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Integrating U.S. Input-Output Tables with SNA: Valuations and Extensions

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Abstract

The 1993 System of National Accounts (SNA93) is a standard for the compilation of a coherent, consistent and integrated set of economic accounts based on internationally agreed concepts and rules. SNA93 recommends that the input-output (I-O) tables be an integral part of a national accounting system. Furthermore, the SNA serves as a coordinating framework for economic statistics, both conceptually for ensuring the consistency of the definitions and classifications used, and as an accounting framework for ensuring the numerical consistency of data drawn from different sources. The recommended I-O framework includes changes in format and valuation with respect to the 1968 System of National Accounts (SNA68). For the supply and use tables, and the symmetric I-O tables, one of the main recommendations is the use of basic prices as the measure of gross output and for the valuation of transactions. The U.S. I-O tables currently produced by BEA consist of make and use tables valued at producers' prices, and a set of direct and total requirements tables following the recommendations of the SNA68. A recent study by BEA explored the feasibility of adopting the SNA93 standard into the U.S. I-O tables. This paper continues that research. Specifically, it explains the conversion of the U.S. I-O tables to the recommended SNA93 format, providing procedures for deriving tables in different valuations and the preparation of the symmetric input-output tables and U.S. total requirements tables. It compares basic value total requirements with producers' prices total requirement tables and raises some potential problems when using basic price tables for economic analysis.

Introduction

The System of National Accounts (SNA93), developed by the international community in response to increasing complexity and integration of world's economies, provides a more harmonized and integrated standard for compiling national accounts than did the previous version (SNA68). BEA has supported the goal of the international harmonization of its national accounts and has improved its national income and product accounts (NIPAs) and its other components by incorporating the major SNA guidelines¹.

The SNA93 recommends that the input-output (I-O) tables be an integral part of the national accounting system. It provides a coordinated framework within which the basic source data collected by statistical agencies can be presented in a consistent manner. However, the current U.S. Input-Output tables produced at BEA, which adopted the *make* and *use* format for its 1972 U.S. benchmark I-O tables, has not adopted the changes proposed by SNA93.

¹ For a detailed discussion of BEA's efforts in incorporating NIPAs to SNA93, see Charles Ian Mead, Karin E. Moses, and Brent R. Moulton "The NIPAs and the System of National Accounts," Survey of Current Business 84 (December 2004): 17-32.

Over the past several years, BEA has made many significant improvements to the U.S. I-O tables. These improvements include integrating the I-O accounts with the Gross Domestic Products by industry accounts, accelerating the production of the annual I-O accounts to within one year of the reference year, the development of statistical techniques for the reconciliation of industry income data with I-O accounts value added estimates, and working with the U.S. Bureau of the Census to make significant improvements in source data. This paper explores further improvements to the U.S. I-O accounts that incorporate recommendations from SNA93.

In previous research the authors explored the feasibility of presenting U.S. I-O tables consistent with the SNA93 guidelines². In that research the U.S. I-O tables were presented following the SNA93 I-O framework.³ The authors proposed a new set of U.S. I-O accounts following the SNA93 guidelines with some modifications to preserve consistency with the overall system of U.S. accounts maintained by BEA. The research reached the following conclusions: the SNA93 format enables international comparability of the U.S. I-O accounts; it enhances the usability of source data used to compile the U.S. I-O accounts; it produces more accurate measures of industry contributions to production by using basic price value added and output, and it improves the presentation of data by focusing on supply.

This paper continues the investigation and comparison of the currently published U.S. I-O tables with the proposed SNA93 formatted I-O tables. The first section provides an overview of the current U.S. I-O accounts make and use tables and the conversion to the SNA93 format supply and use tables. The second section discusses the preparation of the analytical or total requirements tables. This section includes steps required to convert the use table from purchasers' prices to basic prices and the U.S. treatment of secondary products as well as the preparation of the total requirements tables and the symmetric input-output tables. The third section compares the currently published total requirements tables with those derived following the SNA93 guidelines. The final section provides a summary and conclusions.

I. Proposed U.S. SNA93 input-output framework

The current U.S. I-O accounts are presented as a make and use table. Conversion of the U.S. I-O accounts to the SNA93 framework replaces the make table with a supply table and modifies the use table. The supply table shows the value and origination of commodities at basic prices produced by industries and imported. It also shows the conversion of supply at basic prices to supply at purchasers' prices (see the appendix A for definitions).

The proposed SNA93 framework for the I-O accounts has several advantages:

- Production is valued at prices relevant to the producer, basic prices,

² See Jiemin Guo, Mark A. Planting, Mikael Mortensen, and Yvon Pho "Integrating U.S. Input-Output Tables with SNA93: An Assessment Study", presented at the 15th International Conference on Input-Output Techniques, Beijing, China, June 27-July 1, 2005.

³ George M. Smith, Matthew J. Gruenberg, Tameka R.L. Harris, and Erich H. Strassner, "Annual Industry Accounts: Revised Estimates for 2000–2003," Survey of Current Business 85 (January 2005): 9–43.

- Expenditures are valued at prices relevant to the user, purchasers' prices,⁴
- The sources of supply for goods and services used by the economy are presented more clearly than in the SNA68 framework, and
- The wedge between what producers receive and what users pay (commodity taxes, transportation costs and trade margins) is clearly shown.

