sup>	49.38	16.46
Rest of the world <sup>b</sup>	-5.19	-70.59	2.04

<sup>a</sup> This percentage is not the same as that reported in table E.4 of Hanslow, Phamduc and Verikios (2000). In adjusting the bond income data, a mistake in the original calculation of net factor income from abroad for the European Union was found and is now corrected. <sup>b</sup> Data for the rest of the world region is calculated as residual.

Source: See text.

---

Assuming the government sector cannot borrow or lend in GTAPICM also requires the removal of the equation which facilitates government wealth accumulation in GTAPICM, that is, equation GOVT\_WEALTH\_ACCN. The new TABLO input file containing this change is ZRGOVBND.TAB. Once this is done, the ‘imperfect capital mobility’ simulation in Verikios and Hanslow (1999) is rerun using the TABLO command file ZRGOVBND.CMF. The new post-UR GTAPICM database is ZRGOVBND.UPD.

## **4.2 Splitting out telecommunications and banking services in the post-UR database**

The ‘new’ post-UR GTAPICM database does not contain separate telecommunications and banking services sectors, despite having a high degree of commodity detail. In order to accurately incorporate the estimated impediments to trade in telecommunications and banking services into the post-UR database, separate telecommunications and banking services sectors must be split out from existing commodities in the post-UR database. Table 4.2 presents a concordance between the 50 sectors in the post-UR database and the 57 sectors in the post-UR database with telecommunications and banking (financial) services split out.

Table 4.2 indicates that in disaggregating the post-UR database, sectors 47 (trade, transport) and 48 (financial, business, recreational services) are split into five and four separate sectors, respectively. The commodity detail in the disaggregated database matches that in the GTAP 5 database (Huff, McDougall and Walmsley 1999) and this is intentional to ensure that future work using GTAP 5 can be accommodated with existing procedures and programs. With no information on the size of individual sectors within sectors 47 and 48, equal shares are used to split all header arrays, that is, output, exports, intermediate inputs etc.

The procedures used to split out the communication and financial services sectors were developed in order to accommodate the use of the forthcoming GTAP 5 database. This is possible by creating a GTAP 5 ‘lookalike’ database, that is, a database with the same commodity detail as the forthcoming GTAP 5 database. As such, the procedures used to split the post-UR database involve some unnecessary steps. The greater commodity detail for services in GTAP 5 can be used in the future to disaggregate almost all privately-provided services in the post-UR database.

**Table 4.2 Concordance between the post-UR database with and without separate telecommunications and banking services sectors**

<i>50 sector post-UR database with abbreviation</i>	<i>57 sector post-UR database with telecommunications and banking services split out, and abbreviation</i>
1. Paddy rice (pdr)	1. Paddy rice (pdr)
2. Wheat (wht)	2. Wheat (wht)
3. Cereal grains nec (gro)	3. Cereal grains nec (gro)
4. Vegetables, fruit, nuts (v_f)	4. Vegetables, fruit, nuts (v_f)
5. Oil seeds (osd)	5. Oil seeds (osd)
6. Sugar cane, sugar beet (c_b)	6. Sugar cane, sugar beet (c_b)
7. Plant-based fibers (pfb)	7. Plant-based fibers (pfb)
8. Crops nec (ocr)	8. Crops nec (ocr)
9. Bovine cattle, sheep and goats, horses (ctl)	9. Bovine cattle, sheep and goats, horses (ctl)
10. Animal products nec (oap)	10. Animal products nec (oap)
11. Raw milk (rmk)	11. Raw milk (rmk)
12. Wool silk-worm cocoons (wol)	12. Wool silk-worm cocoons (wol)
13. Forestry (for)	13. Forestry (for)
14. Fishing (fsh)	14. Fishing (fsh)
15. Coal (col)	15. Coal (col)
16. Oil (oil)	16. Oil (oil)
17. Gas (gas)	17. Gas (gas)
18. Minerals nec (omn)	18. Minerals nec (omn)
19. Bovine cattle, sheep, goat, horse meat products (cmt)	19. Bovine cattle, sheep, goat, horse meat products (cmt)
20. Meat products nec (omt)	20. Meat products nec (omt)
21. Vegetable oils and fats (vol)	21. Vegetable oils and fats (vol)
22. Dairy products (mil)	22. Dairy products (mil)
23. Processed rice (pcr)	23. Processed rice (pcr)
24. Sugar (sgr)	24. Sugar (sgr)
25. Food products nec (ofd)	25. Food products nec (ofd)
26. Beverages and tobacco products (b_t)	26. Beverages and tobacco products (b_t)
27. Textiles (tex)	27. Textiles (tex)
28. Wearing apparel (wap)	28. Wearing apparel (wap)
29. Leather products (lea)	29. Leather products (lea)
30. Wood products (lum)	30. Wood products (lum)
31. Paper products, publishing (ppp)	31. Paper products, publishing (ppp)
32. Petroleum, coal products (p_c)	32. Petroleum, coal products (p_c)
33. Chemical, rubber, plastic products (crp)	33. Chemical, rubber, plastic products (crp)
34. Mineral products nec (nmm)	34. Mineral products nec (nmm)
35. Ferrous metals (i_s)	35. Ferrous metals (i_s)
36. Metals nec (nfm)	36. Metals nec (nfm)
37. Metal products (fmp)	37. Metal products (fmp)
38. Motor vehicles and parts (mvh)	38. Motor vehicles and parts (mvh)
39. Transport equipment nec (otn)	39. Transport equipment nec (otn)
40. Electronic equipment (ele)	40. Electronic equipment (ele)
41. Machinery and equipment nec (ome)	41. Machinery and equipment nec (ome)

(Continued next page)

Table 4.2 (continued)

<i>50 sector post-UR database with abbreviation</i>	<i>57 sector post-UR database with telecommunications and banking services split out, and abbreviation</i>
42. Manufactures nec (omf)	42. Manufactures nec (omf)
43. Electricity (ely)	43. Electricity (ely)
44. Gas manufacture, distribution (gdt)	44. Gas manufacture, distribution (gdt)
45. Water (wtr)	45. Water (wtr)
46. Construction (cns)	46. Construction (cns)
47. Trade, transport (t_t)	47. Trade (trd)
47. Trade, transport (t_t)	48. Transport nec (otp)
47. Trade, transport (t_t)	49. Water transport (wtp)
47. Trade, transport (t_t)	50. Air transport (atp)
47. Trade, transport (t_t)	51. Communication (cmn)
48. Financial, business, recreat services (osp)	52. Financial services nec (ofi)
48. Financial, business, recreat services (osp)	53. Insurance (isr)
48. Financial, business, recreat services (osp)	54. Business services nec (obs)
48. Financial, business, recreat services (osp)	55. Recreational and other services (ros)
49. Public admin, defence, educ, health (osg)	56. Public admin, defence, educ, health (osg)
50. Dwellings (dwe)	57. Dwellings (dwe)

## Creating a GTAP 5 lookalike database

All files discussed in this section are located in h:\epb05\projects\ftap2\split\_UR.

