GTAP-M: A GTAP Model and Data Base that Incorporates Domestic Margins

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Abstract:

Transportation, wholesaling, and retailing activities are a significant segment of economic activity in many economies. The magnitude of these activities can vary greatly between products, users, and regions. However, in most applied general equilibrium (AGE) analyses, these marketing activities are not tied to specific commodities. This paper develops a model framework and database that incorporates domestic marketing margins on domestic and imported goods going to final demand or used as intermediate inputs, and margins on exports, into the standard GTAP Model. The effects of incorporating domestic marketing activities into an AGE model are illustrated by comparing the results of the standard GTAP Model to the new GTAP-M Model for several different technological change scenarios. The comparison yields two main results. First, tying the domestic marketing activities to specific commodities changes the degree of price transmission from producers to users, compared to a model that does not include margin activities explicitly. For example, the reduction in the crop price due to global technical change in the crop sector is completely passed through to consumers in the standard GTAP Model while only about fifty to eighty percent of the reduction in the crop price is passed through to consumers in the GTAP-M Model. This leads to smaller increases in the quantity demanded and therefore smaller increases in crop production following the technical change. The second main result is that the magnitude of the elasticity of substitution between commodities and the composite marketing activity is very important. Allowing variable margins creates a new source of demand-responsiveness for commodities. This impact was illustrated in the case of technical change in the crops sector. Allowing the domestic marketing margins to vary resulted in larger increases in crop, livestock, and processed food production than was the case for fixed margins or the case without domestic marketing margins. This result occurred because the prices of food commodities decrease relative to the prices of trade and transport activities.

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1. Introduction

Transportation, wholesaling, and retailing activities, commonly referred to as distribution or marketing activities, play an important role in most economies. The magnitude of these marketing activities can vary widely between products and users. For example, Tables 1 and 2 provide estimates of the value of marketing activities relative to the commodity value for products purchased by households and firms for the United States (US) for all GTAP commodities.[1] For the private household, this ratio varied from zero for some agricultural commodities not directly purchased by consumers (or consumed directly on-farm) and services to over one for commodities such as petroleum and coal (p_c), wood products (lum), leather products (lea) and crops, nec (ocr). Excluding services, the average marketing margin on domestic and imported goods purchased by the US private household was approximately 82.5 percent. However, the marketing margins on domestic and imported intermediate imports were much smaller, averaging approximately 19 percent. Bradford and Gohin found that the ratio of consumer to producer prices averaged between 1.4 and 1.86 for Australia, Canada, Japan, the Netherlands, the UK, and the US.

In most applied general equilibrium (AGE) analyses, the marketing activities in the economy are not tied to specific commodities. This is a reflection of usual treatment of margins in the underlying input-output (I-O) tables. The values in these I-O tables are computed to reflect producer prices. Thus, all of the marketing margins associated with the purchase of specific commodities are allocated to the appropriate margin activity and then treated as a direct purchase of that margin activity. For example, the purchase of a food product by consumers does not include all transportation, wholesale, and retail activities necessary to get that product from the producer to the consumer. Instead, consumers are assumed to purchase a bundle of marketing services separately from their purchases of commodities. However, this treatment can generate inappropriate demand behavior (Dixon *et al.*). For example, by not tying marketing activities to individual commodities, an increase in the price of food (or any commodity) may lead to increased purchases of marketing services, even though higher food prices would be expected to reduce the demand for marketing services associated with food products. Of course, the reverse would happen for a reduction in the price of food.

There are two objectives of this paper. The first objective is to develop a modeling framework and database that incorporates domestic marketing margins into the standard GTAP Model. Note the emphasis on domestic marketing margins because transportation margins on all internationally traded commodities are all ready accounted for in the existing GTAP Model. The second objective is to illustrate the importance of including domestic marketing margins by comparing the results of several experiments using the standard GTAP Model to the results of the GTAP-M Model. These experiments

[1] These estimates are based on the 1997 Use data from the Input-Output benchmark accounts (US Department of Commerce).

chosen follow the work of Frisvold and consider the impacts of technological change in agriculture on production, consumption, trade and factor returns.

2. Modeling Framework

As discussed by Gohin, marketing margins have been incorporated into AGE models in a variety of ways. The ORANI model of the Australian economy (Dixon *et al.*) identifies eight services that are assumed to facilitate the flow of goods from domestic producers or imports to domestic private households, domestic firms, government demands, and foreign demand for exports. The eight services are wholesale trade, retail trade, road transport, rail transport, water transport, air transport, other insurance, and restaurants and hotels. These eight marketing services are combined in fixed proportion with producer goods to form consumer goods. The consumer price, which differs by user, equals the producer price plus a weighted sum of the prices of all marketing services. This approach ties marketing activities to specific commodities.

Peterson *et al.* developed a treatment of marketing margins in an AGE model with as many wholesale/retail activities as goods in the model. Each wholesale/retail industry is assumed to use a nested CES production structure that combines domestic and imported goods, with labor and capital services to produce a consumer good. The magnitude of the marketing margin is determined by the value of labor and capital services used in the corresponding wholesale/retail industry. Unlike the ORANI model, substitution is allowed between goods and marketing services but no margins are specified for intermediate inputs or exports.

Komen and Peerlings developed a static, single country AGE model (WAGEM) of the Netherlands that trade and transportation services into the buyers' price of each commodity at three levels: exports, total domestic use (wholesale margins), and household demand (retail margins). At each of these three levels, the marketing margin is assumed to be a constant percent of the value of the transaction at the sellers' price. Bradford and Gohin show that this is equivalent to assuming a Cobb-Douglas relationship between commodities and marketing services and is compatible with cost-plus pricing or mark-up pricing rules. Bradford and Gohin call this an "imperfectly competitive" approach to the explicit modeling of marketing margins.

In order to minimize the changes in the existing GTAP Model structure, the chosen treatment of marketing margins follows the specification in the ORANI model and the work of Bradford and Gohin. The marketing sector is characterized by perfect competition with CES functions describing the margin "technology." Utilizing a CES function allows the model to encompass the case where no substitution is permitted between commodities and marketing services (ORANI model) and the case where substitution is permitted (Peterson, *et al.* and Bradford and Gohin). The model will extend the approach of Bradford and Gohin by incorporating multiple trade and transport sectors into the model rather than aggregating into a single sector. The GTAP version 5 Data Base identifies four trade and transport sectors: trade (trd), transport nec (otp), water transport (wtp), and air transport (atp).

It should be pointed out that households may also directly consumer each of the "marketing services." This is because the trade and transportation sectors are defined to include services directly purchased by households. For example, air transport includes commercial airlines that provide services directly to individual consumers; water transport includes ferry services; the trade sector includes the repair of personal and household goods; and transport, nec includes all activities of travel agents. Thus, it is not the case that these four services are used exclusively to provide marketing services.

The demands for the marketing services are associated with the following uses: intermediate or firm purchases of imported goods; firm purchases of domestic goods; private household purchases of imported

goods; private household purchases of domestic goods; government purchases of imported goods; government purchases of domestic goods; and exports of all commodities. For all imported goods, the usage of marketing services only pertains to those required to get those goods from the "border" to domestic users. Similarly, for all exported commodities, the use of marketing services only pertains to those required to get the goods from the domestic producer to the border. The GTAP Model already contains international transport margins for all traded commodities.

To allow some generality in the modeling of domestic marketing margins, substitution possibilities are allowed between the commodity and an aggregate marketing service as well as between marketing services. To illustrate this, consider the nested CES structure of domestic marketing margins for imported commodities in figure 1.[2] Not withstanding the Armington assumption of imports differentiated by region of origin, the level of marketing services required to deliver these imports to the domestic purchaser should be the same regardless of country of origin. For example, the amount of marketing services required for an auto manufactured in Japan and imported into the US should be quite similar to that of an auto manufactured in Germany and imported in the US[3]. Thus, the composite imported commodity aggregate is determined before being incorporated with any marketing services. The individual marketing services are also combined in the second level of the nested CES structure in figure 1 to create a composite marketing service. The constant elasticity of substitution σ_s governs the degree of substitutability between individual marketing services, such as land and air transport, as relative prices change.

At the top-level of figure 1, the composite imported commodity and composite marketing service are combined to form a "retail" good purchased by domestic users. Based on previous work by Holloway, Wohlgenant, and others, the potential for substitution between the composite commodity and composite marketing service, denoted as σ_T in figure 1, is allowed in the model. The idea is that if there is producer heterogeneity (e.g., between different retailers) then we could observe input substitution at the industry level even if the individual firms employ Leontief technologies. Certainly in the US, there is a diversity of different types of retailers from the discounters like Wal-Mart to small convenience stores.

The following sections document the changes to the standard GTAP Model structure and nomenclature that are utilized in the GTAP-M model and Data Base. The main modifications to the standard GTAP model occur in the preference structure for the private household and the government, the production structure for firms, determining the *fob* value of exports, the market clearing conditions, the computation of taxes, and the decomposition of welfare changes.

2.1 Modification of Private Household Preference Structure

The modified preference structure for the private household is shown in figure 2. The private household allocates income between different "composite" commodities based on a CDE implicit expenditure function. The value of private household purchases of the composite commodity *i* at agents prices is equal to price of the composite commodity, *PP*(*i*,*r*), times the amount of the composite commodity, *QP*(*i*,*r*), purchased. Each composite commodity is a CES function of domestically produced or imported goods. It is at this point where the preference structure of the GTAP-M model differs from the preference structure in the standard GTAP model. Note that there are now three price levels in the GTAP-M model: *basic* or *market* prices, a new intermediate level of *producers'* or *delivered tax-free*

[2] Of course, by replacing the imported composite commodity with the corresponding domestic commodity, figure 1 would then illustrate the marketing margins for domestically produced commodities.
[3] To treat these margins differently would require a level of data detail that is not currently available for any country.

prices, and *agents'* prices. In addition, there are two quantities, a *basic* and *delivered* quantity, with the latter being an aggregate of the basic quantity and a domestic margin.

The value of expenditures on the *i*th domestically produced commodity in region *r, VDPA(i,r),* and on the *i*th imported commodity in region *r, VIPA(i,r),* is expressed as follows:

$$VDPA(i,r) = PPDA(i,r) * QPDL(i,r), \tag{1}$$

$$VIPA(i,r) = PPMA(i,r) * QPML(i,r), \tag{2}$$

where *PPDA(i,r)* is the *agents' price* of the *domestically* produced commodity purchased by the *private* household, *QPDL(i,r)* is the *deLivered quantity* of the *domestically* produced commodity purchased by the *private* household, *PPMA(i,r)* is the *agents'* composite *price* of the *imported* commodity purchased by the *private* household, and *QPML(i,r)* is the *delivered* composite *quantity* of the *imported* commodity purchased by the *private* household. Note that the notation for these prices and quantities differs from the standard GTAP notation. An *A* is appended to the prices to denote that they are agents' prices and an *L* is appended to quantities to denote they are delivered quantities.

It is assumed that any tax or subsidy applied to a "retail product" occurs after all marketing services have been incorporated into the producer goods. Thus, margin inclusive *value* of expenditures for the composite *imported* commodity by the *private* household *free* of consumption taxes/subsidies is denoted by *VIPF(i,r).* Similarly, the "tax-free" margin inclusive value of expenditures on the domestically produced commodity is denoted by *VDPF(i,r).* These values are defined as:

$$VIPF(i,r) = PPMF(i,r) * QPML(i,r) \text{ and} \tag{3}$$

$$VDPF(i,r) = PPDF(i,r) * QPDL(i,r), \tag{4}$$

where *PPMF(i,r)* and *PPDF(i,r)* are the *prices* of *imported* or *domestic* commodities purchased by the *private* household *free* of any consumption taxes. Note that

$$VIPA(i,r) = VIPF(i,r) + IPTAX(i,r), \text{ and} \tag{5}$$

$$VDPA(i,r) = VDPF(i,r) + DPTAX(i,r). \tag{6}$$

The value *VIPF(i,r)* can also be defined as the sum of the *value* of expenditure on the composite *imported* commodity purchased by the *private* household at *market* prices, *VIPM(i,r),* and the value of expenditure on the composite domestic marketing margin for the composite imported commodity purchased by the private household, *IPMARG(i,r).* Formally,

$$VIPF(i,r) = VIPM(i,r) + IPMARG(i,r). \tag{7}$$

The value of *VIPM(i,r)* in equation (7) is now defined as:

$$VIPM(i,r) = PIM(i,r) * QPMB(i,r), \tag{8}$$

where *PIM(i,r)* is the composite *price* of the *imported* commodity at *market* prices and *QPMB(i,r)* is composite *basic quantity* of the *imported* commodity purchased by the *private* household. Note that *QPMB(i,r)* has the same definition as *QPM(i,r)* in the standard GTAP model. Again, a *B* is appended to denote a basic versus delivered quantity.

Next, focusing on the domestic margins applied to the imported commodities, the term *IPMARG(i,r)* is defined as:

$$\begin{aligned} IPMARG(i,r) &= PRPM(i,r)*QRPM(i,r) \\ &= \sum_m VNIP(i,m,r) \\ &= \sum_m PM(m,r)*QNPM(i,m,r). \end{aligned} \tag{9}$$

For the notation defining the domestic margins, *R* denotes the *aggRegate margin* and *N* denotes the *iNdividual margin service*. Thus, *PRPM(i,r)* and *QRPM(i,r)* are the aggregate price and quantity of domestic marketing services for the *i*th composite import. *VNIP(i,m,r)* is the value of *m*th individual marketing service incorporated into the *i*th imported commodity in region *r*, *QNPM(i,m,r)* is the quantity of the *m*th individual marketing service incorporated into the *i*th imported commodity in region *r*, and *PM(m,r)* is the domestic market price of the *m*th marketing service in region *r*.

A similar structure for the value *VDPF(i,r)* can also be defined.

$$VDPF(i,r) = VDPM(i,r) + IPMARG(i,r). \tag{10}$$

Again, note that the definition of *VDPM(i,r)* in equation (10) is slightly different than the standard GTAP definition. The new definition is:

$$VDPM(i,r) = PM(i,r)*QPDB(i,r), \tag{11}$$

where *PM(i,r)* is the domestic market price and *QPDB(i,r)* is the basic quantity of the domestic commodity purchased by the private household. The term *DPMARG(i,r)* is defined as:

$$\begin{aligned} IPMARG(i,r) &= PRPD(i,r)*QRPD(i,r) \\ &= \sum_m VNDP(i,m,r) \\ &= \sum_m PM(m,r)*QNPD(i,m,r), \end{aligned} \tag{12}$$

where *PRPD(i,r)* and *QRPD(i,r)* are the aggregate price and quantity of domestic marketing services incorporated into the *i*th domestic commodity, *VNIP(i,m,r)* is the value of *m*th individual marketing service incorporated into the *i*th domestic commodity in region *r*, and *QNPD(i,m,r)* is the quantity of the *m*th individual marketing service incorporated into the *i*th domestic commodity in region *r*.

In equations (1) through (12), there are six new price variables and eight new quantity variables that now need formal definitions. First, consider the demand for the individual marketing services required to get the *i*th composite imported commodity from the border to domestic consumers:[4]

$$\begin{aligned} qnpm(i,m,r) = qrpm(i,r) &+ ESUBPL(i)*\{prpm(i,r) + anpd(i,m,r) - pm(m,r)\} \\ &- anpd(i,m,r), \end{aligned} \tag{13}$$

where *ESUBPL(i)* is the elasticity of substitution between marketing services and *anpd(i,m,r)* is a biased technical change variable to allow for the possibility of a marketing service saving technical change.

[4] The standard GTAP nomenclature of designating percentage changes with lower case and the levels with upper case variables is followed in this manuscript.

Moving up one level in figure 2, the composite price and quantity of marketing services incorporated in the *i*th imported commodity are defined as:

$$prpm(i,r) = \sum_m PMRSHR(i,m,r) * \{ pm(m,r) - anpd(i,m,r) \}, \tag{14}$$

where *PMRSHR(i,m,r)* is the share of marketing service *m* in the total cost of all marketing services incorporated in the *i*th imported commodity.

$$\begin{aligned} qrpm(i,r) = qpml(i,r) + ESUBPR(i) * \{ ppmf(i,r) + arpd(i,r) - prpm(i,r) \} \\ - arpd(i,r), \end{aligned} \tag{15}$$

where *ESUBPR(i)* is the elasticity of substitution between the composite marketing service and the composite imported commodity, and *arpd(i,r)* is a biased technical change variable that reduces the overall magnitude of the composite marketing service.[5] Next, the composite quantity of imported commodity *i* purchased by the private household is defined as:

$$qpmb(i,r) = qpml(i,r) + ESUBPR(i) * \{ ppmf(i,r) - pim(i,r) \} \tag{16}$$

Next, the margin inclusive, before tax composite price of imports is defined as:

$$\begin{aligned} ppmf(i,r) = PMFRSHR(i,r) * \{ prpm(i,r) - arpd(i,r) \} + \\ \{ 1 - PMFRSHR(i,r) \} * pim(i,r) \end{aligned} \tag{17}$$

where *PMFRSHR(i,r)* is the cost share of total marketing services in the "tax free" cost of the imported commodity. The margin inclusive composite quantity of imports is defined as:

$$qpml(i,r) = qp(i,r) + ESUBD(i) * [pp(i,r) - ppma(i,r)], \tag{18}$$

where *qp(i,r)*, *pp(i,r)*, and *ESUBD(i)* maintain their standard GTAP definitions. Finally, the after tax, margin inclusive composite price of the imported commodity is defined as:

$$ppma(i,r) = ppmf(i,r) + atpm(i,r), \tag{19}$$

where $atpm(i,r) = tpm(i,r) + tp(r)$ has the standard GTAP definition.

Continuing with the domestic commodity portion of the private household preference structure, the quantity of the *m*th marketing service required for the *i*th domestically produced commodity is defined as:

$$\begin{aligned} qnpd(i,m,r) = qrpd(i,r) + ESUBPL(i) * \{ prpd(i,r) + anpd(i,m,r) - pm(m,r) \} \\ - anpd(i,m,r), \end{aligned} \tag{20}$$

[5] Technical change for the domestic margin of a given commodity may be thought of as changing the margin structure for that commodity. For example, the movement towards more mass merchandisers may lead to lower domestic margins for a number of commodities compared to other forms of retailing. As such, technical change is assumed to only affect the magnitude of the domestic margin directly and so it is modeled as a biased technical change. The effects on the commodity demand are indirect through lower margins and therefore lower retail prices. In addition, technical change is assumed to affect the margins on domestic and imported commodities equally. Note that *anpd(i,m,r)* appears in equations (13) and (20) while *arpd(i,r)* appears in equations (15) and (21).

The composite price and quantity of marketing services incorporated into the *i*th domestically produced commodity purchased by the private household are defined as:

$$qrpd(i,r) = qpdl(i,r) + ESUBPR(i)*\{ppdf(i,r) + arpd(i,r) - prpd(i,r)\} - arpd(i,r), \quad (21)$$

$$prpd(i,r) = \sum_m PDRSHR(i,m,r)*\{pm(m,r) - anpd(i,m,r)\}, \quad (22)$$

where *PDRSHR(i,m,r)* is the share of marketing service *m* in the total cost of all marketing services incorporated in the *i*th domestic commodity. The quantity of the *i*th domestic commodity purchased by the private household and the tax-free (or margin inclusive) composite price of the *i*th domestic commodity are defined as:

$$qpdb(i,r) = qpdl(i,r) + ESUBPL(i)*\{ppdf(i,r) - pm(i,r)\} \text{ and} \quad (23)$$

$$ppdf(i,r) = PDFRSHR(i,r)*\{prpd(i,r) - arpd(i,r)\} + \{1 - PDFRSHR(i,r)\}*pm(i,r), \quad (24)$$

where *PDFRSHR(i,r)* is the cost share of total marketing services in the "tax free" cost of the domestic commodity. The margin inclusive quantity of domestic commodity *i* purchased is defined as:

$$qpdl(i,r) = qp(i,r) + ESUBD(i)*[pp(i,r) - ppda(i,r)], \quad (25)$$

where again *qp(i,r)*, *pp(i,r)*, and *ESUBD(i)* maintain their standard GTAP definitions. The after tax, margin inclusive composite price of the domestic commodity is defined as:

$$ppda(i,r) = ppdf(i,r) + atpd(i,r), \quad (26)$$

where $atpd(i,r) = tpd(i,r) + tp(r)$ has the standard GTAP definition.