The Supply Table

The valuation measure employed in the supply - use framework is important. According to the SNA, basic prices are preferred over producers' prices to measure industry output. Basic prices represent the prices relevant to the producer and are the prices relevant for the analysis of producer behavior. Consequently, artificial value adjustments resulting from external influences, such as government trade policy or tax policy, are not embedded in the basic price. For this reason, basic prices are the recommended valuation measure by the SNA.

The supply table provides a clear view of the sources of goods and services used by the economy and their relevant value to producers and users. It shows production in basic prices, it emphasizes the total supply from domestic and foreign sources and it shows the wedge between prices received by producers and the prices paid by users (commodity taxes, transportation charges and trade margins).

The supply table is significantly different from the current U.S. make table (see tables 1 and 2). First, the orientation of industries and commodities in the table is changed. In the make table industries are oriented along the row and commodities down the column. In the supply table this relationship is transposed with commodities across the rows and industries down the columns. This modification provides a layout for the supply table that is similar to that of the use table.

Second, additional rows and columns are added to account for supply from imports and adjustments to the valuation of supply. The make table only provides information on the production of commodities by industries. The supply table includes these same data on industry production of commodities, but adds columns to account for imports. Additionally, columns are added to show the taxes on production and imports, subsidies, transportation costs and margins on commodities, all which are used to derive supply at purchasers' prices. Finally, two rows are added: 1) customs value including freight (c.i.f.) / free on board (f.o.b.) adjustment on imports, and 2) direct purchases abroad by residents.

Third, the valuation of production and imports are valued in basic prices. The current make table is valued in producers' prices and imports in the use table are valued at domestic port value, which is equivalent to producers' prices. Producers' prices include taxes on production and exclude subsidies. Domestic port value of imports includes duty, a tax on imports.

Table 2 shows a summary version of the proposed supply table using data from the 2003 annual I-O accounts. Columns 1-4, the production portion of the table, are similar to the published

⁴ Dale W. Jorgenson and J. Steven Landefeld, "Blueprint for Expanded and Integrated U.S. Accounts, Assessment, and Next Steps," Conference on Research in Income and Wealth, New Architecture for the U.S. National Accounts, Washington, D.C. April 16-17, 2004: page 15.

make table, except the rows and columns are transposed and the cells are valued at basic prices instead of producers' prices. Imports are shown in columns 5 and 6. The row entries for column 5 show imports valued at c.i.f. value (foreign port value plus transportation and insurance), a value equivalent to domestic basic prices. The import values do not include duty; duty is a tax and included in column 11. Because imported goods include the freight charges and insurance on imports by commodity, and services imports also include these charges, an offsetting adjustment is necessary to the imports of freight and insurance to avoid double counting of these imports. To make this adjustment, the transportation costs and insurance included in the c.i.f. value of goods are summed by type (water, air, and insurance) and included as a row in column 5 (c.i.f./f.o.b. adjustment). The result removes double counting of freight charges included in the domestic port value of goods and in the imported value for freight charges. When the adjustment is added to the imports at c.i.f. value, the result is a total of imports at free on board (f.o.b.) prices which is foreign port value. Column 6, the c.i.f./f.o.b. adjustment distributes the adjustment to the transportation commodities canceling out the double counting of imports of transportation services.

Columns 8 and 9 show transportation costs and trade margins on commodities. Here, transportation costs and margins do not include taxes as they do in the published accounts; they are at basic prices. All taxes, including wholesale and retail sales taxes are included in the tax column. The addition of transportation costs and margins to commodities requires an offset in the respective transportation or margin row to reflect the shift to purchasers' prices. Columns 11 through 13 account for taxes and subsidies. Taxes by commodity include the tax on the good or service as well as any wholesale or retail taxes on the sale. Column 15 is the total supply of commodities at purchasers' prices.

The proposed supply includes a row not included in the make table: direct purchases abroad by residents. This value was previously included in noncomparable imports in the use table.⁵ The proposed supply table for the U.S. differs slightly from the SNA93 proposed framework by adding an additional row for the remaining noncomparable imports.

⁵ Noncomparable imports consist of three types of services: (1) Services that are produced and consumed abroad, such as airport expenditures by U.S. airlines in foreign countries; (2) services imports that are unique, such as payments for the rights to patents, copyrights, or industrial processes; and (3) services imports that cannot be identified by type, such as payments by U.S. companies to their foreign affiliates for an undefined "basket" of services. In preparing the I-O accounts, these imports are distributed directly to industries and to final users.



Table 1.—Published 2003 Annual Make Table Before Redefinitions for the U.S.
(Billions of dollars)

		Commodities			Total industry output
		Goods	Services and other	Trade and transport	
		(1)	(2)	(3)	(4) = (1)+(2)+(3)
Industries	Goods	5,350	28	38	5,416
	Services and other	111	11,487	70	11,668
	Trade and transport	25	174	2,449	2,648
Total commodity output		5,486	11,689	2,558	19,732

Table 2.—Proposed 2003 Supply Table Before Redefinitions for the U.S.
 (Billions of dollars)