1. Equal shares are used to split the 50 sector post-UR database and create a 57 sector post-UR database. The programs MERGEHAR and ViewHAR are used for this procedure.<sup>1</sup> The new database has the same commodity detail as the forthcoming GTAP 5 database. The new file is called MERGE57.UPD.
2. The TABLO generated program SHARE57 is used to calculate row and column shares required to split sectors 47 (trade, transport) and 48 (financial, business, recreational services) in the 50 sector post-UR database, as described in table 4.2. These shares are calculated for all header arrays on MERGE57.UPD. SHARE57 is run using input from the file SHARE57.CMF and all output is written to the file SHARE57.HAR.
3. The DAGG program<sup>2</sup> is used to split the file GTAPICM.UPD, which is identical to the file ZRGOVBND.UPD. DAGG first splits the columns and then the rows in GTAPICM.UPD, using the shares on the file SHARE57.HAR. DAGG is run using four DAGG input files: DAGG.INP, DAGG1.INP, DAGG2.INP,

<sup>1</sup> These programs are part of the GEMPACK software suite (Harrison and Pearson 1996).

<sup>2</sup> This program is also part of the GEMPACK software suite (Harrison and Pearson 1996).

---

DAGG3.INP. Final output is written to DAGG3.HAR. All DAGG procedures are run using the DOS bat file DAGGBAT.

4. As with all DAGG output files, the file DAGG3.HAR contains no set labels. These are then applied manually using ViewHAR. This modified file is then saved as 57X57ICM.UPD.

### **Aggregating the 57 sector post-UR database to 22 sectors**

All files discussed in this section are located in h:\epb05\projects\ftap2\split\_UR\ftapagg\main, except where otherwise indicated. The 57 sector post-UR database with separate telecommunications and banking services sectors does not match the 22 sector FDI stocks and rentals matrices described in chapter 3. As such, the post-UR database must be aggregated in a way which matches the FDI data. The concordance between the two databases appears in table 4.3.

The aggregation is performed using the FTAPAGG program, a modified version of the GTAP aggregation package as described in section 4.1 of Hanslow et al. (2000). A number of steps are involved in performing the aggregation.

1. A mapping file matching the concordance appearing in table 4.3 is first prepared. This is the file 19X22.TXT and it is placed in the directory h:\epb05\projects\ftap2\split\_UR\ftapagg\19x22.
2. As FTAPAGG was previously used for the preparing the FTAP database, it assumes the starting database has 19 regions and 50 commodities (see chapter 4 of Hanslow et al. 2000). The starting database in this case has 19 regions and 57 commodities. As such, the UNIX text file AGGMAP.AWK must be modified accordingly, following the instructions set out in section 4.1 of Hanslow et al. (2000).
3. FTAPAGG uses the starting files GSDSET.HAR and GSDPAR.DAT when performing an aggregation. The former contains all the sets in the starting database, and the latter contains all parameters in the starting database. As FTAPAGG previously assumed a starting database with 50 rather than 57 commodities, these files need to be modified to match the starting database. The changes to GSDSET.HAR are relatively straightforward and are therefore not explained. The changes to GSDPAR.DAT are also straightforward, except in terms of the values used for all elasticities ranging over commodities. For new commodities which are split out from existing commodities (for example, communications is split out from trade, transport), these values are set equal to those for the existing commodities.

**Table 4.3 Concordance between 57 sector and 22 sector post-UR database**

<i>57 sector post-UR database with abbreviation</i>	<i>22 sector post-UR database with abbreviation</i>
1. Paddy rice (pdr)	1. Agriculture (agr)
2. Wheat (wht)	1. Agriculture (agr)
3. Cereal grains nec (gro)	1. Agriculture (agr)
4. Vegetables, fruit, nuts (v_f)	1. Agriculture (agr)
5. Oil seeds (osd)	1. Agriculture (agr)
6. Sugar cane, sugar beet (c_b)	1. Agriculture (agr)
7. Plant-based fibers (pfb)	1. Agriculture (agr)
8. Crops nec (ocr)	1. Agriculture (agr)
9. Bovine cattle, sheep and goats, horses (ctl)	1. Agriculture (agr)
10. Animal products nec (oap)	1. Agriculture (agr)
11. Raw milk (rmk)	1. Agriculture (agr)
12. Wool silk-worm cocoons (wol)	1. Agriculture (agr)
13. Forestry (for)	1. Agriculture (agr)
14. Fishing (fsh)	1. Agriculture (agr)
15. Coal (col)	2. Mining (min)
16. Oil (oil)	3. Oil (oil)
17. Gas (gas)	2. Mining (min)
18. Minerals nec (omn)	2. Mining (min)
19. Bovine cattle, sheep, goat, horse meat products (cmt)	4. Food, beverages and tobacco (fbt)
20. Meat products nec (omt)	4. Food, beverages and tobacco (fbt)
21. Vegetable oils and fats (vol)	4. Food, beverages and tobacco (fbt)
22. Dairy products (mil)	4. Food, beverages and tobacco (fbt)
23. Processed rice (pcr)	4. Food, beverages and tobacco (fbt)
24. Sugar (sgr)	4. Food, beverages and tobacco (fbt)
25. Food products nec (ofd)	4. Food, beverages and tobacco (fbt)
26. Beverages and tobacco products (b_t)	4. Food, beverages and tobacco (fbt)
27. Textiles (tex)	5. Textiles, leather and clothing (tlc)
28. Wearing apparel (wap)	5. Textiles, leather and clothing (tlc)
29. Leather products (lea)	5. Textiles, leather and clothing (tlc)
30. Wood products (lum)	15. Other manufacturing (omn)
31. Paper products, publishing (ppp)	6. Paper and printing (p_p)
32. Petroleum, coal products (p_c)	8. Coal and petroleum (c_p)
33. Chemical, rubber, plastic products (crp)	7. Chemicals (che)
34. Mineral products nec (nmm)	9. Non-metallic minerals (nmm)
35. Ferrous metals (i_s)	10. Metals (met)
36. Metals nec (nfm)	10. Metals (met)
37. Metal products (fmp)	10. Metals (met)
38. Motor vehicles and parts (mvh)	13. Motor vehicles (mvh)
39. Transport equipment nec (otn)	14. Other transport equipment (ote)
40. Electronic equipment (ele)	12. Electric and electronic equipment (eee)
41. Machinery and equipment nec (ome)	11. Mechanical equipment (meq)