Finally, the definition of the private consumption price for commodity *i* in region *r* is modified to account for the changes in notation for the private agents' price of imported and domestic commodity *i*:

$$pp(i,r) = PMSHR(i,r)*ppma(i,r) + [1 - PMSHR(i,r)]*ppda(i,r). \quad (27)$$

2.2 Modification of Government Preference Structure

The preference structure for the government is modified the same way as the private household. These changes are shown in figure 3. Since the modifications to the government preference structure differ only in nomenclature from the private household, all modified and new equations for the government are listed below without any further discussion.

$$VDGA(i,r) = PGDA(i,r)*QDGL(i,r), \quad (28)$$

$$VIGA(i,r) = PGMA(i,r)*QGML(i,r), \quad (29)$$

$$VIGF(i,r) = PGMF(i,r)*QGML(i,r) \quad (30)$$

$$VDGF(i,r) = PGDF(i,r) * QGDL(i,r), \tag{31}$$

$$VIGA(i,r) = VIGF(i,r) + IGTAX(i,r), \tag{32}$$

$$VDGA(i,r) = VDGF(i,r) + DGTAX(i,r). \tag{33}$$

$$VIGF(i,r) = VIGM(i,r) + IGMARG(i,r). \tag{34}$$

$$VIGM(i,r) = PIM(i,r) * QGMB(i,r), \tag{35}$$

$$\begin{aligned} IGMARG(i,r) &= PRGM(i,r) * QRGM(i,r) \\ &= \sum_m VNIG(i,m,r) \\ &= \sum_m PM(m,r) * QNGM(i,m,r), \end{aligned} \tag{36}$$

$$VDGF(i,r) = VDGM(i,r) + DGMARG(i,r), \tag{37}$$

$$VDGM(i,r) = PM(i,r) * QGDB(i,r), \tag{38}$$

$$\begin{aligned} DGMARG(i,r) &= PRGD(i,r) * QRGD(i,r) \\ &= \sum_m VNDG(i,m,r) \\ &= \sum_m PM(m,r) * QNGD(i,m,r), \end{aligned} \tag{39}$$

$$\begin{aligned} qngm(i,m,r) = qrgm(i,r) &+ ESUBGL(i) * \{ prgm(i,r) + angd(i,m,r) - pm(m,r) \} \\ &- angd(i,m,r), \end{aligned} \tag{40}$$

$$prgm(i,r) = \sum_m GMRSHR(i,m,r) * \{ pm(m,r) - angd(i,m,r) \}, \tag{41}$$

$$\begin{aligned} qrgm(i,r) = qgml(i,r) &+ ESUBGR(i) * \{ pgmf(i,r) + argd(i,r) - prgm(i,r) \} \\ &- argd(i,r), \end{aligned} \tag{42}$$

$$qgmb(i,r) = qgml(i,r) + ESUBGR(i) * \{ pgmf(i,r) - pim(i,r) \}, \tag{43}$$

$$\begin{aligned} pgmf(i,r) = GMFRSHR(i,r) &* \{ prgm(i,r) - argd(i,r) \} + \\ &\{ 1 - GMFRSHR(i,r) \} * pim(i,r) \end{aligned}, \tag{44}$$

$$pgma(i,r) = pgmf(i,r) + atgm(i,r), \tag{45}$$

$$qgml(i,r) = qg(i,r) + ESUBD(i) * [pg(i,r) - pgma(i,r)], \tag{46}$$

$$qngm(i,m,r) = qrgd(i,r) + ESUBGL(i)*\{prgd(i,r) + angd(i,m,r) - pm(m,r)\} - angd(i,m,r), \quad (47)$$

$$qrgd(i,r) = qgdl(i,r) + ESUBGR(i)*\{pgdf(i,r) + argd(i,r) - prgd(i,r)\} - argd(i,r), \quad (48)$$

$$prgd(i,r) = \sum_m GDRSHR(i,m,r)*\{pm(m,r) - angd(i,m,r)\}, \quad (49)$$

$$qgdb(i,r) = qgdl(i,r) + ESUBGR(i)*\{pgdf(i,r) - pm(i,r)\}, \quad (50)$$

$$pgdf(i,r) = GDFRSHR(i,r)*\{prgd(i,r) - argd(i,r)\} + \{1 - GDFRSHR(i,r)\}*pm(i,r), \quad (51)$$

$$qgdl(i,r) = qg(i,r) + ESUBD(i)*[pg(i,r) - pgda(i,r)], \quad (52)$$

$$pgda(i,r) = pgdf(i,r) + atgd(i,r), \text{ and} \quad (53)$$

$$pg(i,r) = GMSHR(i,r)*pgma(i,r) + [1 - GMSHR(i,r)]*pgda(i,r). \quad (54)$$

2.3 Modification of Firm Production Structure

Figure 4 shows the modifications to the production structure in the GTAP model to incorporate margins on domestic and imported intermediate inputs. All domestic and imported intermediate inputs are combined with some or all of the four marketing services to form a composite domestic or imported intermediate input. To maintain generality, substitution possibilities are allowed between marketing services and between the domestic or imported commodity and the composite marketing service.

Introducing margins on domestic and imported intermediate inputs requires that six new price and eight new quantity variables be added to the standard GTAP model. First, consider the new price and quantity variables associated with imported intermediate inputs. The quantity of the *m*th individual marketing services associated with the use of the *i*th imported intermediate input by firms the *j*th industry is defined as:

$$qnfm(i,m,j,r) = qrfm(i,j,r) - anfd(i,m,j,r) + ESUBFL(i)*\{prfm(i,j,r) + anfd(i,m,j,r) - pm(m,r)\}, \quad (55)$$

where *prfm(i,j,r)* and *qrfm(i,j,r)* are aggregate price and quantity of marketing services associated with the *i*th imported intermediate input used by firms industry *j*, *ESUBFL(i)* is the elasticity of substitution between marketing services for the *i*th intermediate input, , *anfd(i,m,j,r)* is a biased technical change variable for the *m*th marketing service, and *pm(m,r)* is the market price of the *m*th marketing service in region *r*. The value of the *m*th individual marketing service associated with the *i*th imported intermediate input used by firms in industry *j* in region *r*:

$$VNIF(i,m,j,r) = PM(m,r)*QNFM(i,m,j,r). \quad (56)$$

The composite quantity and price of marketing services associated with the *i*th imported intermediate input used by industry *j* are defined as:

$$prfm(i,j,r) = \sum_m FMRSHR(i,m,j,r) * \{ pm(m,r) - anfd(i,m,j,r) \} \text{ and} \tag{57}$$

$$\begin{aligned} qrfm(i,j,r) = {} & qfml(i,j,r) - arfd(i,j,r) + \\ & ESUBFR(i) * \{ pfmf(i,j,r) + arfd(i,j,r) - prfm(i,j,r) \}, \end{aligned} \tag{58}$$

where *FMRSHR(i,m,j,r)* is the share of the *m*th marketing share in the total cost of all marketing services incorporated in the *i*th imported commodity, *ESUBFR(i)* is the elasticity of substitution between the imported commodity and the composite marketing service, *pfmf(i,j,r)* is the margin inclusive composite price of the imported intermediate input purchased by firms *free* of taxes, and *arfd(i,j,r)* is a neutral technical change variable. The value of all marketing services associated with the *i*th imported intermediate input used by industry *j* is then defined as:

$$IFMARG(i,j,r) = PRFM(i,j,r) * QRFM(i,j,r). \tag{59}$$

The *value* of *imported* intermediate inputs purchased by *firms* at *market* prices [*VIFM(i,j,r)*] and the margin inclusive *value* of *imported* intermediate inputs purchased by *firms free* of taxes are defined as:

$$VIFM(i,j,r) = PIM(i,r) * QFMB(i,j,r) \text{ and} \tag{60}$$

$$VIFF(i,j,r) = PFMF(i,j,r) * QFML(i,j,r). \tag{61}$$

The price and quantity variables in equations (60) and (61) are defined as:

$$qfmb(i,j,r) = qfml(i,j,r) + ESUBFR(i) * \{ pfmf(i,j,r) - pim(i,r) \}, \tag{62}$$

$$qfml(i,j,r) = qf(i,j,r) + ESUBD(i) * [pf(i,j,r) - pfma(i,j,r)], \text{ and} \tag{63}$$

$$\begin{aligned} pfmf(i,j,r) = {} & FMFRSHR(i,j,r) * \{ prfm(i,j,r) - arfd(i,j,r) \} + \\ & \{ 1 - FMFRSHR(i,j,r) \} * pim(i,r) \end{aligned}, \tag{64}$$

where *FMFRSHR(i,j,r)* is the cost share of all marketing services in the margin inclusive cost of the imported intermediate input, and *qf(i,j,r)* and *pf(i,j,r)* maintain their standard GTAP definition.

Adding the tax (or subtracting the subsidy) reported in *IFTAX(i,j,r)* to *VIFF(i,j,r)* yields the value of imported intermediate inputs at agents' prices [*VIFA(i,j,r)*]:

$$VIFA(i,j,r) = PFMA(i,j,r) * QFML(i,j,r) = VIFF(i,j,r) + IFTAX(i,j,r) \tag{65}$$

The agents' composite price of imported intermediate inputs purchased by firms is defined as:

$$pfma(i,j,r) = pfmf(i,j,r) + tfm(i,j,r). \tag{66}$$

The treatment of margins on domestic intermediate inputs is completely analogous to the treatment of margins on imported intermediate inputs. For completeness, all of the new price and quantity variables and value terms are listed below:

$$qnfd(i,m,j,r) = qrfd(i,j,r) - anfd(i,m,j,r) + ESUBFL(i)*\{prfd(i,j,r) + anfd(i,m,j,r) - pm(m,r)\}, \quad (67)$$

$$VNDF(i,m,j,r) = PM(m,r)*QNFD(i,m,j,r), \quad (68)$$

$$prfd(i,j,r) = \sum_m FDRSHR(i,m,j,r)*\{pm(m,r) - anfd(i,m,j,r)\}, \quad (69)$$

$$qrfd(i,j,r) = qfdl(i,j,r) - arfd(i,j,r) + ESUBFR(i)*\{pfdf(i,j,r) + arfd(i,j,r) - prfd(i,j,r)\}, \quad (70)$$

$$DFMARG(i,j,r) = PRFD(i,j,r)*QRFD(i,j,r), \quad (71)$$

$$VDFM(i,j,r) = PM(i,r)*QFDB(i,j,r), \quad (72)$$

$$VDFF(i,j,r) = PFDF(i,j,r)*QFDL(i,j,r), \quad (73)$$

$$qfdb(i,j,r) = qfdl(i,j,r) + ESUBFR(i)*\{pfdf(i,j,r) - pm(i,r)\}, \quad (74)$$

$$qfdl(i,j,r) = qf(i,j,r) + ESUBD(i)*[pf(i,j,r) - pfda(i,j,r)], \quad (75)$$

$$pfdf(i,j,r) = FDFRSHR(i,j,r)*\{prfd(i,j,r) - arfd(i,j,r)\} + \{1 - FDFRSHR(i,j,r)\}*pm(i,r), \quad (76)$$

$$VDFA(i,j,r) = PFDA(i,j,r)*QFDL(i,j,r) = VDFF(i,j,r) + DFTAX(i,j,r), \quad (77)$$

$$pfda(i,j,r) = pfdf(i,j,r) + tfd(i,j,r), \text{ and} \quad (78)$$

$$pf(i,r) = FMSHR(i,r)*pfma(i,r) + [1 - FMSHR(i,r)]*pfda(i,r). \quad (79)$$

2.4 Incorporating Domestic Margins on Exports

Figure 5 illustrates the structure of domestic margins for all exported commodities. Each commodity that is exported is combined with trade and transportation services to form an *fob* commodity ready for export.

Incorporating domestic margins on exports requires four new quantity and two new price variables and equations be added to the standard GTAP model. Beginning at the bottom of figure 5, the quantity of the *m*th individual marketing service associated with the export of commodity *i* from region *r* to region *s* is defined as:

$$qnxd(m,i,r,s) = qrxd(i,r,s) - anxd(m,i,r,s) + ESUBXL(i)*[prxd(i,r,s) + anxd(m,i,r,s) - pm(m,r)], \quad (80)$$

where *prxd*(*i*,*r*,*s*) and *qrxd*(*i*,*r*,*s*) are the aggregate price and quantity of marketing services associated with the export of commodity *i* from region *r* to region *s*, *ESUBXL*(*i*) is the elasticity of substitution among marketing services, and *anxd*(*m*,*i*,*r*,*s*) is the biased technical change variable for the *m*th marketing

service. The value of the *m*th individual marketing service associated with the export of commodity *i* is defined as:

$$VNDX(m,i,r,s) = pm(m,r) * qnxd(m,i,r,s). \tag{81}$$

The aggregate price and quantity of marketing services associated with the export of commodity *i* are defined as:

$$\begin{aligned} qrxd(i,r,s) = {} & qxls(i,r,s) - arxd(i,r,s) + \\ & ESUBXR(i) * \left[pxfs(i,r,s) + arxd(i,r,s) - prxd(i,r,s) \right] \text{ and} \end{aligned} \tag{82}$$

$$prxd(i,r,s) = \sum_{m} XRSHR(m,i,r,s) * \left[pm(m,r) - anxd(m,i,r,s) \right], \tag{83}$$

where *qxls*(*i,r,s*) is the delivered quantity of commodity *i* exported from region *r* to region *s*, *arxd(i,r,s)* is a neutral technical change variable, *ESUBXR(i)* is the elasticity of substitution between the composite marketing service and the export commodity, and *XRSHR(m,i,r,s)* is the cost share of the *m*th marketing service. The value of all marketing services associated with the export of commodity *i* from region *r* to region *s* is defined as:

$$VMARG(i,r,s) = prxd(i,r,s) * qrxd(i,r,s). \tag{84}$$

The final new export quantity and price variables are *qxbs*(*i,r,s*) and *qxls*(*i,r,s*), the basic and delivered quantities of commodity *i* exported from region *r* to region *s*, and *pxfs*(*i,r,s*), the export-tax-free price of commodity *i* exported from region *r* to region *s*. The formal definitions of these variables are as follows:

$$qxbs(i,r,s) = qxls(i,r,s) + ESUBXR(i) * \left[pxfs(i,r,s) - pm(i,r) \right] \text{ and} \tag{85}$$

$$pxfs(i,r,s) = \sum_{s} \left[XFRSHR(i,r,s) * prxd(i,r,s) + \left(1 - XFRSHR(i,r,s)\right) * pm(i,r) \right], \tag{86}$$

where *XFRSHR(i,r,s)* is the cost share of all marketing services in the delivered cost of commodity *i* that is being exported. Note that *pxfs(i,r,s)* is not the f.o.b. price, which is redefined to equal:

$$pfob(i,r,s) = pxfs(i,r,s) - tx(i,r) - txs(i,r,s). \tag{87}$$

The value of commodity *i* exported from region *r* to region *s* at market prices and the margin inclusive value of exports of commodity *i* are defined as:

$$VXMD(i,r,s) = pm(i,r) * qxbs(i,r,s) \text{ and} \tag{88}$$

$$VXFD(i,r,s) = pxfs(i,r,s) * qxls(i,r,s). \tag{89}$$

2.5 Other Model Modifications

Other than the preference structure of the private and government households, and the technology of domestic firms, incorporating domestic marketing margins will also require other model modifications. The first, and most obvious, is that the market clearing conditions must be modified to account for the new demands for domestic commodities used as marketing services and due to changes in notation. The modified market clearing condition for all margin commodities is now:

$$
\begin{aligned}
qds(m,r,s) = \sum_j SHRDFM(m,j,r)*qfdb(m,j,r) + SHRDPM(m,r)*qpdb(m,r) + \\
SHRDGM(m,r)*qgdb(m,r) + \sum_{i\in NMRG}\Big[SHRDNP(i,m,r)*qnpd(i,m,r) + \\
SHRINP(i,m,r)*qnpm(i,m,r) + SHRDNG(i,m,r)*qngd(i,m,r) + \\
SHRING(i,m,r)*qngm(i,m,r)\Big] + \sum_{i\in NMRG}\sum_j\Big[SHRDNF(i,m,j,r)*qnfd(i,m,j,r) + \\
SHRINF(i,m,j,r)*qnfm(i,m,j,r)\Big] + \sum_{i\in NMRG}\sum_s SHRDNX(m,i,r,s)*qnxd(m,i,r,s),
\end{aligned}
\tag{90}
$$

where the set *NMRG* refers to the non-margin commodities (a subset of *TRAD_COMM*). There are seven new share expressions that refer to the share of domestic production of the margin commodities utilized in margin activities. The shares *SHRDNP*(*i,m,r*) and *SHRINP*(*i,m,r*) are the share of the *m*th margin commodity utilized for margin activities for domestic and imported commodity *i* purchased by the private household. Similarly, *SHRDNG*(*i,m,r*) and *SHRING*(*i,m,r*) are the shares of the *m*th margin commodity used for margin activities for commodities purchased by the government household, and *SHRDNF*(*i,m,j,r*) and *SHRINF*(*i,m,j,r*) are the shares of the *m*th margin commodity used for activities for commodities purchased by firms. Finally, *SHRDNX*(*m,i,,r,s*) is the share of the *m*th margin commodity used for margin activities for the export of commodity *i* from region *r* to region *s*.

The decomposition of equivalent variation equation is modified in three areas. First, not the definition of tax receipts from equations (5), (6), (32), (33), (65), and (77) are slightly different than in the standard GTAP Model. Second, the terms for the domestic margin-inclusive quantities, such as *qfml* and *qfdl* replace the variables *qfm* and *qfd* in the standard GTAP Model. Finally, additional terms representing the welfare gain from technical change in the domestic margins sector must be included. The new equation for the decomposition of equivalent variation (*EV_DECOMPOSITION*) is now specified as:

$$
\begin{aligned}
EV\_ALT(r) \;=\; & [0.01*UTILELASEV(r)*INCOMEEV(r)]* \\
& [\,DPARPRIV(r)*\log(UTILPRIVEV(r)/UTILPRIV(r))*dppriv(r) \\
& +\; DPARGOV(r)*\log(UTILGOVEV(r)/UTILGOV(r))*dpgov(r) \\
& +\; DPARSAVE(r)*\log(UTILSAVEEV(r)/UTILSAVE(r))*dpsave(r)] \\
+\; & [0.01*EVSCALFACT(r)]*\Big[\sum_{i\in NSAV} PTAX(i,r)*[qo(i,r) - pop(r)] \\
& +\; \sum_{i\in ENDW}\sum_{j\in PROD} ETAX(i,j,r)*[qfe(i,j,r) - pop(r)] \\
& +\; \sum_{j\in PROD}\sum_{i\in TRAD} IFTAX(i,j,r)*[qfml(i,j,r) - pop(r)] \\
& +\; \sum_{j\in PROD}\sum_{i\in TRAD} DFTAX(i,j,r)*[qfdl(i,j,r) - pop(r)] \\
& +\; \sum_{i\in TRAD} IPTAX(i,r)*[qpml(i,r) - pop(r)] + \sum_{i\in TRAD} DPTAX(i,r)*[qpdl(i,r) - pop(r)] \\
& +\; \sum_{i\in TRAD} IGTAX(i,r)*[qgml(i,r) - pop(r)] + \sum_{i\in TRAD} DGTAX(i,r)*[qgdl(i,r) - pop(r)]
\end{aligned}
\tag{91}
$$

$$+ \sum_{i \in TRAD} \sum_{s \in REG} XTAXD(i,r,s) * [qxls(i,r,s) - pop(r)]$$

$$+ \sum_{i \in TRAD} \sum_{s \in REG} MTAX(i,s,r) * [qxls(i,s,r) - pop(r)]$$

$$+ \sum_{i \in ENDW} VOA(i,r) * [qo(i,r) - pop(r)] - VDEP(r) * [kb(r) - pop(r)]$$

$$+ \sum_{i \in PROD} VOA(i,r) * ao(i,r) + \sum_{j \in PROD} VVA(j,r) * ava(j,r)$$

$$+ \sum_{i \in ENDW} \sum_{j \in PROD} VFA(i,j,r) * afe(i,j,r) + \sum_{j \in PROD} \sum_{i \in TRAD} VFA(i,j,r) * af(i,j,r)$$

$$+ \sum_{m \in MARG} \sum_{i \in TRAD} \sum_{s \in REG} VTMFSD(m,i,s,r) * atmfsd(m,i,s,r)$$

$$+ \sum_{i \in NMRG} (DPMARG(i,r) + IPMARG(i,r)) * arpd(i,r)$$

$$+ \sum_{i \in NMRG} \sum_{m \in MARG} (VNDP(i,m,r) + VNIP(i,m,r)) * anpd(i,m,r)$$

$$+ \sum_{i \in NMRG} (DGMARG(i,r) + IGMARG(i,r)) * argd(i,r)$$

$$+ \sum_{i \in NMRG} \sum_{m \in MARG} (VNDG(i,m,r) + VNIG(i,m,r)) * angd(i,m,r)$$

$$+ \sum_{j \in PROD} \sum_{i \in NMRG} (DFMARG(i,j,r) + IFMARG(i,j,r)) * arfd(i,j,r)$$

$$+ \sum_{j \in PROD} \sum_{i \in NMRG} \sum_{m \in MARG} (VNDF(i,m,j,r) + VNIF(i,m,j,r)) * anfd(i,m,j,r)$$

$$+ \sum_{s \in REG} \sum_{j \in NMRG} \sum_{m \in MARG} VNDX(m,j,r,s) * anxd(m,j,r,s)$$

$$+ \sum_{s \in REG} \sum_{j \in NMRG} XMARG(j,r,s) * arxd(j,r,s) + \sum_{i \in TRAD} \sum_{s \in REG} VIMS(i,s,r) * ams(i,s,r)$$

$$+ \sum_{i \in TRAD} \sum_{s \in REG} VXWD(i,r,s) * pfob(i,r,s) + \sum_{i \in MARG} VST(m,r) * pm(m,r) + NETINV(r) * pcgds(r)$$

$$- \sum_{i \in TRAD} \sum_{s \in REG} VXWD(i,s,r) * pfob(i,s,r) - \sum_{m \in MARG} VTMD(m,r) * pt(m)$$

$$- SAVE(r) * psave(r)] + 0.01 * INCOMEEV(r) * pop(r);$$

2.6 Technical Change in Margin Activities

The treatment of technical change in margin activities incorporates two main assumptions. First, technological change variables are provided for individual margin services and for the aggregate margin, but not for basic commodity inputs into the basic-margin aggregator. Thus technical change for the domestic margin of a given commodity may be thought of as changing the margin structure for that commodity. For example, the movement towards more mass merchandisers may lead to lower domestic margins for a number of commodities compared to other forms of retailing. As such, technical change is assumed to only affect the magnitude of the domestic margin directly and so it is modeled as a biased technical change. The effects on the commodity demand are indirect through lower margins and therefore lower retail prices. The second assumption is that technical change is assumed to affect the margins on

domestic and imported commodities equally. For the private household, note that *anpd(i,m,r)* appears in equations (13) and (20) while *arpd(i,r)* appears in equations (15) and (21). Thus a movement towards mass merchandisers that lowers domestic margins is assumed to affect domestic and imported commodities equally.