		Output of industries at basic prices			Total commodity output at basic prices	Imports		Total product supply at basic prices	Trade margins and transport costs			Taxes less subsidies on products				Total product supply at purchasers' prices
		Goods	Services and other	Trade and transport		Imports c.i.f. (total f.o.b.)	c.i.f./f.o.b. adjustment		Trade margins	Transport costs	Total trade margins and transport costs	Import duties	Tax on products	Subsidies	Total taxes less subsidies on products	
Commodities	Goods	5,347	111	25	5,483	1,215		6,698	1,530	248	1,778	21	256	14	263	8,740
	Services and other	28	11,414	169	11,611	47	0	11,657	55	4	58	0	111	29	82	11,798
	Trade and transport	38	67	2,187	2,292	52	-40	2,305	-1,585	-252	-1,837	0	4	4	0	468
	c.i.f./f.o.b. adjustment						-40	40	0							
	Noncomparable imports					65		65								65
	Direct purchases abroad by residents						105	105								105
Total supply at basic prices		5,414	11,592	2,381	19,387	1,443	0		0	0	0	21	370	47	345	21,175

Note: Values may not add due to rounding.

The Use Table

The proposed SNA 93 use table has several advantages over the currently published use table. First it presents value added at basic prices, the prices received by producers, which is the valuation relevant for modeling producer behavior. Second, it shows the value of goods and services used at purchasers' prices, the valuation relevant to industries, consumers, investors, and government.

The format of the proposed use table is similar to the current U.S. use table (see tables 3 and 4). It shows the use of commodities by industries and final uses. Though the format of the two use tables is similar, there are several significant differences. First, the values in the proposed use table are valued at purchasers' prices, the current use table values transactions in producers' prices. Valuation in purchasers' prices shows inputs to industries and final uses at values that are seen by the user of the good or service; the costs of moving the good to the user as well as the costs of marketing are included in the price. The current use table, valued in producers' prices, show inputs in values the user rarely sees. The current use table shows separate commodity inputs for the good purchased, the costs of transportation, and the costs of marketing.

Second, as with the supply table, direct purchases abroad by residents are separated from the noncomparable imports row. Direct purchases abroad include travel by U.S. residents abroad, port expenditures, education expenditures abroad by students, direct defense expenditures, expenditures by non-government U.S. residents abroad, and other miscellaneous services purchased abroad.

Third, the value added section of the use table is changed to reflect the different concept of value added and industry output at basic prices. Value added is changed to show value added at basic prices and is equal to industry output at basic prices less intermediate consumption. The change to value added only affects the currently published value added row 'taxes on production and imports less subsidies;' compensation and gross operating surplus are unchanged. In the proposed table, taxes on products and imports and subsidies are excluded leaving only other taxes on production. Other taxes on production are taxes that are part of production, but are not a tax collected on the sale of a good or service; examples include property taxes, license fees, and gross receipts taxes.

An addendum is added to the use table to show value added at market prices which is equivalent to the currently published U.S. I-O tables. The addendum includes rows for taxes on products and subsidies to convert value added at basic prices to value added at market prices. The sum of this measure of value added is equal to GDP.

The proposed use table adds four additional columns that are not included in the SNA93 recommendations: 1) imports, 2) c.i.f./f.o.b adjustment, 3) total final uses, and 4) total domestic commodity output. The first three columns are added in order to show imports and GDP in the I-O use table. The SNA93 format does not enable GDP to be



shown in the use table. The last column, total domestic commodity output, is included to be consistent with commodity output shown in the supply table.

Table 3.—Published 2003 Annual Use Table in Producers' Prices Before Redefinitions for the U.S.
 (Billions of dollars)

		Intermediate consumption of industries				Final Uses							Total commodity output
		Goods	Services and other	Trade and transport	Total intermediate	Personal consumption expenditures	Private fixed investment	Change in private inventories	Exports of goods and services	Imports of goods and services	Government consumption expenditures and gross investment	Total final uses (GDP)	
		(1)	(2)	(3)	(4)=(1)+(2)+(3)	(5)	(6)	(7)	(8)	(9)	(10)	(11)=(5)+...+(9)+(10)	
Commodities	Goods	1,995	976	188	3,158	1439	1236	29	545	-1236	314	2328	5486
	Services and Other	783	3,192	565	4,540	4974	292	-19	179	-46	1769	7149	11689
	Trade and Transport	481	303	163	947	1331	127	5	129	9	10	1611	2558
	Noncomparable imports	31	58	27	116	54	0	0	0	-170	0	-116	0
	Rest of the world adjustment	0	0	0	0	-88	0	0	89	0	-1	0	0
Total Intermediate		3,290	4,529	942	8,761	7,710	1,655	15	942	-1,443	2,092	10,971	19732
Value added	Value added	2,127	7,139	1,706	10,971								
	Compensation of employees	1,311	4,031	984	6,327								
	Taxes on production and imports less subsidies	59	383	313	755								
	Gross operating surplus	757	2,724	409	3,890								
Total industry output		5,416	11,668	2,648	19,732								

Total value added = Total industry output - total intermediate = compensation of employees + taxes on production and imports less subsidies + gross operating surplus

Note: Values may not add due to rounding.