(Continued next page)



**Table 4.3 (continued)**

<i>57 sector post-UR database with abbreviation</i>	<i>22 sector post-UR database with abbreviation</i>
42. Manufactures nec (omf)	15. Other manufacturing (omn)
43. Electricity (ely)	21. Other services (osr)
44. Gas manufacture, distribution (gdt)	21. Other services (osr)
45. Water (wtr)	21. Other services (osr)
46. Construction (cns)	16. Construction (con)
47. Trade (trd)	17. Wholesale and retail trade (wrt)
48. Transport nec (otp)	18. Transport (tra)
49. Water transport (wtp)	18. Transport (tra)
50. Air transport (atp)	18. Transport (tra)
51. Communication (cmn)	20. Communications (cmn)
52. Financial services nec (ofi)	19. Finance, insurance and business (fib)
53. Insurance (isr)	19. Finance, insurance and business (fib)
54. Business services nec (obs)	19. Finance, insurance and business (fib)
55. Recreational and other services (ros)	21. Other services (osr)
56. Public admin, defence, educ, health (osg)	21. Other services (osr)
57. Dwellings (dwe)	22. Dwellings (dwe)

4. The file 57X57ICM.UPD is then saved as GSDDAT.HAR, as it is this file that FTAPAGG assumes contains the starting database. FTAPAGG is then run in the same way as the standard GTAP aggregation package (see chapter 9 of McDougall, Elbehri and Truong 1998). The aggregated data, sets and parameter files are GDAT.HAR, GSET.HAR and GPAR.DAT, respectively.

### Calculating domestic rentals

All files discussed in this section are located in h:\epb05\projects\ftap2\split\_UR\ftapagg\19x22. As with the FTAP database, the only tool for adjusting tax rates and readily available and applicable to the FTAP2 database is ALTERNATAX (Malcolm 1998). As ALTERNATAX is a version of GTAP (Hertel 1997), it does not distinguish separate domestic and foreign-owned industries. Thus, in order to incorporate the impediments to trade in telecommunications and banking services into the 22 sector post-UR database, the domestic and foreign impediment rates need to be combined into a single impediment rate for each region. This is done by calculating the combined impediment rate as a share-weighted average of domestic and foreign rates, where the shares are generated from the pre-tax, impediment-exclusive rentals to domestic and foreign capital. The calculation of foreign capital rentals has already been described in chapter 3, whereas domestic rentals are yet to be calculated. The calculation of pre-tax, impediment-exclusive rentals to domestic capital is described in this section.

All procedures and programs required to calculate the pre-tax, impediment-exclusive rentals to domestic capital are run by the DOS bat file CMP\_STCK. Table 4.4 lists all procedures, and input and output data files which are run by CMP\_STCK.

**Table 4.4 Steps in calculating the 22 sector pre-tax, impediment-exclusive rentals to domestic capital using the DOS bat file CMP\_STCK**

<i>Command</i>	<i>Input data files</i>	<i>Output data file</i>
1. copy h:\epb05\projects\ftap2\ras1\all\agg_22.har>log		
2. copy gdat.har 19x22icm.upd>>log		
3. cmp_stck -cmf cmp_stck.cmf>>log	CALC_ICM.HAR; AGG22.HAR; 19X22ICM.UPD; 19X22SET.HAR; 19X22PAR.DAT; FDI.HAR	CMP_STCK.HAR

Line one of CMP\_STCK copies the file with the 22 sector FDI stocks and rentals matrices described in chapter 3, AGG\_22.HAR, to the present working directory and creates a new log file called LOG. Line two saves the file with the 22 sector post-UR database, GDAT.HAR, as 19X22ICM.UPD. Line three runs the program CMP\_STCK taking inputs from CMP\_STCK.CMF, which does two things.

First, it scales down the FDI stocks and rentals by the ratio of the global post-UR capital stock to the global FTAP capital stock. It then calculates the post-UR stocks and rentals and compares them to the scaled FDI stocks and rentals. These ratios are written to CMP\_STCK.HAR. If the share of FDI stocks and rentals is greater than 100 per cent of global capital stocks and rentals, then the RAS procedure for creating the FDI stocks matrices needs to be revisited. This requires adjusting the shares of the inward FDI stock matrix and rerunning the RAS procedure.

Second, the 22 sector domestic rentals for each region are calculated as the difference between the post-UR rentals for each region and total inward FDI rentals for each region.

### 4.3 Applying impediment rates using ALTERTAX

All files discussed in this section are located in h:\epb05\projects\ftap2\ALTERTAX\19x22. The impediment rates presented in chapter 3 are incorporated into the post-UR database via the DOS bat file ALTERTAX. Table 4.5 lists all procedures, and input and output data files which are run by ALTERTAX.

The first four lines of the file ALTERNAX copy four files to the present working directory. These are the FDI stocks and rentals matrices (AGG\_22.HAR), the sets file (19X22SET.HAR), the post-UR database (19X22ICM.UPD) and the domestic rentals (CMP\_STCK.HAR).