2.7 Elasticities of Substitution for Domestic Margins

Little empirical evidence exists on the magnitudes of the elasticities of substitution between the commodities and the composite marketing service, or the magnitude of the elasticity of substitution between marketing services. For agricultural commodities, Wohlgenant estimated that the elasticity of substitution between farm commodities and marketing services for six aggregate agricultural commodities in the United States: beef and veal; pork; poultry; eggs; dairy; and fresh vegetables. His estimates of the elasticity of substitution varied from not being statistically different than zero for poultry to 0.96 for dairy products. Other estimates of the elasticity of substitution were 0.25 for eggs, 0.35 for pork, 0.54 for fresh vegetables, and 0.72 for beef and veal. These results suggest limited substitution possibilities between commodities and the aggregate marketing service (e.g., *ESUBPR*, *ESUBGR*, *ESUBFR*, and *ESUBXR*). With no empirical evidence on elasticities of substitution between marketing services (*ESUBPL*, *ESUBGL*, *ESUBFL*, and *ESUBXL*) these should also be set to relatively small values. In the empirical example below, *ESUBPL*, *ESUBGL*, *ESUBFL*, and *ESUBXL* are set equal to zero.

As noted earlier, all elasticities of substitution for the domestic margins have been allowed to vary by commodity, but not by region. This decision reflects the work by Wohlgenant that indicates these elasticities may vary by commodity. But it also reflects the limited empirical evidence available for countries other than the United States. In addition, this treatment of the margin elasticities of substitution is the same as the Armington and production elasticities of substitution that also do not vary across regions. By allowing these parameters to vary by region would greatly increase the number of parameters that must be specified to implement the model.

3. Margin Data

To implement the GTAP-M Model, the values of the domestic marketing margins must be identified for all transactions in all regions. Because the national I-O accounts are the underlying foundation of the GTAP Data Base, the best source of margin data would be from these accounts. For example, the I-O accounts for the US (U.S. Department of Commerce, Bureau of Economic Analysis) contain information on trade and transportation margins for all intermediate transactions, purchases by consumers, and purchases by federal and state governments for all domestically produced and imported commodities. They also contain trade and transportation margins for all goods that are exported. However, this type of data is not publicly available for all regions.

In addition to the US, I-O based margin data are available for the following countries: Australia, Austria, Belgium, Denmark, Estonia, Germany, Greece, Finland, France, Hungary, Italy, Japan, Malta, the Netherlands, Poland, Portugal, Spain, Sweden, Slovakia, Slovenia, and the United Kingdom. The Japanese data was obtained online from the Statistics Bureau of the Japanese Ministry of Internal Affairs and Communication. Patrick Jomini of the Productivity Commission provided the data for Australia and the data for the Netherlands were provided by the Agricultural Economics Research Institute LEI. Peter Ritzmann of Eurostat provided the data for the remaining countries.

The level of sectoral aggregation of the I-O data varies across these countries. For example, the US I-O data are available for 483 different sectors. The I-O data for Australia and Japan contain 106 and 104 sectors respectively. The I-O data for the Netherlands correspond to the 57 sectors in the GTAP v5.4

Data Base. Finally, the I-O data for the other regions are available for 59 different sectors. Concordance between the I-O sectors and the GTAP sectors are given in Appendix tables 1 through 4. Appendix table 5 lists the reference year for the I-O data for each region.

The level of detail in I-O margin data also varies across countries. Beginning with the countries with most detailed margin data, the US and Australia provide complete margin data on trade margins and transport margins by type of transport (otp, wtp, and atp) for intermediate inputs, consumption, investment, and exports. For Japan, the same data is available except that only a total transport margin is identified instead of margins by transport type. The Danish and Dutch I-O data report only a combined trade and transport margin for intermediate inputs, consumption, investment, and exports. Finally, the I-O margin data for the remaining countries are the least disaggregate. A total trade and transport margin is identified for each commodity with no information on how the margin varies across uses (i.e., intermediate inputs, consumption, investment, or exports).

For the countries that do not provide all of the required margin data, further margin disaggregation is necessary. For Japan the total value of otp, wtp, and atp used to provide domestic transportation services are used to compute their respective transportation shares. For example, the values of otp, wtp, and atp used to provide domestic transport services in Japan was 11,349.5 billion Yen, 1,522.9 billion Yen, and 56.7 billion Yen respectively. Thus, otp accounts for 87.8% of the transport services while wtp and atp account for 11.8% and 0.4% respectively. These transport shares are then utilized to decompose the total transport margin in transport margins for otp, wtp, and atp respectively. For the Netherlands, the total trade and transport margin is decomposed in trade and transport margins based on the share of trade and transport activities used in margin activities. From the Dutch I-O data, the values of trd, otp, wtp, and atp services utilized as margins were $58.289 billion, $5.245 billion, $433 million, and $92 million respectively. Thus, trd activities account for 91.0% of the total margin, while otp, wtp, and atp activities account for 8.2%, 0.7%, and 0.1% of the total Dutch margins.

Similar to the Dutch data, the I-O data obtained from Eurostat only identifies a total trade and transport margin for each commodity. However, for most countries, the total value of all margin activities is decomposed in trade and transportation activities. Table 3 lists the trade and transport shares of the total value of all margin activities for twelve European countries. For the remaining six countries, Denmark, Greece, Malta, Portugal, Sweden, and the United Kingdom, the I-O data attribute the total value of all margins to trade activities. It is assumed that margin data for these six countries actually refers to both trade and transport margins. The average margin activity shares of the twelve European countries listed in table 3 are used to decompose the trade and transport margins for these six countries.

Once the trade and transport margins for Denmark are decomposed, no further margin disaggregation is required because the Danish I-O data contains margin information for intermediate inputs, consumption, investment, and exports. The margin data for the other seventeen countries provided by Eurostat require further disaggregation across uses. To accomplish this decomposition, the average trade and transport margin shares for those countries with I-O margin data across uses (i.e., Australia, Denmark, Japan, the US), given in table 4, are utilized.[6] The margin shares are computed as the value of trade or transport margin divided by the producer value evaluated at market prices. On average, the trade margin shares for goods purchased by the private household are much larger than the trade margins for any other use. (See Peterson for a more detailed discussion of the differences in margin shares across commodity uses.) The total trade and transport margins for each commodity are decomposed using a four-step process based on the average margin activity shares in table 3, the average margin shares in table 4, the total margin for

[6] Due to a lack of available I-O margin data across uses, two different base years, 1992 and 1997, were utilized for the US in order to increase the sample size.

each commodity, and the before tax value of intermediate use, private household purchases, government household purchases, investment, and exports.

To illustrate this three-step process, consider the margin decomposition for the agricultural sector in Austria (see table 5). The first step is to decompose the total margin on agricultural commodities into separate trade and transport margins. Based on the average margin activity shares for Austria in table 3, the total margin of €1,680.323 million is decomposed into a €1,582.425 million trade margin and €97.898 million transport margin. The second step multiplies the average margin shares by use in table 4 by the before tax value of intermediate use, private household purchases, government household purchases, investment, and exports.[7] Note that because the use values from the Eurostat data are margin-inclusive while the margin shares in table 4 are base on producer value that does not include margins; the margin shares used in table 5 are specified as:

$$msr = \frac{m}{pr} = \frac{m/pp}{1+m/pp} = \frac{m}{pp+m},$$

where *msr* is the margin share based on the margin-inclusive or "retail" value, *m* is the margin value, *pr* is the retail (buyer's) price, and *pp* is the producer price. This yields the value of an initial trade and transport margin for each use. Because the initial margin values from step 2 are based on average shares, they will not equal the target values from step 1. The third step then compares the total initial trade and transport margins, which is the sum across the different uses, to values determined in the first step. In this example, the total initial trade margin of €2472.516 million exceeds the €1582.425 million. The initial trade margins for each use are then decreased proportionally such that the sum across all uses is equal to the total value determined in the first step. The same procedure is used to ensure that the sum of the transport margins across all uses is equal to the total transport margin determined in the first step. The last step allocates the transport margin based on the transportation activity shares in Austria.

3.1 Other Margin Data

A unique secondary source of margin estimates is obtained from the Euromonitor International Integrated Market Information System.[8] This database covers 95 percent of global retail and food service sales. Industry average mark-ups as defined by Euromonitor include wholesaler, distributor, and retailer markets. Mark-up estimates are derived from a combination of official statistics and secondary sources such as trade interviews with companies at all levels of the supply chain. Data on the average ratio of retail to manufacturer prices for six GTAP processed food products (cmt, omt, vol, mil, pcr, and ofd) are available for 43 regions (see table 6) for the year 2001. These data are assumed to represent the total margin for these six GTAP commodities for private households in each region. Note that fifteen of these regions (Austria, Belgium, Denmark, Finland, France, Germany, Hungary, Italy, Japan, Poland, Portugal, Slovakia, Spain, Sweden, and the United Kingdom) also have I-O margin data available. The Euromonitor data replaces the margins calculated from the I-O margin data for the private household for these regions because food processing was aggregated into a single sector in the I-O data. Thus, the Euromonitor data provides more disaggregate margin estimates for processed food products for these regions. The Euromonitor margins are decomposed in trade and transport margins based on the average trade and transport activity shares in table 3.

[7] The before tax value is used to be consistent with the structure of the GTAP-M where any taxes or subsidies are applied after all marketing services have been incorporated into the producer goods.

[8] The Euromonitor data are provided by Mark Gehlhar from the Economic Research Service, United States Department of Agriculture.

Table 7 provides a comparison of margins for aggregate food sector reported in I-O data with the simple average of Euromonitor estimates for all processed food commodities in table 6. While the overall averages across countries are similar, 0.33 for the I-O data and 0.32 for the Euromonitor data, there are some substantial differences across countries, in particular Denmark, Japan, and the UK. While the I-O and Euromonitor margin estimates are positively correlated, the correlation coefficient is fairly low at 0.18. However, if the countries with the largest differences in margin estimates are excluded (Denmark, Japan, and the UK), the correlation coefficient increases to 0.63 and with the overall averages remain very similar: 0.30 for the I-O data and 0.31 for the Euromonitor data.

A third source of margin databased on I-O data provides estimates of the ratio of consumer price to producer price for goods sold for private domestic final demand for 125 product categories in Canada for the year 1990.[9] The 125 product categories correspond to 22 GTAP sectors and the estimated margins are given in table 8.

3.2 Margin Estimates for Regions/Commodities without Margin Data

For all commodities, regions, and uses where no margin data are available, average margin shares are used. These average margin shares are computed using the I-O margin data for the countries Australia, Austria, Belgium, Denmark, Estonia, Germany, Greece, Finland, France, Hungary, Italy, Japan, Malta, the Netherlands, Poland, Portugal, Spain, Sweden, Slovakia, Slovenia, the United Kingdom, and the United States and are reported in table 9. The trade and transport margins are decomposed from these averages based on the average trade and transport activity shares in table 3.

4. Modifying the GTAP Data Base

The GTAP-M Data Base developed in this paper is based on version 5.4 of the standard GTAP Data Base. Because the margin data may be reported for more highly aggregate sectors than the GTAP Data Base (e.g., agriculture is aggregated into a single sector in the Eurostat I-O data) and the reference years of the margin data differ from the reference year of the v5.4 GTAP Data Base, it is not possible to simply use the margin values to develop the GTAP-M Data Base.

Rather, margin shares, defined as the value of the trade and transport margin divided by commodity sales valued at producer price (not including domestic margins), are used to compute the relative size of the domestic margins.

To create the GTAP-M Data Base, the margin shares are multiplied by the values of agents' purchases at market prices in the v. 5.4 Data Base. For example, the first two columns in table 10 provide the purchases of domestic and imported commodities by the US private household at market prices. The third column lists the trade margin shares for the US private household derived from the 1997 US I-O margin data.[10] Multiplying the first two columns by the third column yields the implied value of the trade margins for domestic and imported commodities purchased by the US private household. The trade margin inclusive values are obtained by adding the trade margins to v5.4 value of agents' purchases at market (and agents') prices. This is represented in the last two columns in table 10. The same procedure

[9] This data has been generously provided by Scott Bradford from the Department of Economics at Brigham Young University. The data provided contained information for Australia, Belgium, Canada, Germany, Italy, Japan, the Netherlands, United Kingdom, and the United States. Only the data for Canada is incorporated because more recent I-O margin data are available for the other regions.

[10] No distinction is made in the US I-O margin data between imports and domestic products. Thus the same margin shares are applied for both imports and domestic products.

is used to compute the transport margin values for domestic and imported commodities for the private household and the trade and transport margin values for government purchases.

To maintain a balance set of accounts, (i.e., zero profits, constant level of private consumption expenditures), the total value of margin activities must be subtracted from the value of agent purchases on those activities in the original GTAP Data Base. For example, again consider the case of trade margins on good purchased by the private household. In the version 5.4 GTAP Data Base, expenditure on trade (trd) by the private household at market prices is $1,118.103 billion. Estimated expenditures for trade margin related activities for all domestic and imported commodities purchased by the private household are $856.440 billion ($684.625 billion on domestic products and $171.815 billion on imported products). Subtracting the trade margins from the initial expenditure on trade yields $261.663 billion in non-margin related expenditures on trade services.[11] To prevent all expenditures on trade services from being allocated to margin activities, no more than ninety percent of the expenditure on trade in the version 5.4 Data Base is allocated to trade margin activities. The same procedure is used to adjust private household expenditures on transport services and the government household expenditures on trade and transport services.

Firm expenditures on trade and transport services are adjusted by the level of expenditure on margin activities for all domestic and imported intermediated inputs and for any domestic export margins.[12] For intermediate inputs, the procedure is the same as for the private and government households and results in a reallocation of expenditures. For domestic export margins, the amount of trade and transport margins subtracted from firm expenditure is also subtracted from the value of exports (*VXMD*) in order to maintain a balanced set of accounts. Because exports in the version 5.4 Data Base are valued at *fob* prices by construct, the value of production of any commodity exported is overstated by the value of the domestic margins on exports. Thus, reducing the value of export sales by the amount of the domestic export margin eliminates the inherent overvaluation in the existing GTAP Data Base. No more than ninety percent of firm expenditures on trade and transport services in the version 5.4 Data Base are allowed to be allocated to intermediate and domestic export margin activities.

4.1. Changes in Size of Data/Base

Incorporating domestic margins increases the size of the database substantially. For the full GTAP version 5.4 Data Base with 58 commodities and 78 regions, the size of the database increased from 23.6 megabytes to 44.1 megabytes. For smaller models, the increase in size is more modest. In the empirical example below with seven commodities, six regions, and five primary factors, the size of the database increased from 44 kilobytes for the standard GTAP Model to 72 kilobytes for the GTAP-M Model.

4.2. Limitations of Data Base Revision

While the procedure outlined above provides a domestic margin inclusive database, modifying an existing database should be viewed as an interim measure given the problems of matching external margin estimates with the data in an existing database. For example, there are numerous instances of where the computed trade and transport margins are "too large" relative to the firm or household expenditures on trade and transport in the existing database. For the private household, the maximum allocation of ninety percent of trade services to margin activities occurred for 58 out of the 78 regions in the database. While

[11] This implies that all imported trade and transport services are consumed directly by agents and not used for domestic margin activities.

[12] Note that the trade and transport margins for investment are applied to the GTAP capital good "cgds" and treated the same way as all other intermediate inputs.

the majority of these instances occurred for regions with no available I-O margin data, it also occurred for nine countries with I-O margin data available (Belgium, Denmark, Estonia, France, Greece, Portugal, Poland, Slovakia, and Slovenia). To a lesser extent, similar maximum allocations occurred for the transportation industries: 13 times for otp, 20 times for wtp, and 4 times for atp. For firms, the maximum reallocation occurred 2,983 times for trade services, 1,286 times for otp, 1,395 times for wtp, and 792 times for atp out of a total possible 4,524 instances (58 commodities and 78 regions). Even in regions with available I-O margin data, such as the US, the maximum limit was reached frequently. For the US, the ninety percent limit was reached 17 times for trade services, 30 times for otp, 7 times for wtp, and 8 times for atp. Raising the maximum reallocation limit to 95 percent did not dramatically reduce this problem. This suggests that the collection of margin data should be an integral part future database construction, rather than a post-construction revision.

5. Empirical Illustration

To illustrate the potential impacts of incorporating domestic marketing margins in the GTAP Model, several experiments are conducted following the work of Frisvold that analyze the impacts of technical change. The first set of experiments compare the results of a *global* 2 percent output augmenting technical change in the crops sector from the standard GTAP Model and using the GTAP-M Model with fixed and variable domestic margins.[13] The second set of experiments compares the results of a global labor augmenting technical change in the trade services sector from the standard GTAP Model and the GTAP-M Model with fixed domestic margins.[14]

Following Frisvold, there are six regions defined in the GTAP and GTAP-M Models: North America (NAM), Australasia (ANZ), European Union (EU), Southeast Asia (SEA), East Asia (EA), and the rest-of-the-world (ROW). The specific countries included in each aggregate region are listed in table 11. The commodity aggregation used in each model is modified slightly from that used by Frisvold, who used five aggregate commodities: crops, livestock, processed food, mining and manufacturing, and services. Because of the focus on domestic margins, trade and transportation services are identified as separate commodities in each model. See table 12 for the detailed definition of each aggregate commodity. All markets are assumed to be perfectly competitive in the GTAP and GTAP-M Models.

5.1. Global Output Augmenting Technical Change in the Crops Sector

The first three columns in table 13 present selected results from the standard GTAP Model. The impact of the output augmenting technical change is to reduce the per unit input requirement for all inputs by two percent, thereby reducing the cost of production in the crops sector and the market price (due to the assumption of perfect competition). The decrease in the price of crops is approximately 3.3 percent across regions except for the EU, with a 2.69 percent price decrease, and Southeast Asia with a 4.07 percent price decrease. The differences in the price decreases for the EU and Southeast Asia are due to differences in the land cost shares in the crops sector in these regions. In the EU, the initial land cost share in crops is relatively small at 0.07 while the initial crops' land cost share in Southeast Asia is relatively large at 0.374. Because land is a specific factor to the crops and livestock sector, with limited transformation possibilities between these sectors,[15] more of the impact of the output augmenting

[13] The shock applied to both models is a 2% increase in the parameter *aosec*(*i*) for the crops sector.

[14] The magnitude of the technical change is computed to yield a 1% reduction in cost in the trade services sector in each region. The technical change is applied evenly to skilled and unskilled labor.

[15] The constant elasticity of transformation for land used in the crops and livestock sectors is equal to -1.0 in all experiments.

technical change is absorbed by the land factor price than the other factors of production. In results not shown in table 13, the land factor price decreased by at least five percent in each region. Therefore, the larger the land cost share, the larger the reduction in production costs, and the larger the reduction in price due to the assumption of perfect competition.

The decrease in the price of crops also leads to reductions in the cost of production for the sectors that have relatively intensive crop input use; namely the livestock and processed food sectors. For livestock, the price decreases are similar at approximately 1.4 percent for North America, Southeast Asia, East Asia, and the ROW. The EU and Australasia experience smaller decreases, less than one percent, in the price of livestock due to relatively smaller cost shares for land and crops in those regions, leading to smaller price reductions. Price decreases for processed food range from 0.33 percent in the EU to 1.03 percent in Southeast Asia. Again, the differences in the food price decreases are due to differences in input usage in the food sector across regions. In Southeast Asia, East Asia, and the ROW, crops, livestock, and own-use accounts for about half of the per-unit cost of processed food, while these inputs account for forty percent or less of the per-unit cost of processed food in North America, Australasia, and the EU.

The impacts on all other sectors are much smaller for several reasons. First, manufacturing, trade, transportation, and services use relatively little crops, livestock, and processed food as inputs. Second, because the crops sector is relatively small sector in the economies in all regions in the model, technical progress in the crops sector will not release relatively large amounts of labor and capital for use in the other sectors or generate relatively large increases in real income that would spur increases in demand for the commodities produced by these sectors.[16] In results not shown in table 13, the prices changes for manufacturing, trade, transportation, and services were generally less than or equal 0.1 percent on an absolute basis across all regions.