Table 4.—Proposed 2003 Use Table in Purchasers' Prices Before Redefinitions for the U.S.
(Billions of dollars)

		Intermediate consumption of industries				Final Uses					Total use of products at purchasers' prices	Imports of goods and services	c.i.f./f.o.b. adjustment	Total final uses (GDP)	Total domestic commodity output
		Goods	Services and other	Trade and transport	Total intermediate	Personal consumption expenditures	Private fixed investment	Change in private inventories	Government consumption expenditures and gross investment	Exports of goods and services					
		(1)	(2)	(3)	(4)=(1)+(2)+(3)	(5)	(6)	(7)	(8)	(9)					
Commodities	Goods	2,370	1,167	232	3,769	2619	1361	34	324	632	8740	-1215		3756	7525
	Services and Other	783	3,199	565	4,548	5025	294	-19	1769	181	11798	-46	0	7204	11752
	Trade and Transport	105	105	118	328	100	0	0	0	40	468	-52	40	128	456
	Noncomparable imports	24	31	10	65	0	0	0	0	0	65	-65		-65	0
	Direct purchases at home by nonresidents	0	0	0	0	-88	0	0	-1	89	0	0		0	0
	Direct purchases abroad by residents	7	27	18	52	54	0	0	0	0	105	-105		-52	0
	c.i.f./f.o.b adjustment											40	-40	0	0
Total Intermediate		3,283	4,502	925	8,709	7,710	1,655	15	2,092	942	21,175	-1,483	0	10,972	19,733
Value added	Value added at basic prices	2,124	7,063	1,439	10,626										
	Compensation of employees	1,311	4,031	984	6,327										
	Other taxes on production	56	307	46	410										
	Gross operating surplus	757	2,724	409	3,890										
Total industry output at basic prices		5,407	11,565	2,364	19,335										
Addendum:															
	Value added at basic prices	2,124	7,063	1,439	10,626										
	Plus: Taxes on products and imports	16	105	271	392										
	Less: Subsidies	14	29	4	47										
	Value added at market prices	2,127	7,139	1,706	10,971										

Value added at basic prices = output at basic prices less intermediate = compensation of employees + other taxes on production + gross operating surplus

Total value added = value added at basic prices + taxes on products and imports less subsidies

Note: Values may not add due to rounding.

II. Development of the Analytical I-O Tables

There are two broad applications of the I-O accounts: As an economic accounting model and as an analytical model. The accounting model shows the relationship between the producing sectors, final demand, and income by industry. It shows industry purchases of goods and services that are used to produce commodities; in turn, these commodities serve as inputs for other industries or as purchases by final users. It also accounts for the income originating from each industry as a result of its production. In the U.S. I-O accounts, the supply and use tables constitute the major elements of the accounting model. These tables are presented following the North American Industry Classification System (NAICS) definition of industries and are referred to as the standard supply and use tables.

The analytical model is derived from the accounting model and is used to show the relationship between final demand and industry production. The model may be used to evaluate the interrelationships among industries and the relationships between industries and the commodities they use and produce. In the U.S. I-O accounts the requirements tables are the analytical models.

The SNA93 recommends symmetric I-O tables as part of the process of preparing the requirements tables. Symmetric I-O tables are industry-by-industry or commodity-by-commodity use tables. The preparation of the symmetric tables requires that the production of secondary products be moved to the industry where the product is primary.

Secondary Products in the U.S. I-O Accounts: In traditional I-O analysis, industries are required to have homogeneous production processes: each industry produces only one commodity, and each commodity is produced by only one industry. Thus, secondary products present a special problem because they can represent heterogeneity in an industry's output. In order to transform the supply and use tables into the required format, assumptions about the technology of producing secondary products are needed. The two most commonly used technology assumptions are the industry technology assumption and the commodity technology assumption.

The U.S. I-O accounts use a two step process to reassign the secondary products from the industry in which they were produced to the industries in which these products are primary products. The first step is referred to as the redefinition process. In this step, secondary products are divided into two groups. The first group includes those where it is assumed that the input structure of a secondary product differs from the input structure of the primary product of the industry in which the secondary product was produced, and that its input structure is similar to the primary product of the industry to which it is reassigned.⁶ In the second step the remaining secondary products are assumed to use a production process similar to the production process of the producing industry, the industry technology assumption.⁷

⁶ The commodity technology assumption.

⁷ For a more detailed discussion of the treatment of secondary products in BEA's input-output accounts, see Jiemin Guo, Ann Lawson and Mark Planting "From Make-Use to Symmetric I-O Tables: An Assessment

The Preparation of Analytical Tables: The preparation of the analytical model involves three steps:

1. Convert the use table in purchasers' prices to basic prices;
2. Redefine selected secondary products to the primary industry, and
3. Prepare symmetric I-O tables and calculate the total requirements matrices.

(1) *Convert the use table in purchasers' prices to basic prices:* The use table presented in table 4 is in purchasers' prices. The analytical tables must be converted to basic prices in order to show the production required by each industry to meet final uses. The underlying data for this table contain information that enable the calculation of the table in basic prices. Each cell, or transaction, in the table includes information on the purchasers' price, the transportation costs, and trade margins associated with the transaction, the taxes included in the purchasers' price and the value of subsidies associated with the transaction.⁸ Transactions in basic prices are calculated as purchasers' price less trade margins, transportation costs and taxes plus subsidies.

The trade margins and transportation costs associated with each transaction in the purchasers' price use table become separate transactions in the basic price use table (see table 5). These costs represent the inputs of the trade and transportation services used by the industry or final use when purchasing goods in basic prices. Using the underlying use table transaction data, each transportation cost and trade margin associated with the transactions is summed by industry and then added to the respective trade or transportation row of the use table.