**Table 4.5 Steps in applying impediment rates in the post-UR database using the DOS bat file ALTERNAX**

<i>Command</i>	<i>Input data file(s)</i>	<i>Output data file(s)</i>
1. copy h:\epb05\projects\ftap2\ras1\all\agg_22.har >log		
2. copy h:\epb05\projects\ftap2\split_ur\ftapagg\19x22\19x22set.har >>log		
3. copy h:\epb05\projects\ftap2\split_ur\ftapagg\19x22\19x22icm.upd >>log		
4. copy h:\epb05\projects\ftap2\split_ur\ftapagg\19x22\cmp_stck.har >>log		
5. shocks -cmf shocks.cmf>>log	AGG22.HAR; 19X22ICM.UPD; 19X22SET.HAR; CMP_STCK.HAR	19X22SHK.HAR; TF_SHKS.TXT; TO_SHKS.TXT; TXS_SHKS.TXT
6. copy slug.exe c:\ftap2\alternax\19x22\slug.exe>>log		
7. copy slug.axt c:\ftap2\alternax\19x22\slug.axt>>log		
8. copy slug.axs c:\ftap2\alternax\19x22\slug.axs>>log		
9. copy slug.cmf c:\ftap2\alternax\19x22\slug.cmf>>log		
10. copy 19x22set.har c:\ftap2\alternax\19x22\19x22set.har>>log		
11. copy 19x22icm.upd c:\ftap2\alternax\19x22\19x22icm.upd>>log		
12. copy tf_shks.txt c:\ftap2\alternax\19x22\tf_shks.txt>>log		
13. copy to_shks.txt c:\ftap2\alternax\19x22\to_shks.txt>>log		
14. copy txs_shks.txt c:\ftap2\alternax\19x22\txs_shks.txt>>log		
15. c:>>h:\epb05\projects\ftap2\alternax\19x22\log		
16. cd c:\ftap2\alternax\19x22>>h:\epb05\projects\ftap2\alternax\19x22\log		
17. slug -cmf slug.cmf >>h:\epb05\projects\ftap2\alternax\19x22\log	19X22ICM.UPD; 19X22SET.HAR; TF_SHKS.TXT; TO_SHKS.TXT; TXS_SHKS.TXT	SLUG.SL4; SLUG.DIS; SLUG.UPD
18. h:>>h:\epb05\projects\ftap2\alternax\19x22\log		
19. cd h:\epb05\projects\ftap2\alternax\19x22>>h:\epb05\projects\ftap2\alternax\19x22\log		
20. copy c:\ftap2\alternax\19x22\slug.sl4 >>log		
21. copy c:\ftap2\alternax\19x22\slug.log >>log		
22. copy c:\ftap2\alternax\19x22\slug.dis >>log		
23. copy c:\ftap2\alternax\19x22\slug.upd >>log		
24. cmphar -sti cmphar.sti>>log	19X22ICM.UPD; SLUG.UPD	ALTERNAX.PRN
25. chkpwr -cmf chkpwr.cmf>>log	19X22SET.HAR; SLUG.UPD	CHKPWR.HAR
26. chkrts -cmf chkrts.cmf>>log	19X22SET.HAR; SLUG.UPD	CHKRTS.HAR
27. chkall -cmf chkall.cmf >>log	19X22SHK.HAR	CHKPWR.HAR

Line five runs the program SHOCKS using inputs from the command file SHOCKS.CMF. This program calculates the shocks required to inject the

---

impediments into the post-UR database. This is done by calculating the share-weighted impediment rate to be applied in each region and sector, where the shares are the pre-tax, impediment-exclusive rentals to domestic and foreign capital. Once the combined impediment rate is calculated, the shocks are calculated as the difference between the power of the existing output or capital tax rate (usually zero), and the power of the target output or capital tax rates, that is, the combined impediment rate.

Lines six to 14 of the file `ALTERTAX` transfer the `ALTERTAX` program files (`SLUG.EXE`, `SLUG.AXT`, `SLUG.AXS` and `SLUG.CMF`) from the present network drive to a local hard drive. The post-UR database is also transferred to a local hard drive, as are the text files containing the shocks (`TF_SHKS.TXT`, `TO_SHKS.TXT` and `TXS_SHKS.TXT`). This transfer is done in order to run the `ALTERTAX` program on a local hard drive which speeds up the solution time considerably.

Lines 15 to 17 invoke the `ALTERTAX` program. `ALTERTAX` is run using the same settings as those used in generating the FTAP database (see section 4.2 of Hanslow et al. 2000). The next six lines move the solution (`SLUG.SL4`), log (`SLUG.LOG`), display (`SLUG.DIS`) and updated data (`SLUG.UPD`) files to a network directory.

The `CMPHAR` program<sup>3</sup> is then invoked, taking inputs from the file `CMPHAR.STI`. `CMPHAR` compares the pre- and post-`ALTERTAX` databases and reports the value of the ‘average of all difference ratios’. Smaller values are preferred as they indicate that the database has been disturbed minimally from the injection of the impediment rates. The value of the average of all difference ratios is 0.006.

The program `CHKPWR` is then invoked taking inputs from `CHKPWR.CMF`. `CHKPWR` calculates the power of the capital, output and export taxes in the post-`ALTERTAX` database, for all commodities and all regions.

Line 26 invokes the program `CHKRTS` taking inputs from `CHKRTS.CMF`. `CHKRTS` calculates the ad valorem capital, output, import and export tax rates in the post-`ALTERTAX` database, for all commodities and all regions.

The final line of the file `ALTERTAX` invokes the program `CHKALL` taking inputs from the file `CHKALL.CMF`. This program compares the powers of the target impediment rates, with the powers of the post-`ALTERTAX` impediment rates. This is done for impediment rates on capital, output and exports. The header arrays `CAP`, `OUT` and `EXP` on the file `CHKPWR.HAR` should be checked to see the results of

---

<sup>3</sup> This program is part of the GEMPACK software suite (Harrison and Pearson 1996).

---

the comparison. The values should be zero for sectors with no impediments and one for all other sectors.

---

## 5 Splitting the post-UR, post-ALERTAX database between domestic and foreign constituents

Once the impediments data have been injected into the post-UR database using ALERTAX, the post-UR, post-ALERTAX database can be split between domestic and foreign constituents. Due to lack of detailed information on FDI firms' cost structures it is assumed that all firms have the same cost structure. The region-specific ratio of FDI rentals to total capital rentals is used to split intermediate inputs and output of all FDI firms in each sector. This chapter describes the procedures employed to split out domestic and foreign firms in the post-UR, post-ALERTAX database. Most programs described in this chapter are adapted and modified from those used to develop the FTAP database. The procedures used in these programs are described in detail in chapter 7 of Hanslow et al. (2000). This chapter largely provides a brief description of the programs used, and concentrates only on any new programs used and modifications that have been made to the original programs.<sup>1</sup>

All files and programs discussed in this chapter are located in `h:\epb05\projects\ftap2\dom_for\19x8`.

### 5.1 Splitting domestic and foreign capital impediments

Before running ALERTAX, the impediment-exclusive rentals to foreign capital are calculated (header array EVMS) using the FDI stocks matrix and the regional rates of return from the post-UR database (see chapter 3, section 3.4). The results are compared with the impediment-exclusive rentals to capital (header array VFM) from the post-UR database. The impediment-exclusive rentals to domestic capital are calculated as the difference between VFM and EVMS (summed over all home regions). The foreign and domestic impediment-exclusive rentals are used as weights to calculate the weighted-average impediment rates for shocks in running

---

<sup>1</sup> Some of the procedures in the original files may be redundant due to changes in or modifications of the database and the model theory. These redundant procedures have not been removed from the files.