While technical progress is usually associated with an increase in production, this is not the case for the crops sector in Australasia and the EU, which experience a 0.4 percent decrease in crop production. This decrease is driven by reductions in the export of crops across regions. For all regions except the EU, the composite import price does not decrease as much as the price for domestically produced crops. The opposite is true for the EU because of the relatively small decrease in the EU crops price. This change in relative prices between the domestic and imported commodity leads to agents substituting domestically produced crops for imported crops. The decline in imports has the largest effects on the EU, Australasia, and North American who export a significant share of their crop production (see table 14 for export sales shares). The decrease in crop exports account for all of the decrease in crop production in the EU and approximately one-third of the decrease in crop production in Australasia. Crop exports from North America change very little overall due to increases in exports to the EU offsetting decreases to all other regions. The remaining decrease in crop production in Australasia is due to a decrease in domestic use, which can also be traced by to reduced exports of livestock and processed food from Australasia. Because of the relatively smaller price decreases in Australasian livestock and processed food, importers of these commodities substitute towards other regions that provide these commodities for less. This drop in Australasian exports of livestock and processed food leads to reduction in livestock and processed food production in Australasia, and a reduction in the intermediate use of crops. Because livestock and processed food account for approximately sixty percent of all domestic crop use in Australasia, this decrease in demand by these sectors leads to a reduction in the overall use of domestically produced crops in Australasia.

[16] In results not shown in table 14, the increase in equivalent variation generated by technical change in the crops sector was less than 0.2 percent of the initial GDP in all regions.

Columns four, five, and six in table 13 present results from the GTAP-M Model with *fixed domestic margins* for the same experiment. The relative size of the domestic margins are maintained by setting all of the margin related elasticities of substitution, *ESUBPR*, *ESUBPL*, *ESUBGR*, *ESUBGL*, *ESUBFR*, *ESUBFL*, *ESUBXR*, and *ESUBXL*, equal to zero. The magnitudes of the domestic margins for the private households, intermediate inputs, and exports across all regions are given in table 15.[17]

The major difference in the results between the GTAP-M Model with fixed margins and the GTAP Model is the degree of price transmission from producers to consumers or buyers. Without domestic margins, all of the change in the market price of a commodity is transmitted to the domestic buyer of that commodity. This may be seen by comparing the change in market price to the changes in the *fob* export price and the demand price for the domestic household for domestically produced commodities. In both instances, the changes are equal, implying a one hundred percent price transmission. However, once domestic margins are introduced into the model, the degree of price transmission will not necessary equal one hundred percent, except for all services that by definition have zero domestic margins. For example, in the case of fixed domestic margins, the degree of price transmission for domestically produced crops purchased by the private household varies from about fifty percent in North America to a little over eighty percent in Southeast Asia. This can be seen by dividing the percentage change in demand price for the domestic household by percentage change in the market price. Similarly, the degree of export price transmission varies from approximately eighty percent for North America to 95 percent for Southeast Asia. Again, this can be seen by dividing the percentage change in the *fob* export price by the percentage change in the market price for a given commodity.

The degree of price transmission depends on the size of the domestic margins relative to the producer value and changes in the commodity price and the trade and transportation prices. Recall from equations (22) and (24) that the percentage change in the margin-inclusive tax-free price of a domestically produced commodity purchased by the private household, assuming no technical change is defined as:

$$ppdf(i,r) = PDFRSHR(i,r) * \left\{ \sum_{m} PDRSHR(i,m,r) * pm(m,r) \right\} + \left\{ 1 - PDFRSHR(i,r) \right\} * pm(i,r)$$

where *m* is the margin commodity index, *PDFRSHR(i,r)* is the cost share of total marketing services in the "tax free" cost of the domestic commodity, and *PDRSHR(i,m,r)* is the share of marketing service *m* in the total cost of all marketing services incorporated in the *i*th domestic commodity. Using the margin share data in table 15 for domestically produced crops purchased by the North American private household, one can determine the degree of price transmission for this commodity in this experiment. The trade margin share in table 15 is 0.796 and the transportation margin share is 0.18. Thus, the value of *PDRSHR* for trade is 0.8156 [0.796/(0.796 + 0.18)] and the value of *PDRSHR* for transportation is 0.1844. The value of *PDFRSHR* is equal to 0.4939 (0.976/1.976). Using the percentage changes in the market prices (*pm*) of trade (0.02), transportation (0.02), and crops (-3.49) from the experiment yields and the above expression yields:

$$ppdf(crops, NAM) = 0.4939 * (0.8156 * 0.02 + 0.1844 * 0.02) + 0.5061 * (-3.49) = -1.76 .$$

Thus, the degree of price transmission is (-1.76/-3.49)*100 = 50.4. So the larger the size of the domestic margin, the smaller the degree of price transmission. Also note that the degree of price transmission can

[17] For most regions, the domestic margins for a given commodity are the same for both imports and domestic products. However, when aggregating across regions and commodities, this relationship need not hold.

exceed one hundred percent if the prices of the margin services and the commodity in question both increase.

The implication of a price transmission of less than one hundred percent is that only a portion of a price decrease is transmitted from the producer to the buyer. So the lower the degree of price transmission, the smaller the increase in the quantity demanded from a given price decrease. This can be seen by comparing the changes in domestic use and exports in table 13 between the GTAP and GTAP-M Models. In almost all instances, there is either a smaller increase or larger decrease in the percentage change of domestic use or exports in the GTAP-M Model compared to the GTAP Model. The largest changes occur in crop exports from NAM and ANZ that decline by 0.21 percent and 0.15 percent respectively. These larger reductions in exports are due to NAM and ANZ having larger domestic export margins compared to the other regions in the model. The larger domestic export margins lead to smaller decreases in the *fob* export prices for NAM and ANZ compared to all other regions (except for the EU) and therefore importing regions to substitute away from NAM and ANZ crop exports. Finally, the reduced commodity demand also leads to larger decreases in the price of crops, livestock, and processed food when compared to the standard GTAP Model.

The last six columns of table 13 reports the GTAP-M Model results for a two percent global output augmenting technical change when the relative size of the domestic margins are allowed to vary. In the first experiment, the elasticities of substitution between the composite marketing service and commodities (*ESUBPR*, *ESUBGR*, *ESUBFR*, and *ESUBXR*) are set equal to 0.25 while the elasticities of substitution between marketing services (*ESUBPL*, *ESUBGL*, *ESUBFL*, and *ESUBXL*) remain equal to zero. Thus, the relative amounts of trade and transportation margin services required for each commodity remains constant but the total amount of the composite marketing service will vary as the relative price of the composite marketing service and the commodity varies. The values of *ESUBPR*, *ESUBGR*, *ESUBFR*, and *ESUBXR* are chosen to reflect limited substitution possibilities between commodities and marketing services.

Because global technical change in the crops sector leads to substantial reductions in the prices of crops, livestock, and processed food, but has very little effect on the prices of trade and transportation, there is a substitution away from the composite marketing service for those commodities. This substitution effect leads to an increase in the quantity of crops, livestock, and processed food demanded when compared to the results for the fixed margin case and in most instances for the standard GTAP Model. This can be seen by comparing the percentage changes in output use across the three different models in table 13. The largest percentage increases or smallest percent decreases in output occur for the GTAP-M Model with variable margins with the exception of crop production in North America and processed food production in Southeast Asia, East Asia, and the ROW. Because of this increase in demand, the largest increase or smallest decrease in the market price of crops, livestock, and processed food occur in the GTAP-M Model with variable margins for all regions except NAM and ANZ. This illustrates the importance of the value of the elasticity of substitution between commodities and the composite market service.

The choice of the parameter values for *ESUBPR*, *ESUBGR*, *ESUBFR*, and *ESUBXR* can have a significant effect on the model results. As shown in the last three columns of table 13, there are significant increases in crop production in all regions, except for Southeast Asis, when the values of these elasticities are increased from 0.25 to 0.50. For North America, the increase in crop production is twice as large when the elasticities of substitution were set equal to 0.50 compared to when they are set to 0.25. For Australasia and the EU, the percentage decrease in crop production is over fifty percent smaller. East Asia and the ROW have approximately a twenty percent larger increase in crop production. The market price decreases for crops are generally around three percent lower using the larger elasticities of

substitution. So not only are the magnitudes of the domestic margins important but also the magnitudes of the elasticities of substitution.

Table 16 provides the changes in regional equivalent variation for each of the four scenarios considered. The standard GTAP Model estimates the gain in global equivalent variation to be between $525 million and $550 million larger than the GTAP-M Model, or a little over two percent higher. The lower equivalent variation estimates from the GTAP-M Model reflects the smaller price changes that are passed onto buyers when domestic margins are included. The change in global equivalent variation does not appear to be sensitive to the value of the elasticities of substitution between commodities and the composite marketing service. The estimated change in equivalent variation increases for regions with relatively large domestic margins, such as NAM and ANZ, as the elasticity of substitution increases because this allows the magnitude of domestic margins to decrease for crops, livestock, and food. The opposite is true for regions with relatively small domestic margins.

5.2 Global Labor Augmenting Technical Change in Trade Services Sector

The second set of experiments will compare the results of a labor augmenting technical change in the trade services sector that results in a one percent cost reduction in each region using the standard GTAP Model and the GTAP-M Model with fixed domestic margins.[18] The purpose of this set of experiments is to highlight the differences between the standard GTAP and GTAP-M Models when technical change occurs in a sector that provides domestic marketing services. The first six columns in table 17 report selected simulation results for the standard GTAP Model. As expected, the largest changes in production and market price occur for the trade services sector. The last six columns in table 17 report selected simulation results for the GTAP-M Model with fixed domestic margins. When comparing the results of the two models, the large price differentials occur for crops and the land rental rate. The differences in estimated price changes for the rest of the commodities are less the 0.05 percent. However, there are substantial differences in the percentage changes in commodity production. Because the technical change reduces the price of trade services, this leads to reductions in the price of the composite marketing service and the price paid by the buyer. The last seven rows of table 16 illustrate the changes in retail prices paid by the private household. For all of the non-service sectors, there are substantial decreases in retail prices paid by the private household compared to results from the standard GTAP Model. This also occurs for the price of intermediate inputs purchased by firms and the *fob* price of exports. These larger reductions in the purchase price leads to an increase in the quantity demand for the non-services sectors (both domestic and export demand) and larger increases in production. Finally, the increase in trade services production is not a large in the GTAP-M Model compared to the standard GTAP Model.

5.3. Memory Requirements and Solution Time

Because of the larger data requirements and additional equations in the model, the GTAP-M Model requires more memory and more CPU time than the standard GTAP Model. To give a perspective on this issue, for the empirical example just discussed, the standard GTAP Model required approximately 1.5 MB of memory and needed 2.8 seconds of CPU time to complete an experiment. These requirements are the same regardless of the experiment. The GTAP-M Model required almost three times as much memory, 4.2 MB and used approximately 5.5 seconds of CPU time to complete an experiment. So while the increases in memory and computational time are large on a relative basis, they are quite modest for a small to medium size model.

[18] The technical change is assumed to apply equally to skilled and unskilled labor.

6. Summary and Conclusions

Transportation, wholesaling, and retailing activities are a significant segment of economic activity in many economies. The magnitude of these activities can vary greatly between products, users, and regions. However, in most applied general equilibrium (AGE) analyses, these marketing activities are not tied to specific commodities, reflecting the usual treatment of margins in the underlying input-output tables. To rectify this deficiency, this paper has developed a framework for incorporating domestic marketing margins on domestic and imported goods going to final demand or used as intermediate inputs, and margins on exports (e.g., trade and transport activities to get the exported commodity to the border) into the standard GTAP Model.

To illustrate the potential impact of incorporating domestic marketing activities in an AGE model, several experiments were performed analyzing the impact of technological change. Compared with models that do not incorporate domestic marketing activities, two main results emerge. First, tying the domestic marketing activities to specific commodities changes the degree of price transmission from producers to users, compared to a model that does not include margin activities explicitly. For example, only about fifty to eighty percent of the reduction in the crop price for a global technical change in the crops sector was passed through to consumers. This leads to smaller increases in the quantity demand and therefore smaller increases in crop production following the technical change. In addition, the benefits of the technological change are slightly smaller when domestic margins are explicitly incorporated. The total change in equivalent variation was $45.2 million lower for the GTAP-M Model with fixed domestic margins compared to the standard GTAP Model.

The second main result is that the magnitude of the elasticity of substitution between commodities and the composite marketing activity is very important. Previous research by Wohlgenant has suggested that the elasticity of substitution between commodities and marketing services may be non-zero, implying that the marketing margins need not be "fixed." Allowing "variable" margins creates a new source of demand for commodities. This impact was illustrated in the case of technical change in the crops sector. By allowing the domestic marketing margins to vary resulted in larger increases in crop, livestock, and processed food production that was the case for fixed margins or the case without domestic marketing margins. This result occurred because the relative price decrease in food commodities relative to trade and transport activities, leading to a decrease in the domestic marketing margins for food.

Incorporating domestic margin by modifying an existing database should only be viewed as an interim step towards developing a domestic margins inclusive database. There were numerous instances where the trade and transport margins, computed using external data sources, were too large relative to the level of firm or household expenditures on trade services and transportation in the version 5.4 Data Base. This limitation associated with modifying an existing database suggests that the collection of margin data should be an integral part future database construction, rather than a post-construction revision.

Accounting for domestic margins will also be important in other applications, such as energy policy and climate change. Peterson and Lin show that because the domestic margins on energy commodities are substantial, ignoring these domestic margins has important consequences when analyzing the impacts of policies designed to limit greenhouse gas emissions. They conducted results for two different sets of experiments that compared results from GTAP-E Model with and without domestic trade and transport margins. In experiments that varied the real tax on carbon emissions from $25 per ton to $100 per ton, the standard GTAP-E Model over-estimated the reduction in carbon emissions, compared to the GTAP-ME Model that includes domestic margins, by 34 to 80 million metric tons (10 to 15 percent). Similarly, experiments that compared the level of carbon taxes required to attain the country-specific abatement

targets specified in the Kyoto Protocol, found that the standard GTAP-E Model without domestic margins substantially under-estimated the required carbon tax compared to a model with domestic margins.

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Figure 1. Marketing Margins for Imported Commodities