The taxes included in the purchasers' price of each transaction also must be included in industry and final use inputs as a separate row of the basic value use table. Using the underlying transaction data the commodity excise taxes, sales taxes and duty on imports used are summed by industry and added to a new row in the basic value use table titled 'Taxes paid on products and imports.'

Transactions in basic prices include subsidies received by the producer. In order to account for total industry and final use inputs at purchasers' prices an additional row is added to the use table to show total subsidies included in products purchased (see table 5 'Subsidies on products'). The subsidies included in the transactions data are summed by industry and added to this row. The cells are shown as negative values because subsidies are included in the basic prices of goods and services purchased by industries and must be subtracted to obtain total intermediate in purchasers' prices.

of Alternative Technology Assumptions," presented at the 14th International Conference on Input-Output Techniques, Montreal, Canada, October 10–15, 2002. The paper also is available at BEA website <http://www.bea.gov/bea/papers/alttechassump.pdf>.

⁸ Transportation costs include rail, truck, water, air, pipe, and gas pipe costs. Trade margins include wholesale and retail margins. Taxes include commodity excise taxes, sales taxes and duty.

Table 5 shows the results of converting the use table in purchasers' prices to basic prices. The format of Table 5 is identical to the use table in purchasers' prices (table 4) with the following exceptions: two new rows are added to account for subsidies included in basic prices and taxes on products; the trade and transport costs commodity now includes values for trade margins and transport costs associated with the purchase of goods, and all values are in basic prices. The values for total final uses, total intermediate purchases by industry, and value added by industry are unchanged.

(2) *Redefine selected secondary products to the primary industry:* Redefined secondary products move output from the industry originally producing the product into the industry where the product is primary. The following lists some of the principal output redefinitions that are made in the U.S. I-O accounts:

- Construction activities performed by all non-construction industries are redefined to the construction industries;
- Manufacturing activities in trade, services, and other non-manufacturing industries are redefined to manufacturing industries;
- Trade activities in non-trade industries are redefined to trade industries;
- Service activities in non-service industries are redefined to service industries;
- Rents received for equipment and vehicles are redefined to the rental industry.

Redefinitions move output between industry columns in the supply table, but total output across all industries remains the same. For example, in table 3, the supply table before redefinitions shows the goods industry produces \$28 billion of services and \$38 billion of transport and trade margins. It also shows that \$111 billion of goods commodities were produced by services and \$25 billion of goods were produced by the trade and transport industry. Some of these secondary products are redefined as shown in table 6 which shows the net redefinitions between industries. For the goods industry, \$1 billion of the services commodity is redefined out of goods and into the services industry. Similarly, \$38 billion of the trade and transport costs produced by the goods industry is redefined into the trade and transport industry. Additionally, \$95 billion of goods produced in the service industry is redefined into the goods industry and \$25 billion of goods produced by trade and transport is redefined into the goods industry for a total redefinition \$120 billion. Table 6 shows that the redefinitions change industry output by industry, but total industry output for all industries is unchanged, and the output across each commodity is unchanged.

Table 7 shows the supply table after redefinitions, the I-O definition of industries used for the analytical tables. The redefinitions have significantly reduced the value of secondary products. Table 3, the supply table before redefinitions, shows secondary products for the goods industry of \$66 billion, while table 7 shows secondary products of the goods industry as \$27 billion.

The inputs related to redefinitions, which are referred to as reallocations, are also moved from the producing industries to the primary industry. Table 8 shows the net

impact on industries resulting from application of the redefinition concept to the use table. For example, the goods industry has increased inputs of goods by \$58 billion, services by \$9 billion, and trade and transport by \$11 billion. Reallocations of value added included increased gross operating surplus of \$9 billion, and a decrease of \$7 billion of compensation. The values for reallocations of inputs are both positive and negative because they are the net of all reallocations for all industries. In the case of goods, the majority of reallocations into goods industries were made up of goods, services, transportation costs and trade margins, and gross operating surplus. The majority of reallocations out of the goods industries into other industries were made up of compensation. Total reallocations by industry (table 8) equal total redefinitions by industry (table 6). For example in table 6 net redefinitions for goods is \$81 billion and in table 8 total reallocations for goods is also \$81 billion.

Table 9 shows the use table in basic prices after redefinitions, the use table used to calculate the requirements tables. Total value added and final uses are identical to the totals before redefinitions (table 5), but the industry inputs and value added by industry have been modified by the redefinitions.

(3) Calculate the symmetric tables and the total requirements tables:

The final step is to construct the symmetric I-O tables and the requirements tables. The supply and use tables provide a foundation from which the analytical symmetric I-O tables can be constructed. The symmetric I-O table is an analytical tool that is widely used for conducting various types of economic analysis such as the economic impact of natural disasters or changes in energy prices. Symmetric I-O tables are square I-O tables that are in one of two forms: industry-by-industry or commodity-by-commodity. The industry-by-industry table shows the use of industry output by industries. The commodity-by-commodity table shows the use of commodities to produce commodities. These tables fit within the theoretical construct of I-O analysis and are used to show the relationship between final demand and industry or commodity output. The U.S. I-O accounts have implicitly constructed these tables in order to prepare the total requirements tables, but have not published these tables.

The preparation of these tables requires that the production of secondary products be reassigned as part of the production of the industry where the product is primary. Because data on inputs required for secondary production are not generally available these estimates must be developed mathematically from the supply and use tables.