---

ALERTAX. After running ALERTAX, the impediment-exclusive rentals to capital (VFM) are expected to have changed. As a result, the foreign and domestic impediment-exclusive rentals need to be modified to comply with the post-UR, post-ALERTAX database. These are the most important coefficients because the post-UR, post-ALERTAX database is to be split using the shares of these domestic and foreign capital rentals to total rentals.

The main tasks in splitting the domestic and foreign rentals are to

- calculate the impediment-exclusive rentals to foreign capital (header array EVMS) from the post-UR, post-ALERTAX impediment-exclusive rentals to capital (header array VFM);
- calculate the impediment-inclusive rentals to foreign capital (header array EVAS) by multiplying EVMS by the sum of the foreign capital impediment rates and the impediment-exclusive rates of return; and
- check the results by comparing them with the post-UR, pre-ALERTAX values of EVMS and EVAS.

All data processing required to split the post-UR, post-ALERTAX database into domestic and foreign constituents is run by the DOS bat file PREPARE. Table 5.1 lists all procedures, and input and output data files which are run by PREPARE.

The first six lines of PREPARE move the post UR, post-ALERTAX database files (SLUG.UPD and 19X22SET.HAR), the FDI stocks and rentals data (AGG\_22.HAR) and the post-UR, post-ALERTAX domestic rentals and parameter files (CMP\_STCK.HAR and 19X22PAR.DAT), to the present working directory. These files contain sectoral detail equivalent to the 22 sectors listed in table 4.3. As the final FTAP2 database has eight sectors, these data files need to be aggregated to this eight sector detail before proceeding.

Line six of PREPARE runs the program AGG taking inputs from AGG.CMF. This program aggregates the files required for the domestic/foreign splitting procedure, from 22 sectors to eight sectors according to the mapping presented in table 5.2.

Line seven of PREPARE runs the program CHKRTS taking inputs from CHKRTS.CMF. CHKRTS calculates the ad valorem tax rates for factors, output, imports and exports in the eight sector post-UR, post-ALERTAX database.

Lines eight through to 10 rename the eight sector post-UR, post-ALERTAX database files to filenames which are recognisable by subsequent programs. Lines 11 and 12 move two files required by subsequent programs to the present working directory.

**Table 5.1 Steps in splitting domestic and foreign industries in the post-UR, post-ALTERNATIVE database using the DOS bat file PREPARE**

<i>Command</i>	<i>Input data files</i>	<i>Output data file(s)</i>
1. copy h:\epb05\projects\ftap2\ras1\all\agg_22.har>log		
2. copy h:\epb05\projects\ftap2\split_ur\ftapagg\19x22\cmp_stck.har>>log		
3. copy h:\epb05\projects\ftap2\altertax\19x22\slug.upd>>log		
4. copy h:\epb05\projects\ftap2\altertax\19x22\19x22set.har>>log		
5. copy h:\epb05\projects\ftap2\split_ur\ftapagg\19x22\19x22par.dat>>log		
6. agg -cmf agg.cmf>>log	SLUG.UPD; 19X22PAR.DAT; 19X22SET.HAR; COMMAP.HAR; AGG_22.HAR; CMP_STCK.HAR	19X8PAR.DAT; 19X8SLUG.UPD; AGG_8.HAR; CMP_STCK8.HAR; 19X8SET.HAR
7. chkrts -cmf chkrts.cmf >>log	19X8SET.HAR; 19X8SLUG.UPD	CHKRTS.HAR
8. copy 19x8set.har sets.har>>log		
9. copy 19x8par.dat para.dat>>log		
10. copy 19x8slug.upd data.har>>log		
11. copy h:\epb05\projects\ftap2\ras1\all\fdi.har fdiold.har>>log		
12. copy h:\epb05\projects\ftap2\altertax\19x22\19x22shk.har>>log		
13. fdi -cmf fdi.cmf>>log	AGG_8.HAR; FDIOLD.HAR; CMP_STCK8.HAR; 19X8SLUG.UPD; 19X22SHK.HAR; 19X22SET.HAR; 19X8SET.HAR	FDI.HAR; CHECK.HAR
14. call mk_data.bat		
15. call mk_data3.bat		

Line 13 of PREPARE runs the program FDI which recalculates EVMS and EVAS using the post-UR, post-ALTERNATIVE values of VFM and EVFM, and rental shares from AGG\_8.HAR. FDI creates a new FDI.HAR file, which is used by all programs in two subsequent DOS bat files: MK\_DATA and MK\_DATA3.

## 5.2 Splitting domestic and foreign firms' production

All files discussed in this section are located in h:\epb05\projects\ftap2\dom\_for\19x8. There are two main tasks in splitting the supply side of the post-UR, post-ALTERNATIVE GTAPICM database:

1. splitting the post-ALTERNATIVE GATPICM database into domestic and foreign firm's output using the domestic and foreign capital rental shares, respectively; and



**Table 5.2 Concordance between 22 and 8 sector post-UR, post-ALERTAX database and FDI data**

<i>22 sector post-UR, post-ALERTAX database and FDI data, and abbreviation</i>	<i>8 sector post-UR, post-ALERTAX database and FDI data, and abbreviation</i>
1. Agriculture (agr)	1. Primary (pri)
2. Mining (min)	1. Primary (pri)
3. Oil (oil)	1. Primary (pri)
4. Food, beverages and tobacco (fbt)	1. Primary (pri)
5. Textiles, leather and clothing (tlc)	2. Secondary (sec)
6. Paper and printing (p_p)	2. Secondary (sec)
7. Chemicals (che)	2. Secondary (sec)
8. Coal and petroleum (c_p)	2. Secondary (sec)
9. Non-metallic minerals (nmm)	2. Secondary (sec)
10. Metals (met)	2. Secondary (sec)
11. Mechanical equipment (meq)	2. Secondary (sec)
12. Electric and electronic equipment (eee)	2. Secondary (sec)
13. Motor vehicles (mvh)	2. Secondary (sec)
14. Other transport equipment (ote)	2. Secondary (sec)
15. Other manufacturing (omn)	2. Secondary (sec)
16. Construction (con)	3. Construction (con)
17. Wholesale and retail trade (wrt)	4. Trade and transport (tt_)
18. Transport (tra)	4. Trade and transport (tt_)
19. Communications (cmn)	5. Communications (cmn)
20. Finance, insurance and business (fib)	6. Finance, insurance and business (fib)
21. Other services (osr)	7. Other services (osr)
22. Dwellings (dwe)	8. Dwellings (dwe)

2. creating a mapping between the sets HOME, HOST and TRAD\_COMM, and the single set IND used in the CRUSOE model embedded in FTAP2.