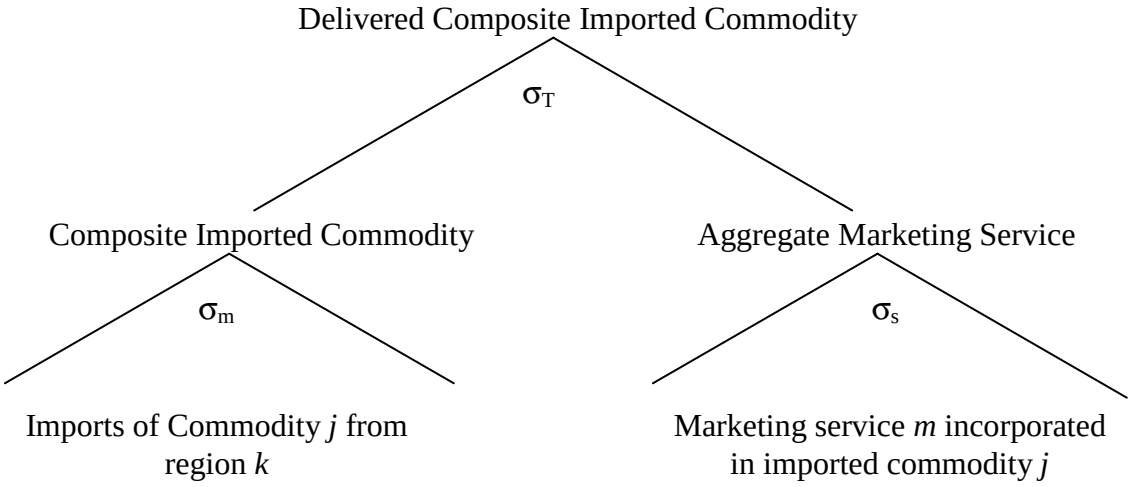

Figure 2. Modified Private Household Preference Structure

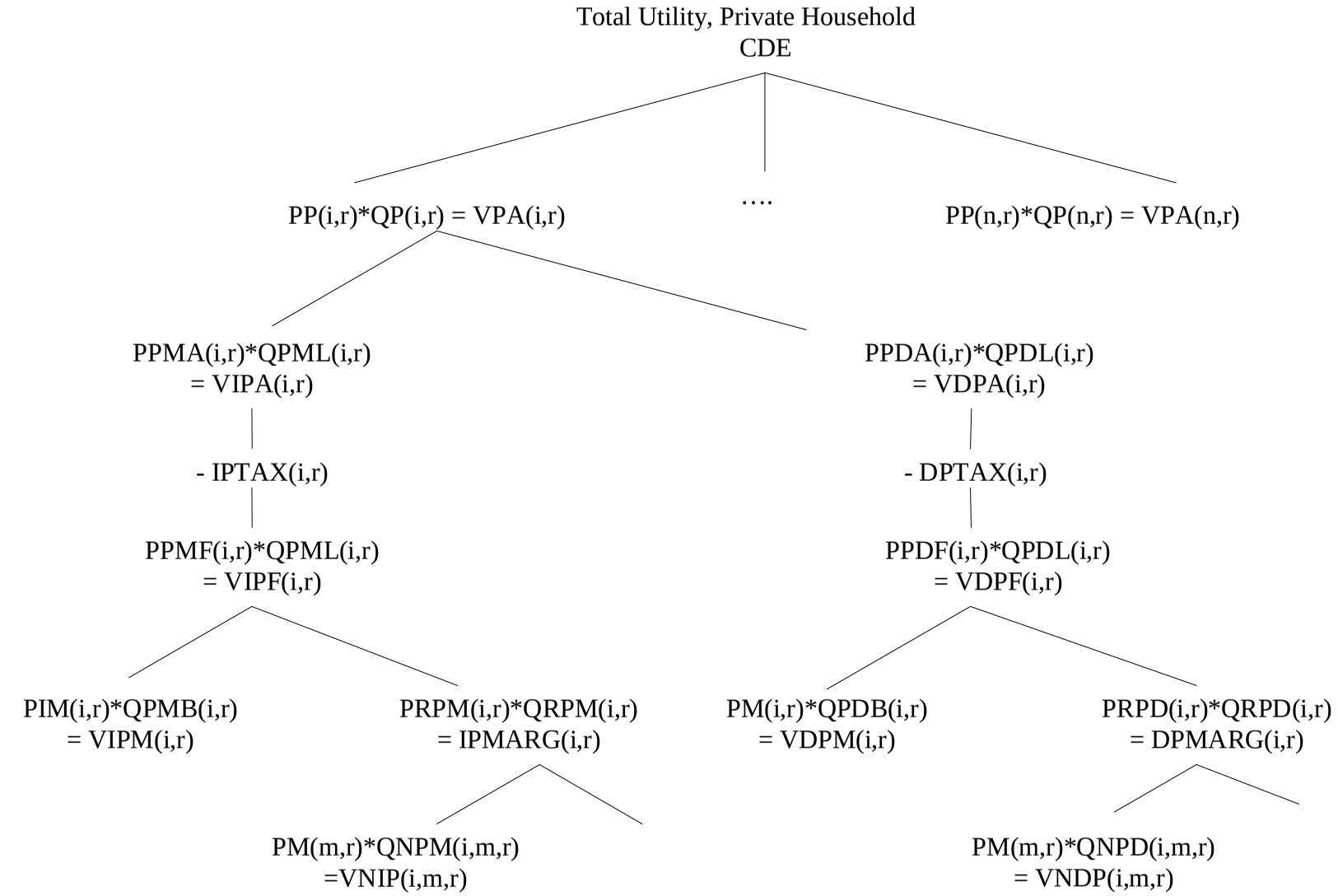

Figure 3. Modified Government Preference Structure

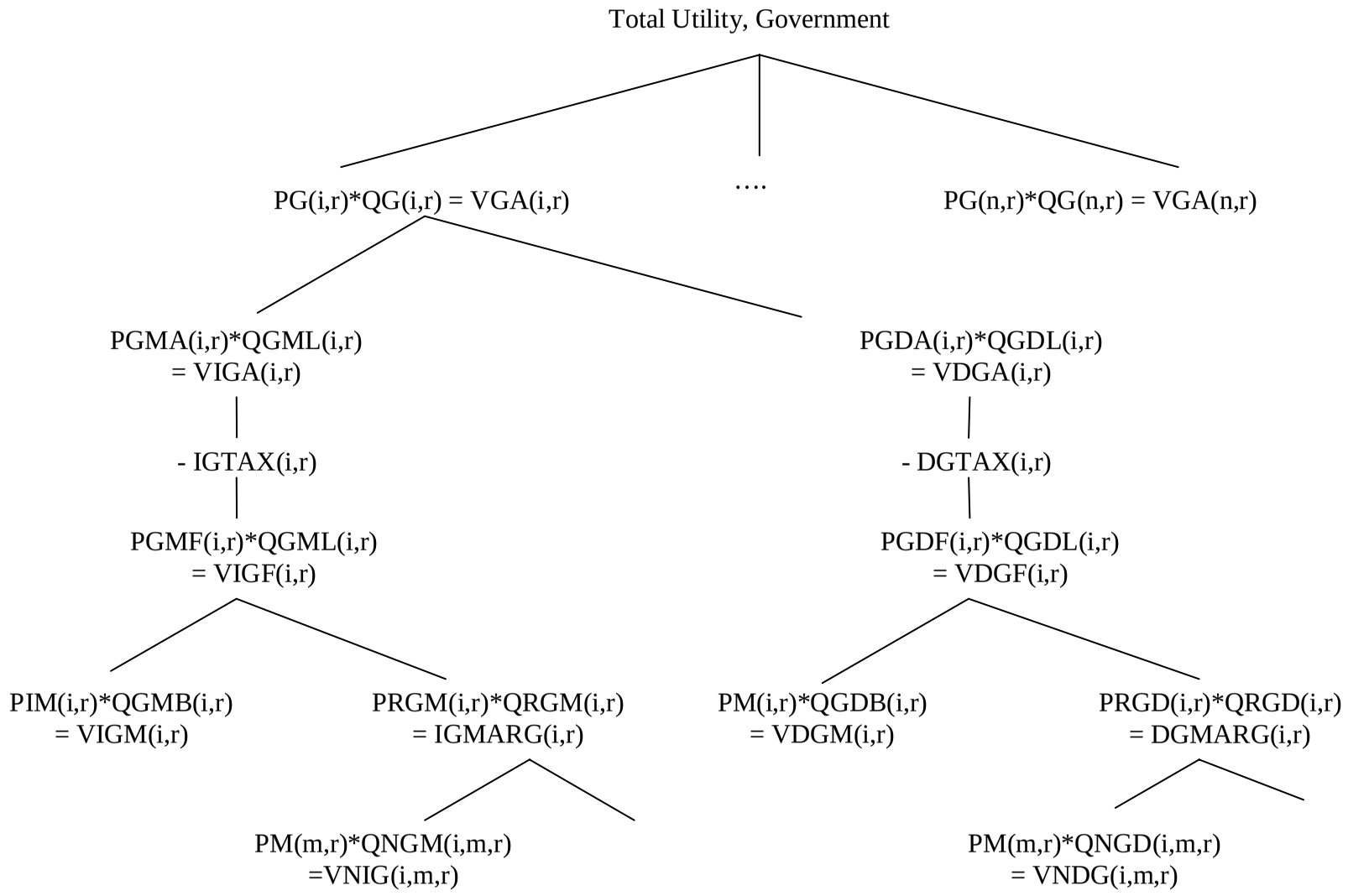

Figure 4. Modified Production Structure

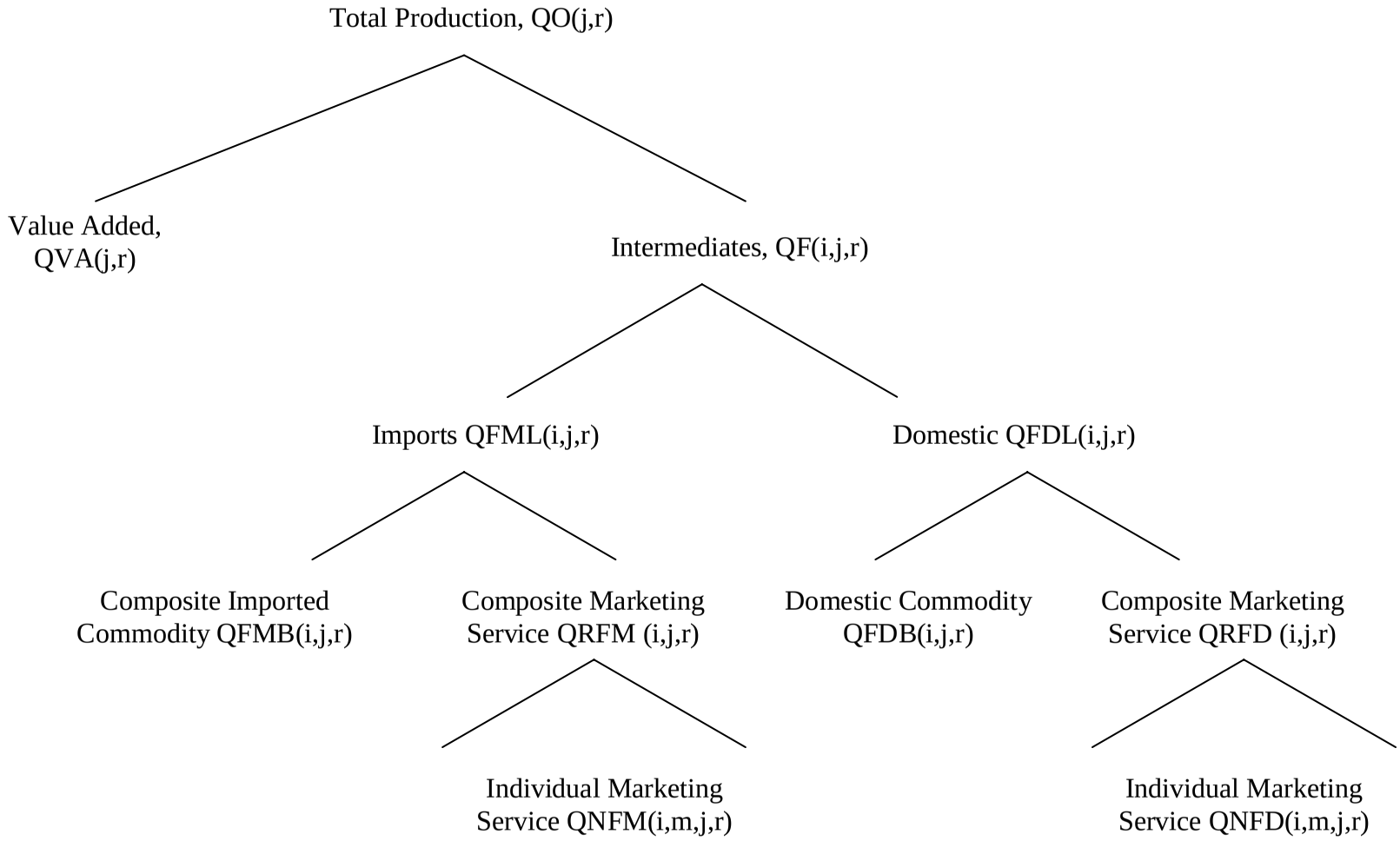

Figure 5. Structure of Domestic Margins on Exported Commodities

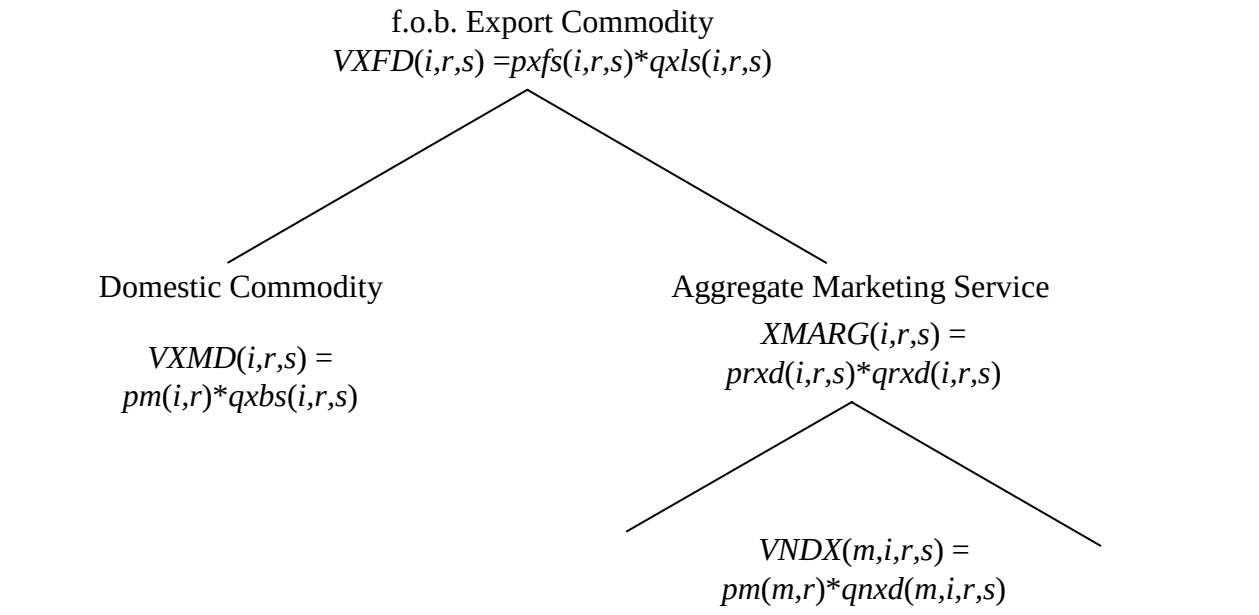

Table 1. Marketing Margins on GTAP Commodities Purchased by US Private Household

	Ratio of Margin Value to Commodity Value[a]				
	GTAP Marketing Activity				
GTAP Commodity	trd	otp	wtp	atp	Total
Pdr	0.718	0.160	0.004	0.000	0.882
Wht	0.718	0.160	0.004	0.000	0.882
Gro	0.718	0.160	0.004	0.000	0.882
v_f	0.740	0.190	0.001	0.013	0.943
osd[b]	0.000	0.000	0.000	0.000	0.000
c_b	0.000	0.000	0.000	0.000	0.000
Pfb	0.000	0.000	0.000	0.000	0.000
ocr	1.058	0.033	0.000	0.119	1.210
ctl	0.000	0.000	0.000	0.000	0.000
oap	0.344	0.006	0.000	0.004	0.354
rmk	0.000	0.000	0.000	0.000	0.452
wol	0.395	0.003	0.000	0.053	0.452
for	0.000	0.000	0.000	0.000	0.000
fsh	0.243	0.003	0.000	0.009	0.255
col	1.185	0.411	0.037	0.000	1.633
oil	0.000	0.000	0.000	0.000	0.000
gas	0.000	0.000	0.000	0.000	0.000
omn	0.747	1.068	0.090	0.000	1.905
cmt	0.446	0.035	0.000	0.001	0.482
omt	0.439	0.004	0.000	0.002	0.445
vol	0.430	0.085	0.001	0.000	0.515
mil	0.486	0.009	0.000	0.008	0.503
pcr	0.429	0.025	0.003	0.000	0.458
sgr	0.576	0.026	0.004	0.000	0.605
ofd	0.621	0.029	0.000	0.001	0.651
b_t	0.723	0.019	0.000	0.001	0.743
tex	0.911	0.024	0.000	0.002	0.937
wap	0.953	0.004	0.000	0.006	0.963
lea	1.079	0.009	0.000	0.002	1.090
lum	1.174	0.041	0.000	0.000	1.215
ppp	0.644	0.045	0.000	0.012	0.701
p_c	1.448	0.053	0.017	0.000	1.517
crp	0.775	0.045	0.000	0.004	0.824
nmm	0.935	0.035	0.001	0.004	0.974
i_s	0.000	0.000	0.000	0.000	0.000
nfm	0.805	0.059	0.000	0.038	0.902
fmp	1.181	0.048	0.000	0.004	1.233
mvh	0.278	0.022	0.000	0.001	0.301
otn	0.596	0.011	0.000	0.001	0.608
ele	0.629	0.006	0.000	0.006	0.640
ome	0.941	0.029	0.000	0.003	0.972
omf	1.072	0.015	0.000	0.002	1.089
ely[c]	0.000	0.000	0.000	0.000	0.000

continued

Table 1 Marketing Margins on GTAP Commodities Purchased by US Private Household (Continued)

	Ratio of Margin Value to Commodity Value				
	GTAP Marketing Activity				
GTAP Commodity	trd	otp	wtp	atp	Total
gdt	0.000	0.000	0.000	0.000	0.000
wtr	0.000	0.000	0.000	0.000	0.000
cns	0.000	0.000	0.000	0.000	0.000
trd	0.000	0.000	0.000	0.000	0.000
otp	0.000	0.000	0.000	0.000	0.000
wtp	0.000	0.000	0.000	0.000	0.000
atp	0.000	0.000	0.000	0.000	0.000
cmn	0.000	0.000	0.000	0.000	0.000
ofi	0.000	0.000	0.000	0.000	0.000
isr	0.000	0.000	0.000	0.000	0.000
obs	0.000	0.000	0.000	0.000	0.000
ros	0.000	0.000	0.000	0.000	0.000
osg	0.000	0.000	0.000	0.000	0.000
dwe	0.000	0.000	0.000	0.000	0.000

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

[a] The commodity value does not include marketing margins.
[b] Other than services, commodities with zero margins were generally not directly consumed by private households. The exception is bovine cattle (ctl) and raw milk (rmk) that had a small amount of consumption but zero margins. This likely represents on-farm consumption.
[c] By definition, all margins for services are assumed to equal zero. There were a few instances of very small trade margins in the US I-O data for services. These instances are ignored in the GTAP-M Data Base.

Table 2 Marketing Margins on GTAP Commodities Purchased by US Firms

	Ratio of Margin Value to Commodity Value				
	GTAP Marketing Activity				
GTAP Commodity[a]	trd	otp	wtp	atp	Total
pdr	0.240	0.145	0.004	0.000	0.388
wht	0.238	0.143	0.004	0.000	0.385
gro	0.143	0.103	0.003	0.000	0.249
v_f	0.187	0.103	0.001	0.011	0.301
osd	0.106	0.016	0.000	0.000	0.123
c_b	0.016	0.039	0.0003	0.000	0.055
pfb	0.172	0.021	0.0003	0.000	0.193
ocr	0.101	0.048	0.000	0.050	0.199
ctl	0.008	0.000	0.000	0.000	0.008
oap	0.004	0.005	0.000	0.003	0.012
rmk	0.009	0.000	0.000	0.000	0.009
wol	0.026	0.004	0.000	0.051	0.080
for	0.023	0.039	0.001	0.000	0.063
fsh	0.112	0.004	0.00002	0.013	0.129
col	0.027	0.183	0.030	0.000	0.241
oil	0.030	0.062	0.0008	0.000	0.094
gas	0.003	0.230	0.00004	0.000	0.234
omn	0.019	0.403	0.035	0.000	0.457
cmt	0.061	0.029	0.00002	0.0005	0.090
omt	0.065	0.003	0.00001	0.0009	0.069
vol	0.035	0.073	0.002	0.00000	0.109
mil	0.110	0.005	0.00002	0.003	0.118
pcr	0.034	0.017	0.003	0.000	0.054
sgr	0.066	0.077	0.002	0.000	0.144
ofd	0.111	0.032	0.0005	0.001	0.144
b_t	0.211	0.027	0.0007	0.0007	0.240
tex	0.135	0.028	0.000	0.003	0.165
wap	0.034	0.001	0.000	0.001	0.036
lea	0.048	0.013	0.000	0.004	0.066
lum	0.273	0.047	0.001	0.0004	0.321
ppp	0.119	0.047	0.00004	0.004	0.169
p_c	0.417	0.047	0.014	0.0003	0.478
crp	0.144	0.063	0.002	0.002	0.211
nmm	0.126	0.080	0.002	0.001	0.209
i_s	0.179	0.061	0.0008	0.001	0.242
nfm	0.089	0.023	0.001	0.003	0.116
fmp	0.156	0.021	0.00005	0.004	0.180
mvh	0.131	0.020	0.00009	0.004	0.155
otn	0.019	0.003	0.00001	0.010	0.032
ele	0.156	0.001	0.000	0.007	0.164
ome	0.175	0.014	0.000	0.006	0.194
omf	0.268	0.031	0.00002	0.006	0.304

[a] Values are averages across all intermediate uses weighted by firm purchases at market prices (*VDFM*). All trade and transport margins for services are equal to zero.

Table 3. Average Trade and Transport Activity Shares of All Regions with I-O Margin Data

	GTAP Margin Activity			
Country	trd	otp	wtp	atp
Austria	0.942	0.055	0.0008	0.0020
Belgium	0.919	0.080	0.0014	0.0000
Germany	0.887	0.109	0.0039	0.0000
Estonia	0.913	0.087	0.0000	0.0000
Spain	0.937	0.061	0.0019	0.0000
Finland	0.967	0.031	0.0018	0.0000
France	0.873	0.122	0.0038	0.0012
Hungary	0.930	0.070	0.0001	0.0000
Italy	0.824	0.171	0.0035	0.0008
Poland	0.908	0.090	0.0017	0.0000
Slovenia	0.962	0.038	0.0000	0.0000
Slovak Republic	0.905	0.094	0.0010	0.0000
Japan	0.871	0.113	0.0152	0.0006
Australia	0.877	0.117	0.0036	0.0024
USA	0.861	0.122	0.0041	0.0129
Netherlands	0.910	0.082	0.0068	0.0014
Average	0.906	0.090	0.0031	0.0013

Table 4. Average Trade and Transport Margins Across Uses

	Country[a]				
Use	Australia	Denmark	Japan	US 1997	Average
Intermediate inputs					
Trade margin[b]	0.132	0.135	0.164	0.133	0.139
Transport margin	0.039		0.049	0.057	0.050
Private consumption					
Trade margin	0.715	0.783	0.739	0.793	0.747
Transport margin	0.032		0.044	0.034	0.035
Government consumption[c]					
Trade margin				0.104	0.104
Transport margin				0.034	0.034
Exports					
Trade margin	0.103	0.122	0.080	0.112	0.105
Transport margin	0.036		0.014	0.036	0.031
Investment					
Trade margin	0.355	0.250	0.258	0.174	0.259
Transport margin	0.014		0.020	0.018	0.017

[a] US 1992 and US 1997 refer to I-O data for the United States from the 1992 and 1997 I-O tables.

[b] Margins are computed as the value of trade or transport margins divided by the producer value evaluated at market prices.

[c] Due to a lack of information on government expenditures in the I-O data for Australia, Denmark, and Japan, only the average trade and transport margins for the US of 0.1046 and 0.0339 are utilized.

Table 5. Decomposition of Margin on Agricultural Commodities in Austria

Step 1 Decompose total margin

Margin (€ million)	1680.323
Trade share	0.942
Transport share	0.058
Trade margin	1582.528
Transport margin	97.795

Step 2 Calculate initial trade and transport margins by use

	Inter-mediate Inputs	Private hhld	Gov't hhld	Invest	Exports	Total
Before tax use value	4736.946	2298.298	182.083	112.118	448.043	7777.488
Average trade share[a]	0.122	0.428	0.095	0.206	0.095	
Average transport share	0.048	0.034	0.004	0.017	0.030	
Initial trade margin	579.542	982.730	17.227	23.079	42.758	1645.336
Initial transport margin	227.716	77.935	0.707	1.928	13.345	321.632

Step 3 Adjust initial trade and transport margins

Trade margin adjustment	0.9618
Transport margin adjustment	0.3041

	Inter-mediate Inputs	Private hhld	Gov't hhld	Invest	Exports	Total
Trade margin	557.419	945.216	16.570	22.198	41.125	1582.528
Transport margin	69.239	23.697	0.215	0.586	4.058	97.795

Step 4 Allocate transport margins

	otp	wtp	atp
Transport margin shares	0.951	0.014	0.035

Final margin shares[b]

	Inter-mediate Inputs	Private hhld	Gov't hhld	Invest	Exports	Total
Trade margin share	0.1334	0.6986	0.1001	0.2469	0.1011	0.1334
otp margin share	0.0141	0.0099	0.0011	0.0050	0.0087	0.0141
wtp margin share	0.0002	0.0001	0.0000	0.0001	0.0001	0.0002
atp margin share	0.0005	0.0004	0.0000	0.0002	0.0003	0.0005

[a] Average trade and transport shares for margin-inclusive value are equal to m/(1+m) where m is the margin exclusive trade and transport shares in table 4.

[b] Final margin shares are computed as the margin value divided by the before tax producer value.

Table 6. Euromonitor Processed Foods Margin Share Estimates[a]

	GTAP Processed Food Commodities					
Country	cmt	omt	vol	mil	pcr	ofd
Argentina	0.453	0.453	0.416	0.616	0.404	0.469
Austria	0.222	0.267	0.297	0.258	0.271	0.308
Belgium	0.361	0.360	0.320	0.289	0.382	0.333
Brazil	0.506	0.506	0.407	0.491	0.537	0.529
Bulgaria	0.410	0.414	0.319	0.346	0.428	0.404
Canada	0.230	0.229	0.193	0.247	0.230	0.278
Chile	0.294	0.289	0.199	0.244	0.220	0.274
China	1.168	1.177	1.580	0.677	1.026	0.868
Colombia	0.386	0.389	0.263	0.294	0.399	0.362
Czech Republic	0.214	0.232	0.254	0.162	0.223	0.205
Denmark	0.333	0.302	0.301	0.463	0.261	0.323
Finland	0.350	0.344	0.197	0.242	0.349	0.329
France	0.550	0.549	0.229	0.307	0.226	0.300
Germany	0.431	0.433	0.429	0.266	0.431	0.488
Hong Kong, China	0.455	0.451	0.459	0.401	0.434	0.457
Hungary	0.479	0.471	0.251	0.160	0.481	0.293
India	0.447	0.448	0.426	0.414	0.494	0.480
Indonesia	0.759	0.760	0.559	0.436	0.705	0.558
Ireland	0.267	0.278	0.223	0.263	0.258	0.333
Italy	0.225	0.208	0.224	0.244	0.224	0.241
Japan	0.667	0.636	0.537	0.470	0.579	0.506
Malaysia	0.590	0.575	0.401	0.260	0.609	0.535
Mexico	0.333	0.393	0.305	0.343	0.286	0.339
New Zealand	0.368	0.371	0.406	0.372	0.372	0.381
Philippines	0.603	0.594	0.834	0.427	0.593	0.559
Poland	0.484	0.486	0.431	0.461	0.354	0.398
Portugal	0.304	0.307	0.261	0.268	0.305	0.266
Romania	0.349	0.350	0.267	0.313	0.352	0.360
Russia	0.227	0.229	0.161	0.198	0.229	0.231
Singapore	0.333	0.392	0.288	0.201	0.212	0.237
Slovakia	1.000	0.750	0.214	0.168	0.591	0.299
South Africa	0.314	0.375	0.323	0.212	0.202	0.158
South Korea	0.530	0.596	0.614	0.572	0.613	0.602
Spain	0.158	0.158	0.117	0.383	0.165	0.269
Sweden	0.833	0.837	0.136	0.337	0.591	0.391
Switzerland	0.286	0.333	0.259	0.221	0.256	0.244
Taiwan	0.453	0.453	0.416	0.616	0.404	0.469
Thailand	0.222	0.267	0.297	0.258	0.271	0.308
Turkey	0.361	0.360	0.320	0.289	0.382	0.333
Ukraine	0.506	0.506	0.407	0.491	0.537	0.529
United Kingdom	0.410	0.414	0.319	0.346	0.428	0.404
Venezuela	0.230	0.229	0.193	0.247	0.230	0.278
Vietnam	0.294	0.289	0.199	0.244	0.220	0.274

[a] Margin shares are computed as the ratio of retail to manufacturer prices minus one. Each share represent a total margin for private households in the respective region.