As described earlier, the U.S. uses a two step process to move the production of secondary products to the primary industry. The first step redefines selected secondary products using the commodity technology assumption. For the second step, it is assumed the input structure for each secondary product is similar to that of the producing industry, the industry technology assumption. Using the supply table after redefinitions (table 7) and the use table in basic prices after redefinitions (table 9) the symmetric tables are calculated using the mathematical equations shown in the appendix.



The resulting symmetric matrices are shown in tables 10 and 11. The commodity-by-commodity table shows the use of commodities to produce each commodity. The industry-by-industry table shows the industry output used by industries and final uses. These tables are used to construct the total requirements tables as described in the appendix.

Table 5.—Proposed 2003 Use Table in Basic Prices Before Redefinitions for the U.S.
(Billions of dollars)

		Intermediate consumption of industries				Final Uses					Total use of products at basic prices	Imports of goods and services	c.i.f./f.o.b. adjustment	Total final uses (GDP)	Total domestic commodity output
		Goods	Services and other	Trade and transport	Total intermediate	Personal consumption expenditures	Private fixed investment	Change in private inventories	Government consumption expenditures and gross investment	Exports of goods and services					
		(1)	(2)	(3)	(4)=(1)+(2)+(3)	(5)	(6)	(7)	(8)	(9)					
Commodities	Goods	1,983	974	188	3,144	1426	1236	29	314	549	6698	-1215		2339	5483
	Services and Other	776	3,162	559	4,497	4941	291	-19	1769	179	11657	-46	0	7115	11611
	Trade and Transport	464	291	149	904	1143	116	5	9	127	2305	-52	40	1388	2293
	Noncomparable imports	24	31	10	65	0	0	0	0	0	65	-65		-65	0
	Direct purchases at home by nonresidents	0	0	0	0	-88	0	0	-1	89	0	0		0	0
	Direct purchases abroad by residents	7	27	18	52	54	0	0	0	0	105	-105		-52	0
	c.i.f./f.o.b. adjustment											40	-40	0	0
	Subsidies on products	-12	-2	0	-14	-29	0	0	0	-4	-47	0		-33	-47
	Taxes paid on products and imports	47	45	20	113	264	12	0	0	2	392	0		279	392
Total Intermediate		3,290	4,529	942	8,761	7,710	1,655	15	2,092	942	21,175	-1,443	0	10,971	19,732
Value added	Value added at basic prices	2,124	7,063	1,439	10,626										
	Compensation of employees	1,311	4,031	984	6,327										
	Other taxes on production	56	307	46	410										
	Gross operating surplus	757	2,724	409	3,890										
Total industry output at basic prices		5,414	11,592	2,381	19,387										
Addendum:															
Value added at basic prices		2,124	7,063	1,439	10,626										
Plus: Taxes on products and imports		16	105	271	392										
Less: Subsidies		14	29	4	47										
Value added at market prices		2,127	7,139	1,706	10,971										
Total Intermediate at Purchasers' Prices		3,290	4,529	942	8,761										
Total Industry Output at Purchasers' Prices		5417	11668	2648	19732										

Table 6.—2003 Net Redefinitions of Supply for the U.S
 (Billions of dollars).

		Output of industries at basic prices			Total commodity output at basic prices	Imports		Total product supply at basic prices	Trade margins and transport costs			Taxes less subsidies on products				Total product supply at purchasers' prices
		Goods	Services and other	Trade and transport		Imports c.i.f. (total f.o.b.)	c.i.f./f.o.b. adjustment		Trade margins	Transport costs	Total trade margins and transport costs	Import duties	Tax on products	Subsidies	Total taxes less subsidies on products	
		(1)	(2)	(3)	(4) = (1)+(2)+(3)	(5)	(6)	(7)=(4)+(6)	(8)	(9)	(10)=(8)+(9)	(11)	(12)	(13)	(14)=(11)+(12)-(13)	(15)=(7)+(10)+(14)
Commodities	Goods	120	-95	-25	0	0	0	0	0	-1	-1	0	0	-1	1	0
	Services and other	-1	171	-169	0	0	0	0	0	0	0	0	0	0	0	0
	Trade and transport	-38	-46	84	0	0	0	0	0	1	1	0	0	1	-1	0
	c.i.f./f.o.b. adjustment					0	0	0	0	0		0	0	0		
	Noncomparable imports					0	0	0	0	0	0	0	0	0	0	0
	Direct purchases abroad by residents					0	0	0								0
Total supply at basic prices		81	30	-111	0	0	0	0	0	0	0	0	0	0	0	0

Table 7.—Proposed 2003 Supply Table After Redefinitions for the U.S.
 (Billions of dollars)

		Output of industries at basic prices			Total commodity output at basic prices (4) = (1)+(2)+(3)	Imports		Total product supply at basic prices (7)=(4)+(6)	Trade margins and transport costs			Taxes less subsidies on products				Total product supply at purchasers' prices (15)=(7)+(10)+(14)
		Goods	Services and other	Trade and transport		Imports c.i.f. (total f.o.b.)	c.i.f./f.o.b. adjustment		Trade margins	Transport costs	Total trade margins and transport costs	Import duties	Tax on products	Subsidies	Total taxes less subsidies on products	
Commodities	Goods	5,468	15	0	5,483	1,215		6,698	1,530	247	1,778	21	256	14	264	8,740
	Services and other	27	11,584	0	11,611	47	0	11,657	55	4	58	0	111	29	82	11,798
	Trade and transport	0	22	2,271	2,292	52	-40	2,305	-1,585	-251	-1,836	0	4	4	-1	468
	c.i.f./f.o.b. adjustment						40	0								
	Noncomparable imports					65		65	0	0	0	0	0	0	0	65
	Direct purchases abroad by residents					105		105								105
	Total supply at basic prices	5,494	11,622	2,271	19,387	1,443	0	20,830	0	0	0	21	370	47	345	21,175