These tasks are undertaken by programs invoked by the DOS bat file MK\_DATA, which is adapted from chapter 7 of Hanslow et al. (2000) with some modifications. Table 5.3 lists all procedures, and input and output data files which are run by MK\_DATA.

Line one of MK\_DATA uses the MODHAR utility taking inputs from the file FDATA.STI. It appends some headers from FDI.HAR to the post-ALERTAX GTAPICM format file DATA.HAR to create a new file called FDATA.HAR.

Line two uses MODHAR taking inputs from MODH\_INC.STI. This step modifies FDATA.HAR and create the file TMP.HAR. Lines three and four delete the existing file FDATA.HAR and renames TMP.HAR as FDATA.HAR.

**Table 5.3 Steps in splitting domestic and foreign firm's production in the post-UR, post-ALERTAX database using the DOS bat file MK\_DATA**

<i>Command</i>	<i>Input data file(s)</i>	<i>Output data file(s)</i>
1. modhar <fdata.sti >>log	FDI.HAR; DATA.HAR	FDATA.HAR
2. modhar <modh_inc.sti >>log	FDATA.HAR	TMP.HAR
3. del fdata.har >>log		
4. ren tmp.har fdata.har>>log		
5. expand9 -cmf expand9.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR	EXPAND.HAR; EXPAND2.HAR
6. kimpdist -cmf kimpdist.cmf>>log	AGG_22.HAR	KIMPDIST.TXT; IMP_DIST.TXT
7. mkfdihar -cmf mkfdihar.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; KIMPDIST.TXT	NEW_FDI.HAR; MKFDIHAR.DIS; CHK2.HAR; CHK3.HAR
8. del fdi.har >>log		
9. ren new_fdi.har fdi.har>>log		
10. fdi_ind -cmf fdi_ind.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; EXPAND.HAR; IMP_DIST.TXT	19X8PAR.DAT; 19X8SLUG.UPD; AGG_8.HAR; CMP_STCK8.HAR; 19X8SET.HAR
11. copy expand.har vom.har>>log		
12. adjicm -cmf adjicm.cmf>>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; KDATA.HAR; FDI_IND.HAR; SLUG.UPD; VOM.HAR	FDATANEW.HAR
13. mergehar fdatanew.har fdata.har fdata.har yy1>>log		

Line five runs the program EXPAND9 taking inputs from the file EXPAND9.CMF. This program splits the industries into domestic and foreign-owned parts. The data on the files EXPAND.HAR and EXPAND2.HAR are stored in a conventional way with an additional ownership dimension. This data will be subsequently used in the program FDI\_IND for creating a mapping for the CRUSOE model.

Line six invokes the program KIMPDIST taking inputs from the command file KIMPDIST.CMF. This program calculates the shares required to distribute impediments between domestic and foreign-owned firms, which will be subsequently used in the programs MKFDIHAR and FDI\_IND.

In constructing the FTAP database, the program MKFDIHAR was used to check whether the capital impediments had been distributed. It does nothing here because the splitting has already been done by the FDI program. It should be noted that the formulas used in distributing the capital impediments are incorrect and need to be revised. This has not been done as these formulas are redundant in this application of the program. The output files CHK2.HAR and CHK3.HAR contain no data.

---

The next two lines of MK\_DATA delete the existing file FDI.HAR and rename the file NEW\_FDI.HAR, which is an output file of the MKFDIHAR program, as FDI.HAR. Line 10 runs the FDI\_IND program taking inputs from FDI\_IND.CMF. This file creates a mapping set for the CRUSOE model used in FTAP2. It also distributes the post-ALERTAX output impediments between domestic and foreign-owned firms. This procedure has been modified as the original formulas generate inaccurate results.

The file EXPAND.HAR is then renamed as VOM.HAR. The program ADJICM then adjusts three GTAPICM headers: CM07 (world real bond rate), CM06 (revenue from property taxes) and CM03 (private bond income). The last line of MK\_DATA runs MERGEHAR merging the files FDATA\_NEW.HAR and FDATA.HAR, placing the three new GTAPICM headers on FDATA.HAR.

### **5.3 Splitting domestic and foreign firm's exports and imports**

Once the supply side of the post-UR, post-ALERTAX database has been split (domestic and foreign firms' production), the same needs to be done for the demand side (domestic and foreign firms' exports and imports). This section summarises how this was done on a step-by-step basis. A detailed description of each step can be found in chapter 7 of Hanslow et al. (2000).

All files discussed in this chapter are located in h:\epb05\projects\ftap2\dom\_for\19x8. The DOS bat file MK\_DATA3 runs all programs which split the demand side of the post-UR, post-ALERTAX database. Table 5.4 lists all procedures, and input and output data files which are run by MK\_DATA3. MK\_DATA3 closely follows what is described in chapter 7 of Hanslow et al. (2000). Some of the original procedures are modified and new procedures are added to take into account the features of the current, more disaggregated database.

The first three lines of MK\_DATA3 makes copies of three output files from programs invoked by MK\_DATA. Line four invokes the program FDATA3, which produces GTAP domestic and imported intermediate inputs arrays consistent with the Petri demand specification. The outputs are sent to TMP.HAR. The output files CHK2.HAR and CHK3.HAR contain no data.

Line five invokes the MODHAR utility taking inputs from FDATA3.STI. Here, the domestic and imported intermediate inputs arrays produced by FDATA3 replace the existing arrays on FDATA.HAR. The results are written to FDATA3.HAR. Line 6

---

runs the EXPAND9A program which splits domestic/foreign industry data on FDATA3.HAR, in the same way that EXPAND9 splits FDATA.HAR in MK\_DATA (table 5.3, line five).