Table 7. Comparison of I-O Margin Estimates with Euromonitor Estimates

Country	I-O Food Margin Estimate[a]	Average Euromonitor Estimate[b]
Austria	0.306	0.346
Belgium	0.218	0.282
Denmark	0.235	0.496
Finland	0.429	0.387
France	0.217	0.234
Germany	0.358	0.253
Hungary	0.248	0.349
Italy	0.396	0.360
Japan	0.652	0.413
Poland	0.286	0.270
Portugal	0.249	0.228
Slovakia	0.347	0.378
Spain	0.248	0.285
Sweden	0.298	0.332
United Kingdom	0.507	0.209

[a] Total trade and transport margin for aggregate food sector reported in I-O data.

[b] Simple average of Euromonitor estimates for all processed food commodities in table 6.

Table 8. Average Retail to Producer Price Ratio for Goods Sold for Private Domestic Final Demand for Canada

GTAP Commodity	Retail-Producer Price Ratio
v_f	1.641
ocr	1.751
cmt	1.544
omt	1.456
vol	1.508
mil	1.360
pcr	1.866
sgr	1.522
ofd	1.580
b_t	1.568
tex	1.664
wap	1.836
lea	1.618
ppp	1.424
p_c	2.052
crp	1.894
fmp	1.434
mvh	1.213
otn	1.216
ele	1.215
ome	1.498
omf	1.588

Table 9. Average Total Margin Shares by GTAP Commodity and Use

GTAP Commodity	Intermediate Inputs	Private Household	Government Household	Investment	Exports
pdr	0.134	0.442	0.041	0.118	0.121
wht	0.137	0.442	0.041	0.118	0.126
gro	0.154	0.442	0.041	0.118	0.121
v_f	0.160	0.523	0.044	0.118	0.113
osd	0.125	0.402	0.027	0.118	0.123
c_b	0.112	0.424	0.021	0.118	0.000
pfb	0.111	0.424	0.031	0.118	0.099
ocr	0.127	0.554	0.036	0.118	0.112
ctl	0.103	0.384	0.021	0.140	0.102
oap	0.095	0.420	0.022	0.118	0.092
rmk	0.101	0.405	0.021	0.118	0.000
wol	0.119	0.398	0.021	0.124	0.098
for	0.143	0.738	0.021	0.089	0.115
fsh	0.175	0.876	0.000	0.017	0.131
col	0.144	0.512	0.018	0.000	0.109
oil	0.043	0.108	0.005	0.011	0.025
gas	0.043	0.108	0.005	0.011	0.025
omn	0.232	1.087	0.000	0.023	0.148
cmt	0.130	0.486	0.043	0.000	0.097
omt	0.125	0.469	0.041	0.000	0.093
vol	0.142	0.481	0.043	0.000	0.101
mil	0.127	0.458	0.042	0.000	0.095
pcr	0.120	0.472	0.040	0.000	0.091
sgr	0.130	0.487	0.047	0.000	0.103
ofd	0.129	0.479	0.046	0.000	0.103
b_t	0.158	0.662	0.016	0.000	0.123
tex	0.129	0.646	0.036	0.152	0.108
wap	0.167	0.911	0.030	0.057	0.157
lea	0.194	0.776	0.034	0.037	0.119
lum	0.155	0.617	0.028	0.151	0.109
ppp	0.115	0.458	0.043	0.065	0.097
p_c	0.167	0.646	0.012	0.010	0.106
crp	0.155	0.755	0.132	0.100	0.111
nmm	0.168	0.824	0.006	0.104	0.118
i_s	0.114	0.319	0.000	0.060	0.095
nfm	0.107	0.410	0.010	0.077	0.085
fmp	0.117	0.618	0.028	0.178	0.096
mvh	0.121	0.384	0.010	0.167	0.073
otn	0.046	0.254	0.009	0.074	0.034
ele	0.118	0.500	0.041	0.228	0.099
ome	0.120	0.487	0.105	0.182	0.091
omf	0.182	0.764	0.113	0.246	0.136

Note: the trade and transport margins for all services are assumed to equal zero.

Table 10 Computing Trade Margin Inclusive Expenditures for US Private Household

GTAP	v 5.4 Expenditures		Trade Margin	Margin Value		Margin Inclusive Expenditures	
Commodity	Domestic	Imports	Share	Domestic	Imports	Domestic	Imports
	$millions		Percent		$millions		
pdr	40.593	0.413	0.7182	29.154	0.297	69.747	0.710
wht	18.038	0.063	0.7182	12.955	0.045	30.993	0.108
gro	409.453	6.439	0.7182	294.074	4.625	703.526	11.064
v_f	17070.066	3420.816	0.7399	12629.664	2530.966	29699.731	5951.782
osd	53.015	2.103	0.0000	0.000	0.000	53.015	2.103
c_b	10.974	4.837	0.0000	0.000	0.000	10.974	4.837
pfb	7.401	0.010	0.0000	0.000	0.000	7.401	0.010
ocr	5736.016	2650.983	1.0582	6069.938	2805.310	11805.953	5456.292
ctl	8.771	0.108	0.0000	0.000	0.000	8.771	0.108
oap	4687.927	234.183	0.3441	1613.153	80.584	6301.080	314.767
rmk	90.238	0.132	0.0000	0.000	0.000	90.238	0.132
wol	0.705	17.267	0.3951	0.279	6.823	0.984	24.089
for	2431.952	72.053	0.0000	0.000	0.000	2431.952	72.053
fsh	139.365	206.164	0.2428	33.841	50.061	173.206	256.225
col	43.217	0.497	1.1845	51.192	0.588	94.409	1.085
oil	0.000	0.000	0.0000	0.000	0.000	0.000	0.000
gas	0.024	0.040	0.0000	0.000	0.000	0.024	0.040
omn	48.015	5.425	0.7469	35.861	4.052	83.875	9.478
cmt	30786.264	1041.540	0.4464	13743.542	464.962	44529.806	1506.502
omt	32944.297	807.751	0.4394	14476.021	354.933	47420.317	1162.685
vol	367.535	62.849	0.4296	157.878	26.997	525.413	89.847
mil	30210.375	801.185	0.4858	14677.197	389.242	44887.572	1190.428
pcr	739.469	203.871	0.4293	317.445	87.519	1056.915	291.390
sgr	1909.052	461.975	0.5756	1098.879	265.920	3007.931	727.895
ofd	136732.750	10058.968	0.6210	84914.183	6246.850	221646.933	16305.818
b_t	90207.180	5351.728	0.7227	65194.443	3867.795	155401.622	9219.523
tex	23139.984	5411.635	0.9110	21081.220	4930.162	44221.204	10341.796
wap	67787.328	34875.988	0.9533	64618.677	33245.745	132406.005	68121.733
lea	7882.023	19679.139	1.0788	8503.237	21230.130	16385.261	40909.269

continued

Table 10. Computing Trade Margin Inclusive Expenditures for US Private Household (Continued)

GTAP	v 5.4 Expenditures		Trade Margin	Margin Value		Margin Inclusive Expenditures	
Commodity	Domestic	Imports	Share	Domestic	Imports	Domestic	Imports
	$millions		Percent	$millions			
lum	28588.443	4337.903	1.1743	33570.580	5093.873	62159.023	9431.776
ppp	55527.035	3562.274	0.6441	35764.130	2294.407	91291.166	5856.681
p_c	47863.691	2549.103	1.4477	69291.787	3690.310	117155.479	6239.413
crp	108477.156	15644.036	0.7753	84101.363	12128.680	192578.519	27772.717
nmm	4797.301	852.348	0.9347	4483.912	796.668	9281.213	1649.016
i_s	37.908	6.790	0.0000	0.000	0.000	37.908	6.790
nfm	70.866	19.028	0.8054	57.074	15.325	127.940	34.352
fmp	8096.886	681.657	1.1813	9564.681	805.228	17661.567	1486.885
mvh	101834.938	36963.539	0.2781	28319.074	10279.117	130154.012	47242.656
otn	22503.621	3643.685	0.5963	13418.257	2172.624	35921.878	5816.308
ele	22734.678	19565.432	0.6288	14296.475	12303.526	37031.152	31868.958
ome	62850.914	20622.828	0.9407	59121.529	19399.131	121972.443	40021.959
omf	21500.834	24481.449	1.0719	23047.754	26242.816	44548.588	50724.265
ely	58139.840	466.097	0.0000	0.000	0.000	58139.840	466.097
gdt	6080.171	23.949	0.0000	0.000	0.000	6080.171	23.949
wtr	29732.574	48.391	0.0000	0.000	0.000	29732.574	48.391
cns	1.915	0.005	0.0000	0.000	0.000	1.915	0.005
trd	1118102.625	7067.431	0.0000	0.000	0.000	261697.863	7067.431
otp	63634.254	5810.892	0.0000	0.000	0.000	63634.254	5810.892
wtp	9977.473	89.293	0.0000	0.000	0.000	9977.473	89.293
atp	44592.465	11321.706	0.0000	0.000	0.000	44592.465	11321.706
cmn	136235.406	760.829	0.0000	0.000	0.000	136235.406	760.829
ofi	329852.656	2293.661	0.0000	0.000	0.000	329852.656	2293.661
isr	177739.641	3269.898	0.0000	0.000	0.000	177739.641	3269.898
obs	251089.734	5255.736	0.0000	0.000	0.000	251089.734	5255.736
ros	400051.438	5420.201	0.0000	0.000	0.000	400051.438	5420.201
osg	1054850.250	10347.166	0.0000	0.000	0.000	1054850.250	10347.166
dwe	606185.500	0.000	0.0000	0.000	0.000	606185.500	0.000

Table. 11 Regional Aggregation

Aggregate Region	GTAP Region
North America (NAM)	Canada
	United States
Australasia (ANZ)	Australia
	New Zealand
European Union (EU)	Austria
	Belgium
	Denmark
	Finland
	France
	Germany
	United Kingdom
	Greece
	Ireland
	Italy
	Luxembourg
	Netherlands
	Portugal
	Spain
	Sweden
Southeast Asia (SEA)	Indonesia
	Malaysia
	Philippines
	Singapore
	Thailand
	Vietnam
East Asia (EA)	China
	Hong Kong
	Japan
	Korea
	Taiwan
Rest-of-World (ROW)	All remaining countries

Table 12. Commodity Aggregation

Aggregate Commodity	GTAP Sector
Crops	Paddy rice
	Wheat
	Cereal grains, nec
	Vegetables, fruit, nuts
	Oil seeds
	Sugar cane, sugar beet
	Plant-based fibers
	Crops, nec
Livestock	Bovine cattle, sheep and goats, horses
	Animal products, nec
	Raw milk
	Wool, silk-worm cocoons
Processed Food	Fishing
	Bovine cattle, sheep and goat, horse meat products
	Meat products, nec
	Vegetable oils and fats
	Dairy products
	Processed rice
	Sugar
	Food products, nec
	Beverages and tobacco products
Mining & manufacturing	Forestry
	Coal
	Oil
	Gas
	Mineral, nec
	Textiles
	Wearing apparel
	Leather products
	Wood products
	Paper products, publishing
	Petroleum, coal products
	Chemical, rubber, plastic products
	Mineral products, nec
	Ferrous metals
	Metals, nec
	Metal products
	Motor vehicles and parts
	Transport equipment, etc
	Electronic equipment
	Machinery and equipment, nec
	Manufactures, nec

continued

Table 12 Commodity Aggregation (Continued)

Aggregate Commodity	GTAP Sector
Services	Electricity
	Gas manufacture, distribution
	Water
	Construction
	Communication
	Financial services, nec
	Insurance
	Business services, nec
	Recreational and other services
	Public administration, defense, education, health
	Dwellings
Trade	Trade
Transportation	Transport, nec
	Water transport
	Air Transport

Table 13 Impacts of 2% Global Output Augmenting Technical Change in Crops Sector

	GTAP Model			GTAP-M Model								
				Fixed Margins			Variable Margins					
							$\sigma = 0.25$[a]			$\sigma = 0.50$[a]		
Variable/Region	Crops	Livestock	Food	Crops	Livestock	Food	Crops	Livestock	Food	Crops	Livestock	Food
						Percentage Change						
Output (*qo*)												
NAM	0.23	0.19	0.15	-0.01	0.18	0.11	0.17	0.22	0.15	0.34	0.26	0.19
ANZ	-0.43	-0.30	-0.08	-0.61	-0.29	-0.04	-0.41	-0.25	-0.02	-0.21	-0.21	0.00
EU	-0.40	-0.21	-0.11	-0.39	-0.22	-0.11	-0.23	-0.17	-0.09	-0.09	-0.13	-0.06
SEA	1.10	0.58	0.72	1.08	0.55	0.67	1.14	0.58	0.69	1.19	0.60	0.71
EA	0.52	0.45	0.44	0.51	0.40	0.37	0.65	0.43	0.41	0.78	0.46	0.45
ROW	0.42	0.30	0.50	0.39	0.27	0.45	0.50	0.32	0.48	0.60	0.36	0.51
Market Price (*pm*)												
NAM	-3.26	-1.35	-0.55	-3.49	-1.48	-0.59	-3.36	-1.40	-0.57	-3.24	-1.32	-0.55
ANZ	-3.32	-0.89	-0.54	-3.46	-0.96	-0.58	-3.36	-0.90	-0.55	-3.28	-0.84	-0.53
EU	-2.69	-0.68	-0.33	-2.69	-0.68	-0.32	-2.65	-0.65	-0.32	-2.61	-0.62	-0.31
SEA	-4.07	-1.38	-1.03	-4.13	-1.43	-1.05	-3.98	-1.31	-1.01	-3.83	-1.21	-0.98
EA	-3.28	-1.39	-0.83	-3.29	-1.39	-0.82	-3.17	-1.30	-0.78	-3.06	-1.21	-0.76
ROW	-3.32	-1.35	-0.85	-3.36	-1.39	-0.86	-3.27	-1.30	-0.83	-3.18	-1.23	-0.81
Exports[a]												
NAM	-0.02	0.03	-0.02	-0.23	0.04	-0.02	-0.23	0.04	-0.02	-0.23	0.04	-0.02
ANZ	-0.16	-0.22	-0.13	-0.31	-0.23	-0.10	-0.27	-0.22	-0.10	-0.23	-0.20	-0.09
EU	-0.41	-0.09	-0.13	-0.43	-0.10	-0.13	-0.39	-0.09	-0.12	-0.35	-0.09	-0.12
SEA	0.30	0.03	0.28	0.29	0.02	0.26	0.27	0.01	0.25	0.26	0.01	0.24
EA	-0.01	0.02	0.02	-0.01	0.01	0.01	-0.01	0.01	0.01	-0.01	0.01	0.01
ROW	0.04	0.02	0.10	0.02	0.02	0.08	0.02	0.02	0.08	0.02	0.02	0.08

continued

Table 13 Impacts of 2% Global Output Augmenting Technical Change in Crops Sector (Continued)

	GTAP Model			GTAP-M Model								
				Fixed Margins			Variable Margins					
							σ= 0.25			σ= 0.50		
Variable/Region	Crops	Livestock	Food	Crops	Livestock	Food	Crops	Livestock	Food	Crops	Livestock	Food
						Percentage Change						
fob Export Price[b]												
NAM	-3.26	-1.35	-0.55	-2.86	-1.45	-0.52	-2.75	-1.37	-0.50	-2.65	-1.30	-0.48
ANZ	-3.32	-0.89	-0.54	-3.03	-0.86	-0.54	-2.95	-0.80	-0.52	-2.88	-0.75	-0.50
EU	-2.69	-0.68	-0.33	-2.53	-0.63	-0.30	-2.49	-0.60	-0.29	-2.45	-0.57	-0.29
SEA	-4.07	-1.38	-1.03	-3.94	-1.33	-0.99	-3.80	-1.22	-0.96	-3.66	-1.13	-0.92
EA	-3.28	-1.39	-0.83	-3.11	-1.32	-0.75	-3.00	-1.23	-0.72	-2.89	-1.15	-0.70
ROW	-3.32	-1.35	-0.85	-3.16	-1.32	-0.81	-3.07	-1.24	-0.78	-2.98	-1.17	-0.76
Domestic Use[c]												
NAM	0.25	0.17	0.17	0.21	0.14	0.13	0.40	0.18	0.17	0.57	0.22	0.21
ANZ	-0.27	-0.08	0.06	-0.30	-0.06	0.06	-0.14	-0.03	0.08	0.02	0.00	0.09
EU	0.01	-0.12	0.02	0.05	-0.11	0.02	0.15	-0.07	0.04	0.26	-0.04	0.05
SEA	0.80	0.55	0.44	0.79	0.53	0.41	0.86	0.56	0.44	0.93	0.59	0.47
EA	0.53	0.43	0.42	0.53	0.39	0.35	0.66	0.42	0.40	0.79	0.45	0.44
ROW	0.38	0.28	0.41	0.36	0.25	0.37	0.48	0.30	0.40	0.58	0.34	0.43
Demand Price for Domestic Commodity for Private Household[d]												
NAM	-3.26	-1.35	-0.55	-1.76	-1.09	-0.36	-1.63	-0.98	-0.33	-1.64	-0.97	-0.34
ANZ	-3.32	-0.89	-0.54	-2.05	-0.80	-0.45	-1.94	-0.72	-0.42	-1.95	-0.70	-0.42
EU	-2.69	-0.68	-0.33	-1.79	-0.45	-0.24	-1.79	-0.45	-0.24	-1.75	-0.42	-0.23
SEA	-4.07	-1.38	-1.03	-3.40	-1.22	-0.83	-3.31	-1.14	-0.81	-3.17	-1.03	-0.77
EA	-3.28	-1.39	-0.83	-2.45	-1.23	-0.57	-2.41	-1.20	-0.57	-2.29	-1.07	-0.53
ROW	-3.32	-1.35	-0.85	-2.71	-1.16	-0.65	-2.65	-1.11	-0.64	-2.57	-1.03	-0.62

[a] Elasticity of substitution between composite marketing service and commodity (*ESUBPR*, *ESUBGR*, *ESUBFR*, and *ESUBXR*).
[b] Share weighted percentage change across all export destinations.
[c] Share weighted percentage change across all domestic uses.
[d] Corresponds to the variable *ppd(i,r)* for the GTAP Model and *ppda(i,r)* for the GTAP-M Model.

Table 14 Export Sales Shares by Sector and Region

	Region					
Commodity	NAM	ANZ	EU	SEA	EA	ROW
Crops	0.201	0.319	0.284	0.086	0.017	0.087
Livestock	0.038	0.179	0.063	0.034	0.015	0.013
Processed Food	0.059	0.252	0.169	0.160	0.025	0.076
Mining & Manufacturing	0.175	0.219	0.390	0.497	0.202	0.245
Trade	0.022	0.063	0.089	0.392	0.092	0.065
Transport	0.185	0.226	0.195	0.386	0.101	0.170
Services	0.019	0.023	0.040	0.092	0.012	0.032

Table 15 Margins on Private Consumption and Intermediate Use

	Trade Margins						Transport Margins					
	NAM	ANZ	EU	SEA	EA	ROW	NAM	ANZ	EU	SEA	EA	ROW
	Share of Commodity Purchases at Market Prices											
Private Household												
Domestic Commodities												
Crops	0.796	0.517	0.471	0.158	0.297	0.187	0.180	0.201	0.022	0.045	0.038	0.046
Livestock	0.347	0.140	0.447	0.118	0.103	0.143	0.015	0.093	0.020	0.032	0.017	0.038
Process Food	0.586	0.327	0.305	0.170	0.345	0.235	0.026	0.026	0.030	0.047	0.039	0.048
Mining & Manufacturing	0.789	0.953	0.523	0.229	0.573	0.324	0.036	0.027	0.024	0.054	0.038	0.063
Imports												
Crops	0.818	0.531	0.452	0.159	0.457	0.211	0.156	0.190	0.019	0.035	0.054	0.046
Livestock	0.347	0.084	0.472	0.175	0.183	0.235	0.015	0.137	0.022	0.035	0.029	0.036
Process Food	0.572	0.362	0.301	0.169	0.391	0.211	0.030	0.031	0.029	0.037	0.047	0.046
Mining & Manufacturing	0.736	1.014	0.577	0.215	0.611	0.324	0.025	0.022	0.027	0.046	0.047	0.055
Intermediate Use[a]												
Domestic Inputs												
Crops	0.138	0.064	0.089	0.047	0.080	0.078	0.026	0.042	0.016	0.013	0.024	0.012
Livestock	0.071	0.112	0.070	0.077	0.046	0.065	0.052	0.075	0.016	0.011	0.029	0.011
Process Food	0.081	0.064	0.070	0.053	0.097	0.065	0.033	0.050	0.023	0.010	0.029	0.010
Mining & Manufacturing	0.090	0.062	0.069	0.052	0.064	0.059	0.044	0.033	0.018	0.009	0.021	0.011
Imported Inputs												
Crops	0.142	0.211	0.085	0.082	0.064	0.084	0.026	0.051	0.015	0.013	0.016	0.013
Livestock	0.079	0.221	0.076	0.073	0.032	0.071	0.045	0.037	0.017	0.010	0.010	0.012
Process Food	0.104	0.132	0.070	0.058	0.116	0.065	0.045	0.019	0.022	0.010	0.037	0.011
Mining & Manufacturing	0.073	0.080	0.053	0.039	0.053	0.057	0.033	0.012	0.013	0.007	0.020	0.010
Exports[a]												
Crops	0.174	0.090	0.012	0.036	0.045	0.056	0.047	0.054	0.007	0.010	0.013	0.008
Livestock	0.013	0.078	0.028	0.056	0.039	0.039	0.006	0.056	0.020	0.008	0.010	0.006
Process Food	0.106	0.069	0.006	0.041	0.067	0.046	0.026	0.009	0.001	0.008	0.013	0.008
Mining & Manufacturing	0.093	0.058	0.001	0.032	0.049	0.037	0.026	0.010	0.000	0.006	0.012	0.007

[a] Aggregate margins across all intermediate uses or destinations.