Table 8.—2003 Net Reallocations of Inputs in the Use Table for the U.S.
 (Billions of dollars)

		Intermediate consumption of industries				Final Uses					Total use of products at purchasers' prices	Imports of goods and services	c.i.f./f.o.b. adjustment	Total final uses (GDP)	Total domestic commodity output
		Goods	Services and other	Trade and transport	Total intermediate	Personal consumption expenditures	Private fixed investment	Change in private inventories	Government consumption expenditures and gross investment	Exports of goods and services					
		(1)	(2)	(3)	(4)=(1)+(2)+(3)	(5)	(6)	(7)	(8)	(9)					
Commodities	Goods	58	-6	-52	0	0	0	0	0	0	0	0	0	0	0
	Services and Other	9	20	-29	0	0	0	0	0	0	0	0	0	0	0
	Trade and Transport	11	-2	-9	0	0	0	0	0	0	0	0	0	0	0
	Noncomparable imports	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Direct purchases at home by nonresidents	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Direct purchases abroad by residents	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	c.i.f./f.o.b. adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subsidies on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Taxes paid on products and imports	0	1	-1	0	0	0	0	0	0	0	0	0	0	0
		Total Intermediate	78	12	-90	0	0	0	0	0	0	0	0	0	0
Value added	Value added at basic prices	3	18	-20	0										
	Compensation of employees	-7	6	1	0										
	Other taxes on production	0	0	0	0										
	Gross operating surplus	9	12	-21	0										
	Total industry output at basic prices	81	30	-111	0										
Addendum:															
	Value added at basic prices	3	18	-20	0										
	Plus: Taxes on products and imports	0	0	0	0										
	Less: Subsidies	0	0	0	0										
	Value added at market prices	3	18	-20	0										

Table 9.—Proposed 2003 Use Table after Redefinitions in Basic Prices for the U.S.
(Billions of dollars)

		Intermediate consumption of industries				Final Uses					Total use of products (10)=(4)+...+(9)	Imports		Total final uses (GDP) (13)=(5)+...+(9)+(11)+(12)	Total domestic commodity output (14)=(4)+(13)
		Goods (1)	Services and other (2)	Trade and transport (3)	Total intermediate (4)=(1)+(2)+(3)	Personal consumption expenditures (5)	Private fixed investment (6)	Change in private inventories (7)	Government consumption expenditures and gross investment (8)	Exports of goods and services (9)		Imports of goods and services (11)	c.i.f./f.o.b. adjustment (12)		
Commodities	Goods	2,040	968	135	3,144	1426	1236	29	314	549	6698	-1215		2339	5483
	Services and Other	785	3,182	530	4,497	4941	291	-19	1769	179	11657	-46	0	7115	11612
	Trade and Transport	475	289	140	904	1143	116	5	9	127	2305	-52	40	1388	2293
	Noncomparable imports	24	31	10	65	0	0	0	0	0	65	-65		-65	0
	Direct purchases at home by nonresidents	0	0	0	0	-88	0	0	-1	89	0	0		0	0
	Direct purchases abroad by residents	7	27	18	52	54	0	0	0	0	105	-105		-52	0
	c.i.f./f.o.b. adjustment											40	-40	0	0
	Subsidies on products	-12	-2	0	-14	-29	0	0	0	-4	-47	0		-33	-47
	Taxes paid on products and imports	47	46	20	113	264	12	0	0	2	392	0		279	392
	Total Intermediate		3,368	4,541	852	8,761	7,710	1,655	15	2,092	942	21,175	-1,443	0	10,972
Value added	Value added at basic prices	2,127	7,081	1,419	10,626										
	Compensation of employees	1,305	4,037	985	6,327										
	Other taxes on production	56	307	46	410										
	Gross operating surplus	766	2,736	387	3,890										
Total industry output at basic prices		5,494	11,622	2,271	19,387										
Addendum:															
Value added at basic prices		2,127	7,081	1,419	10,626										
Plus: Taxes on products and imports		16	105	271	392										
Less: Subsidies		14	29	4	47										
Value added at market prices		2,129	7,157	1,685	10,971										
Total Intermediate at Purchasers' Prices		3,368	4,541	852	8,761										
Total Industry Output at Purchasers' Prices		5497	11698	2537	19732										

Table 10.-- 2003 U.S. Commodity-by-Commodity I-O Table
(Billions of Dollars)