**Table 5.4 Steps in splitting domestic and foreign firm's exports and imports in the post-UR, post-ALTERNATE database using the DOS bat file MK\_DATA3**

<i>Command</i>	<i>Input data files</i>	<i>Output data file(s)</i>
1. copy kdata.har kdata2.har>>log		
2. copy fdi.har fdi2.har>>log		
3. copy fdi_ind.har fdi_ind2.har>>log		
4. fdata3 -cmf fdata3.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; KDATA.HAR; FDI_IND.HAR	CHK2.HAR; CHK3.HAR; TMP.HAR
5. modhar <fdata3.sti >>log	TMP.HAR; FDATA.HAR	FDATA3.HAR
6. expand9a -cmf expftap3.cmf >>log	SETS.HAR; PARA.DAT; FDATA3.HAR; FDI.HAR; KDATA.HAR; FDI_IND.HAR	EXPAND.HAR; EXPAND2.HAR
7. fdi_ind3 -cmf fdi_ind.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; EXPAND.HAR; KDATA2.HAR	KDATA.HAR; FDI_IND.HAR
8. chksave -cmf chksave.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; KDATA.HAR; FDI_IND.HAR; RR_FLAG.TXT	CHKINC.HAR; CHK2.HAR; CHK3.HAR
9. copy chk3.har chksave.har>>log		
10. modhar <tidysave.sti >>log	FDATA.HAR; CHK3.HAR	TMP.HAR
11. del fdata.har>>log		
12. ren tmp.har fdata.har>>log		
13. ftap3dat -cmf ftap3dat.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; KDATA.HAR; FDI_IND.HAR	CHECK.HAR; CHK2.HAR; CHK3.HAR; TMP.HAR; CHECK.TXT
14. if exist fdata2.har del fdata2.har>>log		
15. ren fdata.har fdata2.har>>log		
16. modhar <ftap3dat.sti >>log	FDATA2.HAR; TMP.HAR	FDATA.HAR
17. petri -cmf petri.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; KDATA.HAR; FDI_IND.HAR; RR_FLAG.TXT	CHK2.HAR; CHK3.HAR; PETRI.HAR
18. modhar <petri.sti >>log	PETRI.HAR; FDI.HAR	TMP.HAR
19. del fdi.har>>log		
20. ren tmp.har fdi.har>>log		

(Continued next page)

Table 5.4 (continued)

<i>Command</i>	<i>Input data files</i>	<i>Output data file(s)</i>
21. svr -cmf svr.cmf >>log	SETS.HAR; PARA.DAT; FDATA.HAR; FDI.HAR; KDATA.HAR; FDI_IND.HAR; RR_FLAG.TXT	CHK2.HAR; CHK3.HAR
22. modhar <tidysave.sti >>log	CHK3.HAR; FDATA.HAR	TMP.HAR
23. del fdata.har>>log		
24. ren tmp.har fdata.har>>log		
25. call ft2bmodh fdata		
26. call ft2bmodh kdata		
27. chkrate -cmf chkrate.cmf >>log	SETS.HAR; FDI_IND.HAR; KDATA.HAR; FDATA.HAR; PARA.DAT; FDI.HAR; AGG_8.HAR	CHKRATE.HAR

The program FDI\_IND3 is subsequently invoked to assign domestic/foreign industry data into CRUSOE format as FDI\_IND does in MK\_DATA. CHKSAVE then checks whether the value of national savings on FDATA.HAR agrees with savings calculated as national income minus consumption. The differences are written to CHK3.HAR and the income values to CHKINC.HAR. The output file CHK2.HAR contains no data.

Line nine makes a copy of CHK3.HAR called CHKSAVE.HAR. Line 10 runs MODHAR which replaces the old value of savings on FDATA.HAR with the new value on CHK3.HAR. The file FDATA.HAR is then deleted, and a copy of TMP.HAR is saved as FDATA.HAR.

The program FTAP3DAT is invoked to disaggregate international trade flows into exports of domestic and foreign-owned industries. Trade flows are disaggregated in proportion to the market values of output of these industries (coefficients VODM and VOHM, respectively). The results are sent to CHECK.TXT, CHECK.HAR, CHK2.HAR and CHK3.HAR.

Line 14 of MK\_DATA3 checks whether FDATA2.HAR exists and if it does it is deleted. A copy of FDATA.HAR is then made with the name of FDATA2.HAR. MODHAR is the used to merge FDATA2.HAR with TMP.HAR. The program PERTI calculate the Petri asset values and places these on PETRI.HAR, CHK2.HAR and CHK3.HAR. MODHAR then merges PETRI.HAR with FDI.HAR to produce TMP.HAR.

---

FDI.HAR is then deleted, and TMP.HAR is renamed as FDI.HAR. Line 21 runs the program SVR which tidies up small numerical discrepancies between savings calculated from income and consumption and the savings header in the database. The results are written to CHK2.HAR and CHK3.HAR. MODHAR then adds the header SAVE from CHK3.HAR and all other headers from FDATA.HAR to TMP.HAR.

Lines 23 and 24 delete the existing FDATA.HAR and renames TMP.HAR as FDATA.HAR. The DOS bat file FT2BMODH is run merging FDATA.HAR and FDATA2.HAR giving priority to headers on FDATA2.HAR. FT2BMODH is run again merging KDATA.HAR and KDATA2.HAR giving priority to headers on KDATA2.HAR.

After all the procedures have been carried out, four header array files are generated: FDATA.HAR, KDATA.HAR, FDI.HAR and FDI\_IND.HAR. They are the header array data files for the FTAP2 model.

### **Checking the impediment rates**

The final line of MK\_DATA3 invokes the program CHKRATE which compares the original and final impediment rates, reports the differences in the header DIFF. The original impediment rates contained in the headers DCAP, FCAP, DOUT and FOUT. The final impediment rates are contained in the header IMPD. Tables 5.5 and 5.6 show that the estimates of impediments for telecommunications and financial services are quite accurately injected into the model database by the ALTERNATE procedure. The differences between the estimates and the injected impediment rates are negligible.

**Table 5.5 Original and final impediment rates for telecommunications (per cent)**

Region	Original impediment rates				Post-ALERTAX impediment rates			
	Output		Capital		Output		Capital	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
Australia	-	-	1.4	1.4	-	-	1.4	1.4
NZ	-	-	1.3	1.3	-	-	1.3	1.3
Japan	-	-	1.8	1.8	-	-	1.8	1.8
Korea	2.5	4.9	4.8	9.2	2.5	4.9	4.8	9.2
Indonesia	41.0	82.1	85.9	163.3	41.0	82.0	85.9	163.3
Malaysia	5.5	11.0	3.6	15.0	5.5	11.0	3.6	15.0
Philippines	21.4	54.0	-	50.0	21.4	53.5	-	50.0
Singapore	0.8	0.8	5.5	8.1	0.8	0.8	5.5	8.1
Thailand	14.0	28.0	32.7	55.8	14.0	28.0	32.7	55.8
China	50.0	100.0	339.4	678.8	50.0	100.0	339.4	678.8
Hong Kong	0.6	0.6	3.2	3.2	0.6	0.6	3.2	3.2
Taiwan	1.3	2.1	5.8	9.3	1.3	2.1	5.8	9.3
Canada	0.8	2.3	1.8	6.6	0.8	2.3	1.8	6.6
USA	0.2	0.2	-	-	0.2	0.2	-	-
Mexico	5.4	11.0	1.8	7.8	5.4	10.8	1.8	7.8
Chile	1.3	1.3	1.0	1.0	1.3	1.3	1.0	1.0
R. Cairns <sup>a</sup>	2.7	6.5	11.8	15.9	2.7	6.5	11.8	15.9
EU	0.3	0.7	3.6	4.6	0.3	0.7	3.6	4.6
R. World <sup>b</sup>	16.4	33.0	114.0	215.0	16.4	32.8	114.0	215.0

<sup>a</sup> The rest of the Cairns group (Argentina, Brazil, Colombia and Uruguay). <sup>b</sup> The rest of the world. \* Nil.