Table 16 Changes in Equivalent Variation From 2% Global Output Augmenting Technical Change in Crops Sector

	Region						
Model	NAM	ANZ	EU	SEA	EA	ROW	Total
				$Millions			
GTAP Model	2,163.96	-1.57	3,813.12	1,105.99	6,475.43	11,341.53	24,898.47
GTAP-M Model, $\sigma = 0$[a]	2,091.23	-7.85	3,680.51	1,097.00	6,250.72	11,253.01	24,364.62
GTAP-M Model, $\sigma = 0.25$	2,135.40	4.60	3,645.31	1,092.47	6,244.93	11,232.99	24,355.70
GTAP-M Model, $\sigma = 0.50$	2,176.27	16.11	3,611.23	1,088.44	6,239.27	11,215.05	24,346.36

[a] Values of the elasticity of substitution between composite marketing service and commodity (*ESUBPR, ESUBGR, ESUBFR,* and *ESUBXR*). A value of zero implies the case of fixed domestic marketing margins.

Table 17 Impacts of Global Labor Augmenting Technical Change in Trade Services[a]

	GTAP Model						GTAP-M Model with Fixed Margins					
Variable/Region	NAM	ANZ	EU	SEA	EA	ROW	NAM	ANZ	EU	SEA	EA	ROW
Output (*qo*)						Percentage Change						
Crops	0.12	0.20	0.17	0.00	0.10	0.09	0.23	0.28	0.24	0.02	0.15	0.13
Livestock	0.10	0.19	0.15	0.05	0.19	0.10	0.20	0.29	0.22	0.08	0.25	0.13
Food	0.09	0.17	0.14	0.06	0.14	0.12	0.21	0.24	0.20	0.08	0.20	0.16
Manufacturing	0.15	0.20	0.16	0.23	0.16	0.20	0.29	0.27	0.26	0.26	0.24	0.24
Trade	0.74	0.70	0.76	0.38	0.68	0.48	0.47	0.51	0.48	0.23	0.45	0.27
Transport	0.15	0.25	0.23	0.18	0.23	0.23	0.21	0.29	0.28	0.20	0.25	0.25
Services	0.15	0.18	0.13	0.13	0.18	0.14	0.17	0.19	0.14	0.14	0.20	0.16
Market Prices (*pm*)												
Crops	0.01	0.02	-0.04	0.14	0.11	0.03	0.15	0.10	-0.01	0.20	0.17	0.08
Livestock	-0.06	-0.03	-0.09	0.06	0.07	0.00	0.02	0.02	-0.07	0.11	0.12	0.04
Food	-0.11	-0.13	-0.16	-0.07	-0.08	-0.13	-0.07	-0.10	-0.16	-0.04	-0.06	-0.11
Manufacturing	-0.11	-0.13	-0.14	-0.15	-0.12	-0.15	-0.09	-0.13	-0.14	-0.14	-0.11	-0.15
Trade	-1.03	-1.09	-1.13	-1.06	-1.04	-1.10	-1.03	-1.10	-1.15	-1.06	-1.04	-1.11
Transport	-0.08	-0.14	-0.12	-0.10	-0.09	-0.13	-0.08	-0.16	-0.14	-0.10	-0.10	-0.13
Services	-0.03	-0.08	-0.10	-0.08	-0.07	-0.11	-0.03	-0.10	-0.11	-0.08	-0.07	-0.11
Land	0.70	1.02	0.81	0.26	0.76	0.53	1.30	1.49	1.12	0.40	1.06	0.74
Demand Price for Domestic Commodity for Private Household[b]												
Crops	0.01	0.02	-0.04	0.14	0.11	0.03	-0.35	-0.29	-0.37	0.02	-0.11	-0.11
Livestock	-0.06	-0.03	-0.09	0.06	0.07	0.00	-0.25	-0.12	-0.40	-0.02	0.01	-0.11
Food	-0.11	-0.13	-0.16	-0.07	-0.08	-0.13	-0.42	-0.34	-0.38	-0.19	-0.31	-0.30
Manufacturing	-0.11	-0.13	-0.14	-0.15	-0.12	-0.15	-0.50	-0.60	-0.48	-0.30	-0.44	-0.37
Trade	-1.03	-1.09	-1.13	-1.06	-1.04	-1.10	-1.03	-1.10	-1.15	-1.06	-1.04	-1.11
Transport	-0.08	-0.14	-0.12	-0.10	-0.09	-0.13	-0.08	-0.16	-0.14	-0.10	-0.10	-0.13
Services	-0.03	-0.08	-0.10	-0.08	-0.07	-0.11	-0.03	-0.10	-0.11	-0.08	-0.07	-0.11

[a] Technical change results in 1% cost reduction in each region.

[b] Corresponds to the variable *ppd*(*i*,*r*) for the GTAP Model and *ppda(i,r)* for the GTAP-M Model.

Appendix A: Sectoral Concordance between I-O Margin Data and GTAP Sectors

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors

Sector Description	Industry Code	GTAP Sector(s)
Oilseed farming	1111A0	osd
Grain farming	1111B0	pdr, wht, gro
Vegetable and melon farming	111200	v_f
Tree nut farming	111335	v_f
Fruit farming	1113A0	v_f
Greenhouse and nursery production	111400	ocr
Tobacco farming	111910	ocr
Cotton farming	111920	pfb
Sugarcane and sugar beet farming	1119A0	c_b
All other crop farming	1119B0	ocr
Cattle ranching and farming	112100	ctl, rmk
Poultry and egg production	112300	oap
Animal production, except cattle and poultry and eggs	112A00	oap, wol
Logging	113300	for
Forest nurseries, forest products, and timber tracts	113A00	for
Fishing	114100	fsh
Hunting and trapping	114200	fsh
Agriculture and forestry support activities	115000	for
Oil and gas extraction	211000	oil, gas
Coal mining	212100	col
Iron ore mining	212210	omn
Copper, nickel, lead, and zinc mining	212230	omn
Gold, silver, and other metal ore mining	2122A0	omn
Stone mining and quarrying	212310	omn
Sand, gravel, clay, and refractory mining	212320	omn
Other nonmetallic mineral mining	212390	omn
Drilling oil and gas wells	213111	oil
Support activities for oil and gas operations	213112	oil
Support activities for other mining	21311A	omn
Power generation and supply	221100	ely
Natural gas distribution	221200	gdt
Water, sewage and other systems	221300	wtr
New residential 1-unit structures, nonfarm	230110	cns
New multifamily housing structures, nonfarm	230120	cns
New residential additions and alterations, nonfarm	230130	cns
New farm housing units and additions and alterations	230140	cns
Manufacturing and industrial buildings	230210	cns
Commercial and institutional buildings	230220	cns
Highway, street, bridge, and tunnel construction	230230	cns
Water, sewer, and pipeline construction	230240	cns
Other new construction	230250	cns
Maintenance and repair of farm and nonfarm residential structures	230310	cns
Maintenance and repair of nonresidential buildings	230320	cns
Maintenance and repair of highways, streets, bridges, and tunnels	230330	cns
Other maintenance and repair construction	230340	cns
Dog and cat food manufacturing	311111	ofd

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Other animal food manufacturing	311119	ofd
Flour milling	311211	ofd
Rice milling	311212	pcr
Malt manufacturing	311213	b_t
Wet corn milling	311221	ofd
Soybean processing	311222	vol
Other oilseed processing	311223	vol
Fats and oils refining and blending	311225	vol
Breakfast cereal manufacturing	311230	ofd
Sugar manufacturing	311310	sgr
Confectionery manufacturing from cacao beans	311320	ofd
Confectionery manufacturing from purchased chocolate	311330	ofd
Nonchocolate confectionery manufacturing	311340	ofd
Frozen food manufacturing	311410	ofd
Fruit and vegetable canning and drying	311420	ofd
Fluid milk manufacturing	311511	mil
Creamery butter manufacturing	311512	mil
Cheese manufacturing	311513	mil
Dry, condensed, and evaporated dairy products	311514	mil
Ice cream and frozen dessert manufacturing	311520	mil
Animal, except poultry, slaughtering	311611	cmt
Meat processed from carcasses	311612	cmt
Rendering and meat byproduct processing	311613	cmt
Poultry processing	311615	omt
Seafood product preparation and packaging	311700	ofd
Frozen cakes and other pastries manufacturing	311813	ofd
Bread and bakery product, except frozen, manufacturing	31181A	ofd
Cookie and cracker manufacturing	311821	ofd
Mixes and dough made from purchased flour	311822	ofd
Dry pasta manufacturing	311823	ofd
Tortilla manufacturing	311830	ofd
Roasted nuts and peanut butter manufacturing	311911	ofd
Other snack food manufacturing	311919	ofd
Coffee and tea manufacturing	311920	ofd
Flavoring syrup and concentrate manufacturing	311930	ofd
Mayonnaise, dressing, and sauce manufacturing	311941	ofd
Spice and extract manufacturing	311942	ofd
All other food manufacturing	311990	ofd
Soft drink and ice manufacturing	312110	b_t
Breweries	312120	b_t
Wineries	312130	b_t
Distilleries	312140	b_t
Tobacco stemming and redrying	312210	b_t
Cigarette manufacturing	312221	b_t
Other tobacco product manufacturing	312229	b_t
Fiber, yarn, and thread mills	313100	tex
Broadwoven fabric mills	313210	tex

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Narrow fabric mills and schiffli embroidery	313220	tex
Nonwoven fabric mills	313230	tex
Knit fabric mills	313240	tex
Textile and fabric finishing mills	313310	tex
Fabric coating mills	313320	tex
Carpet and rug mills	314110	tex
Curtain and linen mills	314120	tex
Textile bag and canvas mills	314910	tex
Tire cord and tire fabric mills	314992	tex
Other miscellaneous textile product mills	31499A	tex
Sheer hosiery mills	315111	wap
Other hosiery and sock mills	315119	wap
Other apparel knitting mills	315190	wap
Cut and sew apparel manufacturing	315200	wap
Accessories and other apparel manufacturing	315900	wap
Leather and hide tanning and finishing	316100	lea
Footwear manufacturing	316200	lea
Other leather product manufacturing	316900	lea
Sawmills	321113	lum
Wood preservation	321114	lum
Reconstituted wood product manufacturing	321219	lum
Veneer and plywood manufacturing	32121A	lum
Engineered wood member and truss manufacturing	32121B	lum
Wood windows and door manufacturing	321911	lum
Cut stock, resawing lumber, and planing	321912	lum
Other millwork, including flooring	321918	lum
Wood container and pallet manufacturing	321920	lum
Manufactured home, mobile home, manufacturing	321991	lum
Prefabricated wood building manufacturing	321992	lum
Miscellaneous wood product manufacturing	321999	lum
Pulp mills	322110	ppp
Paper and paperboard mills	3221A0	ppp
Paperboard container manufacturing	322210	ppp
Flexible packaging foil manufacturing	322225	ppp
Surface-coated paperboard manufacturing	322226	ppp
Coated and laminated paper and packaging materials	32222A	ppp
Coated and uncoated paper bag manufacturing	32222B	ppp
Die-cut paper office supplies manufacturing	322231	ppp
Envelope manufacturing	322232	ppp
Stationery and related product manufacturing	322233	ppp
Sanitary paper product manufacturing	322291	ppp
All other converted paper product manufacturing	322299	ppp
Manifold business forms printing	323116	ppp
Books printing	323117	ppp
Blankbook and looseleaf binder manufacturing	323118	ppp
Commercial printing	32311A	ppp
Tradebinding and related work	323121	ppp

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Prepress services	323122	ppp
Petroleum refineries	324110	p_c
Asphalt paving mixture and block manufacturing	324121	p_c
Asphalt shingle and coating materials manufacturing	324122	p_c
Petroleum lubricating oil and grease manufacturing	324191	p_c
All other petroleum and coal products manufacturing	324199	p_c
Petrochemical manufacturing	325110	p_c
Industrial gas manufacturing	325120	crp
Synthetic dye and pigment manufacturing	325130	crp
Other basic inorganic chemical manufacturing	325180	crp
Other basic organic chemical manufacturing	325190	crp
Plastics material and resin manufacturing	325211	crp
Synthetic rubber manufacturing	325212	crp
Cellulosic organic fiber manufacturing	325221	crp
Noncellulosic organic fiber manufacturing	325222	crp
Nitrogenous fertilizer manufacturing	325311	crp
Phosphatic fertilizer manufacturing	325312	crp
Fertilizer, mixing only, manufacturing	325314	crp
Pesticide and other agricultural chemical manufacturing	325320	crp
Pharmaceutical and medicine manufacturing	325400	crp
Paint and coating manufacturing	325510	crp
Adhesive manufacturing	325520	crp
Soap and other detergent manufacturing	325611	crp
Polish and other sanitation good manufacturing	325612	crp
Surface active agent manufacturing	325613	crp
Toilet preparation manufacturing	325620	crp
Printing ink manufacturing	325910	crp
Explosives manufacturing	325920	crp
Custom compounding of purchased resins	325991	crp
Photographic film and chemical manufacturing	325992	crp
Other miscellaneous chemical product manufacturing	325998	crp
Plastics packaging materials, film and sheet	326110	crp
Plastics pipe, fittings, and profile shapes	326120	crp
Laminated plastics plate, sheet, and shapes	326130	crp
Plastics bottle manufacturing	326160	crp
Resilient floor covering manufacturing	326192	crp
Plastics plumbing fixtures and all other plastics products	32619A	crp
Foam product manufacturing	3261A0	crp
Tire manufacturing	326210	crp
Rubber and plastics hose and belting manufacturing	326220	crp
Other rubber product manufacturing	326290	crp
Vitreous china plumbing fixture manufacturing	327111	nmm
Vitreous china and earthenware articles manufacturing	327112	nmm
Porcelain electrical supply manufacturing	327113	nmm
Brick and structural clay tile manufacturing	327121	nmm
Ceramic wall and floor tile manufacturing	327122	nmm
Nonclay refractory manufacturing	327125	nmm

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Clay refractory and other structural clay products	32712A	nmm
Glass container manufacturing	327213	nmm
Glass and glass products, except glass containers	32721A	nmm
Cement manufacturing	327310	nmm
Ready-mix concrete manufacturing	327320	nmm
Concrete block and brick manufacturing	327331	nmm
Concrete pipe manufacturing	327332	nmm
Other concrete product manufacturing	327390	nmm
Lime manufacturing	327410	nmm
Gypsum product manufacturing	327420	nmm
Abrasive product manufacturing	327910	nmm
Cut stone and stone product manufacturing	327991	nmm
Ground or treated minerals and earths manufacturing	327992	nmm
Mineral wool manufacturing	327993	nmm
Miscellaneous nonmetallic mineral products	327999	nmm
Iron and steel mills	331111	i_s
Ferroalloy and related product manufacturing	331112	i_s
Iron, steel pipe and tube from purchased steel	331210	i_s
Rolled steel shape manufacturing	331221	i_s
Steel wire drawing	331222	i_s
Alumina refining	331311	nfm
Primary aluminum production	331312	nfm
Secondary smelting and alloying of aluminum	331314	nfm
Aluminum sheet, plate, and foil manufacturing	331315	nfm
Aluminum extruded product manufacturing	331316	nfm
Other aluminum rolling and drawing	331319	nfm
Primary smelting and refining of copper	331411	nfm
Primary nonferrous metal, except copper and aluminum	331419	nfm
Copper rolling, drawing, and extruding	331421	nfm
Copper wire, except mechanical, drawing	331422	nfm
Secondary processing of copper	331423	nfm
Nonferrous metal, except copper and aluminum, shaping	331491	nfm
Secondary processing of other nonferrous	331492	nfm
Ferrous metal foundaries	331510	i_s
Aluminum foundries	33152A	nfm
Nonferrous foundries, except aluminum	33152B	nfm
Iron and steel forging	332111	fmp
Nonferrous forging	332112	fmp
Custom roll forming	332114	fmp
All other forging and stamping	33211A	fmp
Cutlery and flatware, except precious, manufacturing	332211	fmp
Hand and edge tool manufacturing	332212	fmp
Saw blade and handsaw manufacturing	332213	fmp
Kitchen utensil, pot, and pan manufacturing	332214	fmp
Prefabricated metal buildings and components	332311	fmp
Fabricated structural metal manufacturing	332312	fmp
Plate work manufacturing	332313	fmp

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Metal window and door manufacturing	332321	fmp
Sheet metal work manufacturing	332322	fmp
Ornamental and architectural metal work manufacturing	332323	fmp
Power boiler and heat exchanger manufacturing	332410	fmp
Metal tank, heavy gauge, manufacturing	332420	fmp
Metal can, box, and other container manufacturing	332430	fmp
Hardware manufacturing	332500	fmp
Spring and wire product manufacturing	332600	fmp
Machine shops	332710	fmp
Turned product and screw, nut, and bolt manufacturing	332720	fmp
Metal heat treating	332811	fmp
Metal coating and nonprecious engraving	332812	fmp
Electroplating, anodizing, and coloring metal	332813	fmp
Metal valve manufacturing	332910	fmp
Ball and roller bearing manufacturing	332991	fmp
Small arms manufacturing	332994	ome
Other ordnance and accessories manufacturing	332995	ome
Fabricated pipe and pipe fitting manufacturing	332996	fmp
Industrial pattern manufacturing	332997	fmp
Enameled iron and metal sanitary ware manufacturing	332998	fmp
Miscellaneous fabricated metal product manufacturing	332999	fmp
Ammunition manufacturing	33299A	ome
Farm machinery and equipment manufacturing	333111	ome
Lawn and garden equipment manufacturing	333112	ome
Construction machinery manufacturing	333120	ome
Mining machinery and equipment manufacturing	333131	ome
Oil and gas field machinery and equipment	333132	ome
Sawmill and woodworking machinery	333210	ome
Plastics and rubber industry machinery	333220	ome
Paper industry machinery manufacturing	333291	ome
Textile machinery manufacturing	333292	ome
Printing machinery and equipment manufacturing	333293	ome
Food product machinery manufacturing	333294	ome
Semiconductor machinery manufacturing	333295	ome
All other industrial machinery manufacturing	333298	ome
Office machinery manufacturing	333313	ele
Optical instrument and lens manufacturing	333314	ome
Photographic and photocopying equipment manufacturing	333315	ele
Other commercial and service industry machinery manufacturing	333319	ome
Automatic vending, commercial laundry and drycleaning machinery	33331A	ome
Air purification equipment manufacturing	333411	ome
Industrial and commercial fan and blower manufacturing	333412	ome
Heating equipment, except warm air furnaces	333414	ome
AC, refrigeration, and forced air heating	333415	ome
Industrial mold manufacturing	333511	ome
Metal cutting machine tool manufacturing	333512	ome