Source: Table 3.7 and FTAP2 database.



Table 5.6 **Original and final impediment rates for financial services (per cent)**

Region	Original impediment rates				Post-ALERTAX impediment rates			
	Output		Capital		Output		Capital	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
Australia	-	2.2	-	43.3	-	1.4	-	43.3
NZ	-	2.2	-	8.5	-	1.9	-	8.5
Japan	5.9	7.7	-	3.0	5.8	7.7	-	3.0
Korea	14.9	18.6	-	80.7	14.9	18.6	-	80.7
Indonesia	5.3	16.4	-	81.0	5.3	16.3	-	81.0
Malaysia	6.7	24.7	41.7	97.4	6.7	24.6	41.7	97.4
Philippines	3.7	14.1	24.2	109.9	3.5	13.4	24.0	109.9
Singapore	8.2	20.8	-	62.7	8.0	20.4	-	62.7
Thailand	-	12.5	-	58.4	-	7.3	-	58.4
China	14.9	24.7	60.6	140.7	14.9	24.7	60.6	140.7
Hong Kong	2.6	4.9	-	6.4	2.6	4.9	-	6.4
Taiwan	8.6	14.8	-	48.8	8.6	14.7	-	48.8
Canada	0.0	2.8	-	13.4	0.0	2.3	-	13.4
USA	0.0	2.8	-	8.1	0.0	2.4	-	8.1
Mexico	0.0	2.9	-	21.8	0.0	2.2	-	21.8
Chile	7.7	11.3	39.0	57.4	7.7	11.3	39.0	57.4
R. Cairns <sup>a</sup>	0.2	10.1	8.1	33.2	0.2	9.0	8.1	33.2
EU	-	2.8	-	12.3	-	2.3	-	12.3
R. World <sup>b</sup>	-	12.7	6.4	51.5	-	8.2	6.4	51.5

<sup>a</sup> The rest of the Cairns group (Argentina, Brazil, Colombia and Uruguay). <sup>b</sup> The rest of the world. - Nil.

Source: Table 3.7 and FTAP2 database.

---

# References

- Asia-Pacific Economic Cooperation 1995, *Foreign Direct Investment and APEC Economic Integration*, APEC Publication No. 95-EC-01.1, Singapore.
- Disclosure 1999, Global Researcher — Worldscope Database, Disclosure, United States, January.
- Hanslow, K., Phamduc, T. and Verikios, G. 2000, *The Structure of the FTAP Model*, Research Memorandum MC-58, Productivity Commission, Canberra.
- Hanslow, K., Phamduc, T., Verikios, G. and Welsh, A. 2000, *Incorporating Barriers to Services Trade into the FTAP Database*, Research Memorandum MC-59, Productivity Commission, Canberra.
- Harrison, J.W. and Pearson, K.R. 1996, 'Computing solutions for large general equilibrium models using GEMPACK', *Computational Economics*, vol. 9, no. 2, pp. 83–127.
- Huff, K., McDougall, R. and Walmsley, T. 1999, *Contributing Input-Output Tables to the GTAP Data Base*, GTAP Technical Paper No. 1, Release 4.1, Center for Global Trade Analysis, Purdue University, West Lafayette.
- Kalirajan, K., McGuire, G., Nguyen-Hong, D. and Schuele, M. 1999, The price impact of restrictions on banking services, paper presented at the Trade Policy Forum of the Pacific Economic Cooperation Council, Auckland, 3-4 June.
- Malcolm, G. 1998, *Adjusting Tax Rates in the GTAP Data Base*, GTAP Technical Paper No. 12, Center for Global Trade Analysis, Purdue University, West Lafayette.
- McDougall, R.A., Elbehri, A. and Truong, T.P. (eds) 1998, *Global Trade, Assistance, and Protection: The GTAP 4 Data Base*, Center for Global Trade Analysis, Purdue University, West Lafayette.
- OECD (Organization of Economic Cooperation and Development) 1995, *International Direct Investment Statistics Yearbook*, Paris.
- OECD 1997a, *Activities of Foreign Affiliates in OECD Countries, 1985-1994*, Paris.
- OECD 1997b, *International Direct Investment Statistics Yearbook*, Paris.
- Productivity Commission 1999, Trade and Assistance Review 1998-99, Annual Report Series 1998-99, Ausinfo, Canberra.

- 
- Trade and Investment* (a Japanese periodical) 1991, no. 9, table 3, p.26.
- Stone, R. 1961, *Input-output and National Accounts*, Organisation for European Economic Corporation, Paris.
- UNCTAD (United Nations Conference on Trade and Development) 1992, *World Investment Directory 1992, Volume 1: Asia and the Pacific*, New York.
- UNCTAD 1996, *World Investment Report 1996*, New York.
- UNCTAD 1998, *World Investment Report 1998*, New York.
- UNCTAD 1999, *World Investment Report 1999: Foreign Direct Investment and the Challenge of Development*, Geneva.
- Verikios, G. and Hanslow, K. 1999, 'Modelling the effects of implementing the Uruguay Round: A comparison using the GTAP model under alternative treatments of international capital mobility', paper presented at the Second Annual Conference on Global Economic Analysis, Gl. Avernoes, Denmark, 20-22 June.
- Verikios, G. and Zhang, X-G. 2001, *Global Gains from Liberalising Trade in Telecommunications and Financial Services*, Productivity Commission Staff Research Paper, AusInfo, Canberra, October.
- Wall, D. 1997, *Outflows of capital from China*, OECD Development Centre Technical Paper No. 123, OECD, Paris.
- Warren, T. 2000, 'The impact on output of impediments to trade and investment in telecommunications services', in Findlay, C. and Warren, T. (eds) 2000, *Impediments to Trade in Services: Measurement and Policy Implications*, Routledge, London.