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Metal forming machine tool manufacturing	333513	ome
Special tool, die, jig, and fixture manufacturing	333514	ome
Cutting tool and machine tool accessory manufacturing	333515	ome
Rolling mill and other metalworking machinery	33351A	ome
Turbine and turbine generator set units manufacturing	333611	ome
Other engine equipment manufacturing	333618	ome
Speed changers and mechanical power transmission equipment	33361A	ome
Pump and pumping equipment manufacturing	333911	ome
Air and gas compressor manufacturing	333912	ome
Measuring and dispensing pump manufacturing	333913	ome
Elevator and moving stairway manufacturing	333921	ome
Conveyor and conveying equipment manufacturing	333922	ome
Overhead cranes, hoists, and monorail systems	333923	ome
Industrial truck, trailer, and stacker manufacturing	333924	ome
Power-driven handtool manufacturing	333991	ome
Welding and soldering equipment manufacturing	333992	ome
Packaging machinery manufacturing	333993	ome
Industrial process furnace and oven manufacturing	333994	ome
Fluid power cylinder and actuator manufacturing	333995	ome
Fluid power pump and motor manufacturing	333996	ome
Scales, balances, and miscellaneous general purpose machinery	33399A	ome
Electronic computer manufacturing	334111	ele
Computer storage device manufacturing	334112	ele
Computer terminal manufacturing	334113	ele
Other computer peripheral equipment manufacturing	334119	ele
Telephone apparatus manufacturing	334210	ele
Broadcast and wireless communications equipment	334220	ele
Other communications equipment manufacturing	334290	ele
Audio and video equipment manufacturing	334300	ele
Electron tube manufacturing	334411	ele
Semiconductors and related device manufacturing	334413	ele
All other electronic component manufacturing	33441A	ele
Electromedical apparatus manufacturing	334510	ome
Search, detection, and navigation instruments	334511	ome
Automatic environmental control manufacturing	334512	ome
Industrial process variable instruments	334513	ome
Totalizing fluid meters and counting devices	334514	ome
Electricity and signal testing instruments	334515	ome
Analytical laboratory instrument manufacturing	334516	ome
Irradiation apparatus manufacturing	334517	ome
Watch, clock, and other measuring and controlling device manufacturing	33451A	ome
Software reproducing	334611	ppp
Audio and video media reproduction	334612	ele
Magnetic and optical recording media manufacturing	334613	ele
Electric lamp bulb and part manufacturing	335110	ome
Lighting fixture manufacturing	335120	ome

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Electric housewares and household fan manufacturing	335211	ome
Household vacuum cleaner manufacturing	335212	ome
Household cooking appliance manufacturing	335221	ome
Household refrigerator and home freezer manufacturing	335222	ome
Household laundry equipment manufacturing	335224	ome
Other major household appliance manufacturing	335228	ome
Electric power and specialty transformer manufacturing	335311	ome
Motor and generator manufacturing	335312	ome
Switchgear and switchboard apparatus manufacturing	335313	ome
Relay and industrial control manufacturing	335314	ome
Storage battery manufacturing	335911	ome
Primary battery manufacturing	335912	ome
Fiber optic cable manufacturing	335921	ome
Other communication and energy wire manufacturing	335929	ome
Wiring device manufacturing	335930	ome
Carbon and graphite product manufacturing	335991	ome
Miscellaneous electrical equipment manufacturing	335999	ome
Automobile and light truck manufacturing	336110	mvh
Heavy duty truck manufacturing	336120	mvh
Motor vehicle body manufacturing	336211	mvh
Truck trailer manufacturing	336212	mvh
Motor home manufacturing	336213	mvh
Travel trailer and camper manufacturing	336214	mvh
Motor vehicle parts manufacturing	336300	mvh
Aircraft manufacturing	336411	otn
Aircraft engine and engine parts manufacturing	336412	otn
Other aircraft parts and equipment	336413	otn
Guided missile and space vehicle manufacturing	336414	otn
Propulsion units and parts for space vehicles and guided missiles	33641A	otn
Railroad rolling stock manufacturing	336500	otn
Ship building and repairing	336611	otn
Boat building	336612	otn
Motorcycle, bicycle, and parts manufacturing	336991	otn
Military armored vehicles and tank parts manufacturing	336992	ome
All other transportation equipment manufacturing	336999	otn
Wood kitchen cabinet and countertop manufacturing	337110	omf
Upholstered household furniture manufacturing	337121	omf
Nonupholstered wood household furniture manufacturing	337122	omf
Metal household furniture manufacturing	337124	omf
Institutional furniture manufacturing	337127	omf
Other household and institutional furniture	33712A	omf
Wood office furniture manufacturing	337211	omf
Custom architectural woodwork and millwork	337212	omf
Office furniture, except wood, manufacturing	337214	omf
Showcases, partitions, shelving, and lockers	337215	omf
Mattress manufacturing	337910	omf
Blind and shade manufacturing	337920	omf

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Laboratory apparatus and furniture manufacturing	339111	ome
Surgical and medical instrument manufacturing	339112	ome
Surgical appliance and supplies manufacturing	339113	ome
Dental equipment and supplies manufacturing	339114	ome
Ophthalmic goods manufacturing	339115	ome
Dental laboratories	339116	ome
Jewelry and silverware manufacturing	339910	omf
Sporting and athletic goods manufacturing	339920	omf
Doll, toy, and game manufacturing	339930	omf
Office supplies, except paper, manufacturing	339940	omf
Sign manufacturing	339950	omf
Gasket, packing, and sealing device manufacturing	339991	omf
Musical instrument manufacturing	339992	omf
Broom, brush, and mop manufacturing	339994	omf
Burial casket manufacturing	339995	omf
Buttons, pins, and all other miscellaneous manufacturing	33999A	omf
Wholesale trade	420000	trd
Air transportation	481000	atp
Rail transportation	482000	otp
Water transportation	483000	wtp
Truck transportation	484000	otp
Transit and ground passenger transportation	485000	otp
Pipeline transportation	486000	otp
Scenic and sightseeing transportation and support activities for transportation	48A000	otp
Postal service	491000	cmn
Couriers and messengers	492000	cmn
Warehousing and storage	493000	otp
Retail trade	4A0000	trd
Newspaper publishers	511110	ppp
Periodical publishers	511120	ppp
Book publishers	511130	ppp
Database, directory, and other publishers	5111A0	ppp
Software publishers	511200	obs
Motion picture and video industries	512100	ros
Sound recording industries	512200	ros
Radio and television broadcasting	513100	ros
Cable networks and program distribution	513200	ros
Telecommunications	513300	cmn
Information services	514100	obs
Data processing services	514200	obs
Nondepository credit intermediation and related activities	522A00	ofi
Securities, commodity contracts, investments	523000	ofi
Insurance carriers	524100	isr
Insurance agencies, brokerages, and related	524200	isr
Funds, trusts, and other financial vehicles	525000	ofi
Monetary authorities and depository credit intermediation	52A000	ofi

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Real estate	531000	obs
Automotive equipment rental and leasing	532100	obs
Video tape and disc rental	532230	obs
Machinery and equipment rental and leasing	532400	obs
General and consumer goods rental except video tapes and discs	532A00	obs
Lessors of nonfinancial intangible assets	533000	obs
Legal services	541100	obs
Accounting and bookkeeping services	541200	obs
Architectural and engineering services	541300	obs
Specialized design services	541400	obs
Custom computer programming services	541511	obs
Computer systems design services	541512	obs
Other computer related services, including facilities management	54151A	obs
Management consulting services	541610	obs
Environmental and other technical consulting services	5416A0	obs
Scientific research and development services	541700	obs
Advertising and related services	541800	obs
Photographic services	541920	obs
Veterinary services	541940	osg
All other miscellaneous professional and technical services	5419A0	obs
Management of companies and enterprises	550000	obs
Office administrative services	561100	obs
Facilities support services	561200	obs
Employment services	561300	obs
Business support services	561400	obs
Travel arrangement and reservation services	561500	otp
Investigation and security services	561600	obs
Services to buildings and dwellings	561700	obs
Other support services	561900	obs
Waste management and remediation services	562000	osg
Elementary and secondary schools	611100	osg
Colleges, universities, and junior colleges	611A00	osg
Other educational services	611B00	osg
Home health care services	621600	osg
Offices of physicians, dentists, and other health practioners	621A00	osg
Other ambulatory health care services	621B00	osg
Hospitals	622000	osg
Nursing and residential care facilities	623000	osg
Child day care services	624400	osg
Social assistance, except child day care services	624A00	osg
Performing arts companies	711100	ros
Spectator sports	711200	ros
Independent artists, writers, and performers	711500	ros
Promoters of performing arts and sports and agents for public figures	711A00	ros
Museums, historical sites, zoos, and parks	712000	ros
Fitness and recreational sports centers	713940	ros

continued

Appendix Table A.1 Concordance between US I-O Sectors and GTAP Sectors (Continued)

Sector Description	Industry Code	GTAP Sector(s)
Bowling centers	713950	ros
Other amusement, gambling, and recreation industries	713A00	ros
Hotels and motels, including casino hotels	7211A0	trd
Other accommodations	721A00	trd
Food services and drinking places	722000	trd
Car washes	811192	obs
Automotive repair and maintenance, except car washes	8111A0	trd
Electronic equipment repair and maintenance	811200	obs
Commercial machinery repair and maintenance	811300	obs
Household goods repair and maintenance	811400	trd
Personal care services	812100	ros
Death care services	812200	ros
Drycleaning and laundry services	812300	ros
Other personal services	812900	ros
Religious organizations	813100	osg
Grantmaking and giving and social advocacy organizations	813A00	osg
Civic, social, professional and similar organizations	813B00	osg
Private households	814000	osg

Appendix Table A.2 Concordance between Australian I-O Sectors and GTAP Sectors

Sector Description	IO Code	GTAP Sector(s)
Sheep	0101	oap, wol
Grains	0102	pdr, wht, gro, osd
Beef cattle	0103	ctl
Dairy cattle	0104	rmk, ctl
Pigs	0105	oap
Poultry	0106	oap
Other agriculture	0107	v_f, c_b, pfb, ocr
Services to agriculture; hunting and trapping	0200	pfb, wol, ocr, oap
Forestry and logging	0300	for
Commercial fishing	0400	fsh
Coal;oil and gas	1100	col, oil, gas
Iron ores	1301	omn
Non-ferrous metal ores	1302	omn
Other mining	1400	omn
Services to mining	1500	omn, oil
Meat and meat products	2101	cmt
Dairy products	2102	mil
Fruit and vegetable products	2103	ofd
Oils and fats	2104	vol
Flour mill products and cereal foods	2105	ofd, pcr
Bakery products	2106	ofd
Confectionery	2107	ofd
Other food products	2108	ofd, sgr
Soft drinks, cordials and syrups	2109	b_t
Beer and malt	2110	b_t
Wine and spirits	2111	b_t
Tobacco products	2112	b_t
Textile fibres, yarns and woven fabrics	2201	tex
Textile products	2202	tex
Knitting mill products	2203	tex
Clothing	2204	wap
Footwear	2205	lea
Leather and leather products	2206	lea
Sawmill products	2301	lum
Other wood products	2302	lum
Pulp, paper and paperboard	2303	ppp
Paper containers and products	2304	ppp
Printing and services to printing	2401	ppp
Publishing;recorded media and publishing	2402	ppp
Petroleum and coal products	2501	p_c
Basic chemicals	2502	crp
Paints	2503	crp
Medicinal and pharmaceutical products, pesticides	2504	crp
Soap and detergents	2505	crp
Cosmetics and toiletry preparations	2506	crp
Other chemical products	2507	crp

continued

Appendix Table A.2 Concordance between Australian I-O Sectors and GTAP Sectors (Continued)

Sector Description	IO Code	GTAP Sector(s)
Rubber products	2508	crp
Plastic products	2509	crp
Glass and glass products	2601	nmm
Ceramic products	2602	nmm
Cement, lime and concrete slurry	2603	nmm
Plaster and other concrete products	2604	nmm
Other non-metallic mineral products	2605	nmm
Iron and steel	2701	i_s
Basic non-ferrous metal and products	2702	nfm
Structural metal products	2703	fmp
Sheet metal products	2704	fmp
Fabricated metal products	2705	fmp
Motor vehicles and parts;other transport equipment	2801	mvh
Ships and boats	2802	otn
Railway equipment	2803	otn
Aircraft	2804	otn
Photographic and scientific equipment	2805	ele
Electronic equipment	2806	ele
Household appliances	2807	ome
Other electrical equipment	2808	ome
Agricultural, mining and c	2809	ome
Other machinery and equipment	2810	ome
Prefabricated buildings	2901	omf
Furniture	2902	omf
Other manufacturing	2903	omf
Electricity supply	3601	ely
Gas supply	3602	gdt
Water supply;sewerage and drainage services	3701	wtr
Residential building	4101	cns
Other construction	4102	cns
Wholesale trade	4501	trd
Retail trade	5101	trd
Mechanical repairs	5401	trd
Other repairs	5402	trd
Accommodation, cafes and restaurants	5701	trd
Road transport	6101	otp
Rail, pipeline and other transport	6201	otp
Water transport	6301	wtp
Air and space transport	6401	atp
Services to transport;storage	6601	otp
Communication services	7101	cmn
Banking	7301	ofi
Non-bank finance	7302	ofi
Insurance	7401	isr
Services to finance, investment and insurance	7501	ofi, isr
Ownership of dwellings	7701	obs

continued

Appendix Table A.2 Concordance between Australian I-O Sectors and GTAP Sectors (Continued)

Sector Description	IO Code	GTAP Sector(s)
Other property services	7702	obs
Scientific research, technical and computer services	7801	obs
Legal, accounting, marketing and business management services	7802	obs
Other business services	7803	obs
Government administration	8101	osg
Defence	8201	osg
Education	8401	osg
Health services	8601	osg
Community services	8701	osg
Motion picture, radio and television services	9101	ros
Libraries, museums and the arts	9201	ros
Sport, gambling and recreational services	9301	ros
Personal services	9501	ros
Other services	9601	osg

Appendix Table A.3 Concordance between Japanese I-O Sectors and GTAP Sectors

Sector Description	Sector No.	GTAP Sector(s)
Crop cultivation	1	pdr, wht, gro, v_f, c_b, osd, pfb, ocr
Livestock	2	ctl, oap, rmk, wol
Agricultural services	3	osg
Forestry	4	for
Fisheries	5	fsh
Metallic ores	6	omn
Non-metallic ores	7	omn
Coal mining	8	col
Crude petroleum and natural gas	9	oil
Foods	10	cmt, omt, vol, mil, pcr, sgr, ofd
Beverage	11	b_t
Feeds and organic fertilizer, n.e.c.	12	cmt
Tobacco	13	b_t
Textile products	14	tex
Wearing apparel and other textile products	15	wap
Timber and wooden products	16	lum
Furniture and fixtures	17	omf
Pulp, paper, paperboard, building paper	18	ppp
Paper products	19	ppp
Publishing, printing	20	ppp
Chemical fertilizer	21	crp
Basic inorganic chemical products	22	crp
Basic organic chemical products	23	crp
Organic chemical products	24	crp
Synthetic resins	25	crp
Synthetic fibers	26	tex
Medicaments	27	crp
Final chemical products, n.e.c.	28	crp
Petroleum refinery products	29	p_c
Coal products	30	p_c
Plastic products	31	crp
Rubber products	32	crp
Leather, fur skins and miscellaneous leather products	33	lea
Glass and glass products	34	nmm
Cement and cement products	35	nmm
Pottery, china and earthenware	36	nmm
Other ceramic, stone and clay products	37	nmm
Pig iron and crude steel	38	i_s
Steel products	39	i_s
Cast and forged steel products	40	i_s
Other iron or steel products	41	i_s
Non-ferrous metals	42	nfm
Non-ferrous metal products	43	nfm
Metal products for construction and architecture	44	fmp
Other metal products	45	fmp

continued

Appendix Table A.3 Concordance between Japanese I-O Sectors and GTAP Sectors (Continued)

Sector Description	Sector No.	GTAP Sector(s)
General industrial machinery	46	ome
Special industrial machinery	47	ome
Other general machines	48	ome
Machinery for office and service industry	49	ele
Household electronic and electric appliances	50	ele
Electronic computing equipment and accessory equipment	51	ele
Communication equipment	52	ele
Applied electronic equipment and electric measuring instruments	53	ome
Semiconductor devices and integrated circuits	54	ele
Electronic components	55	ele
Heavy electrical equipment	56	ome
Other electrical equipment	57	ome
Passenger motor cars	58	mvh
Other cars	59	mvh
Ships and repair of ships	60	otn
Other transportation equipment and repair of transportation equipment	61	otn
Precision instruments	62	ome
Miscellaneous manufacturing products	63	omf
Reuse and recycling	64	osg
Building construction	65	cns
Repair of construction	66	cns
Public construction	67	cns
Other civil engineering and construction	68	cns
Electricity	69	ely
Gas and heat supply	70	gdt
Water supply	71	wtr
Waste management service	72	osg
Commerce	73	trd
Financial and insurance	74	ofi
Real estate agencies and rental services	75	obs
House rent	76	dwe
House rent (imputed house rent)	77	dwe
Railway transport	78	Otp
Road transport (except transport by private cars)	79	Otp
Self-transport by private cars	80	Otp
Water transport	81	wtp
Air transport	82	atp
Freight forwarding	83	otp
Storage facility service	84	otp
Services relating to transport	85	otp
Communication	86	cmn
Broadcasting	87	cmn
Public administration	88	osg
Education	89	osg
Research	90	obs

continued

Appendix Table A.3 Concordance between Japanese I-O Sectors and GTAP Sectors (Continued)

Sector Description	Sector No.	GTAP Sector(s)
Medical service and health	91	osg
Social security	92	osg
Nursing care	93	osg
Other public services	94	osg
Advertising, survey and information services	95	obs
Goods rental and leasing services	96	obs
Repair of motor vehicles and machine	97	trd
Other business services	98	obs
Amusement and recreational services	99	ros
Eating and drinking places	100	trd
Hotel and other lodging places	101	trd
Other personal services	102	ros
Office supplies	103	obs
Activities not elsewhere classified	104	obs

Appendix Table A.4 Concordance between Eurostat I-O Sectors and GTAP Sectors

Sector Description	ISIC Code	GTAP Sector(s)
		pdr, wht, gro, v_f, c_b, osd, pfb, ocr, ctl, oap,
Products of agriculture, hunting and related services	01	rmk, wol
Products of forestry, logging and related services	02	for
Fish and other fishing products; services incidental of fishing	05	fsh
Coal and lignite; peat	10	col
Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	11	oil,gas
Uranium and thorium ores	12	omn
Metal ores	13	omn
Other mining and quarrying products	14	omn
		cmt, omt, vol, mil, pcr,
Food products and beverages	15	sgr, ofd
Tobacco products	16	b_t
Textiles	17	tex
Wearing apparel; furs	18	wap
Leather and leather products	19	lea
Wood and products of wood and cork (except furniture); articles of straw and plaiting materials	20	lum
Pulp, paper and paper products	21	ppp
Printed matter and recorded media	22	ppp
Coke, refined petroleum products and nuclear fuels	23	p_c
Chemicals, chemical products and man-made fibres	24	crp
Rubber and plastic products	25	crp
Other non-metallic mineral products	26	nmm
Basic metals	27	i_s, nfm
Fabricated metal products, except machinery and equipment	28	fmp
Machinery and equipment n.e.c.	29	ome
Office machinery and computers	30	ele
Electrical machinery and apparatus n.e.c.	31	ome
Radio, television and communication equipment and apparatus	32	ele
Medical, precision and optical instruments, watches and clocks	33	ome
Motor vehicles, trailers and semi-trailers	34	mvh
Other transport equipment	35	otn
Furniture; other manufactured goods n.e.c.	36	omf
Secondary raw materials	37	omf
Electrical energy, gas, steam and hot water	40	ely, gdt
Collected and purified water, distribution services of water	41	wtr
Construction work	45	cns
Trade, maintenance and repair services of motor vehicles and motorcycles; retail sale of automotive fuel	50	trd
Wholesale trade and commission trade services, except of motor vehicles and motorcycles	51	trd
Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods	52	trd
Hotel and restaurant services	55	trd

continued

Appendix Table A.4 Concordance between Eurostat I-O Sectors and GTAP Sectors (Continued)

Sector Description	ISIC Code	GTAP Sector(s)
Land transport; transport via pipeline services	60	otp
Water transport services	61	wtp
Air transport services	62	atp
Supporting and auxiliary transport services; travel agency services	63	otp
Post and telecommunication services	64	cmn
Financial intermediation services, except insurance and pension funding services	65	ofi
Insurance and pension funding services, except compulsory social security services	66	isr
Services auxiliary to financial intermediation	67	ofi
Real estate services	70	obs
Renting services of machinery and equipment without operator and of personal and household goods	71	obs
Computer and related services	72	obs
Research and development services	73	obs
Other business services	74	obs
Public administration and defence services; compulsory social security services	75	osg
Education services	80	osg
Health and social work services	85	osg
Sewage and refuse disposal services, sanitation and similar services	90	osg
Membership organisation services n.e.c.	91	osg
Recreational, cultural and sporting services	92	ros
Other services	93	ros
Private households with employed persons	95	ros

Appendix Table A.5 Reference Years for I-O Margin Data

Country	Reference Year
Australia	1996/97
Austria	2000
Belgium	1999
Denmark	2000
Estonia	1997
Germany	2000
Greece	1999
Finland	2000
France	2000
Hungary	2000
Italy	2000
Japan	2000
Malta	2000
Netherlands	2001
Poland	1999
Portugal	1999
Slovenia	1996
Slovak Republic	2000
Spain	1998
Sweden	2001
United Kingdom	2000
United States	1997

Appendix B: Description of Accompanying Files to Replicate GTAP-M Results

All of the files necessary to run the GTAP-M Model using the RunGTAP5 software are included in a WINZIP file. The user will need to create a new folder accessible by RunGTAP5 and unzip all of the files into that folder. Once this is accomplished, the following changes must be made for the modules utilized by RunGTAP. By selecting Version|Modules, the user must replace the standard GTAP main model with the GTAPM main model (files will be located in the folder just created). In addition, replace GTPVEW GTAPView module with GTPVEWM, replace DECOMP welfare decomposition module with DECOMPM, and replace PEELAS partial equilibrium elasticity module with PEELASM. Note, the GE elasticities and GTAPVol modules should be turned off.

The data, sets, and parameter files for the standard GTAP Model are also included. These files are named frisvold_data.har, frisvold_sets.har, and frisvold.prm.