		Commodities				Final Uses					Total use of products (10)=(4)+...+(9)	Imports		Total final uses (GDP) (13)=(5)+...+(9)+(11)+(12)	Total domestic commodity output (14)=(4)+(13)
		Goods	Services and other	Trade and transport	Total intermediate (4)=(1)+(2)+(3)	Personal consumption expenditures	Private fixed investment	Change in private inventories	Government consumption expenditures and gross investment	Exports of goods and services		Imports of goods and services	c.i.f./f.o.b. adjustment		
Commodities	Goods	2,032	975	137	3,144	1,426	1,236	29	314	549	6,698	-1,215	0	2,339	5,483
	Services and Other	786	3,175	536	4,497	4,941	291	-19	1,769	179	11,657	-46	0	7,115	11,612
	Trade and Transport	473	290	141	904	1,143	116	5	9	127	2,305	-52	40	1,388	2,293
	Noncomparable imports	24	31	10	65	0	0	0	0	0	65	-65	0	-65	0
	Direct purchases at home by nonresidents	0	0	0	0	-88	0	0	-1	89	0	0	0	0	0
	Direct purchases abroad by residents	7	27	18	52	54	0	0	0	0	105	-105	0	-52	0
	c.i.f./f.o.b. adjustment	0	0	0	0	0	0	0	0	0	0	40	-40	0	0
	Subsidies on products	-12	-2	0	-14	-29	0	0	0	-4	-47	0	0	-33	-47
	Taxes paid on products and imports	47	46	20	113	264	12	0	0	2	392	0	0	279	392
Total Intermediate		3,357	4,543	861	8,761	7,710	1,655	15	2,092	942	21,175	-1,443	0	10,972	19,733
Value added	Value added at basic prices	2,126	7,068	1,432	10,626										
	Compensation of employees	1,304	4,031	992	6,327										
	Other taxes on production	56	306	47	410										
	Gross operating surplus	766	2,731	393	3,890										
Total industry output at basic prices		5,483	11,611	2,292	19,387										

Addendum:				
Value added at basic prices	2,127	7,081	1,419	10,626
Plus: Taxes on products and imports	16	105	271	392
Less: Subsidies	14	29	4	47
Value added at market prices	2,129	7,157	1,685	10,971

Table 11.--2003 U.S. Industry-by-Industry I-O Table
 (Billions of Dollars)

		Intermediate consumption of industries				Final Uses					Total use of products	Imports		Total final uses (GDP)	Total domestic commodity output
		Goods	Services and other	Trade and transport	Total intermediate	Personal consumption expenditures	Private fixed investment	Change in private inventories	Government consumption expenditures and gross investment	Exports of goods and services		Imports of goods and services	c.i.f./f.o.b. adjustment		
Industries	Goods	2,036	973	136	3,146	1,433	1,233	29	317	548	6,706	-1,211	0	2,349	5,494
	Services and Other	794	3,180	530	4,504	4,944	295	-19	1,766	181	11,671	-50	1	7,118	11,622
	Trade and Transport	471	286	139	896	1,132	115	5	9	126	2,283	-52	40	1,375	2,271
	Noncomparable imports	24	31	10	65	0	0	0	0	0	65	-65	0	-65	0
	Direct purchases at home by nonresidents	0	0	0	0	-88	0	0	-1	89	0	0	0	0	0
	Direct purchases abroad by residents	7	27	18	52	54	0	0	0	0	105	-105	0	-52	0
	c.i.f./f.o.b. adjustment	0	0	0	0	0	0	0	0	0	0	40	-40	0	0
	Subsidies on products	-12	-2	0	-14	-29	0	0	0	-4	-47	0	0	-33	-47
	Taxes paid on products and imports	47	46	20	113	264	12	0	0	2	392	0	0	279	392
	Total Intermediate		3,368	4,541	852	8,761	7,710	1,655	15	2,092	942	21,175	-1,443	0	10,972
Value added	Value added at basic prices	2,127	7,081	1,419	10,626										
	Compensation of employees	1,305	4,037	985	6,327										
	Other taxes on production	56	307	46	410										
	Gross operating surplus	766	2,736	387	3,890										
	Total industry output at basic prices		5,494	11,622	2,271	19,387									

Addendum:				
Value added at basic prices	2,127	7,081	1,419	10,626
Plus: Taxes on products and imports	16	105	271	392
Less: Subsidies	14	29	4	47
Value added at market prices	2,129	7,157	1,685	10,971

III. Comparison of the Total Requirements Tables

The use of basic prices to prepare the total requirements tables results in total requirements coefficients that are different than those derived using tables in producers' prices. As the compressed 2003 I-O tables illustrate, the sum of all output multipliers is 15% higher than when using basic prices than when using producers' prices (see table 12). If there is a one dollar change in final demand for each industry, the change in total output of all industries will be 15% greater when using basic prices instead of producers' prices.

The differences in multipliers by industry move in both directions. The largest increase in multipliers is with trade and transportation, where the multipliers are 22% higher in basic prices than they are in producers' prices. This occurs because a significantly large portion of the output of trade and transportation in producers' prices is made up of taxes on products. Producers' valued output for trade and transportation is \$2,537 billion in 2003 tables and output in basic prices is \$2,271 billion (table 7) a difference of \$266 billion, of which \$271 billion is taxes, and \$5 billion subsidies (negative). This reduced value for industry output increases the size of direct coefficients (industry input divided by industry output) which in turn results in larger total requirements coefficients.

The other industries show lower output multipliers in basic prices. For these industries, inputs in basic prices are significantly lower than when valued at purchasers' prices. However, industry output in basic prices is not significantly lower than output in producers' prices. The lower values for inputs result in lower direct requirements coefficients which in turn yield lower output multipliers.

Subsidies do not have much impact on the multipliers. Subsidies included in industry output and in inputs are small and therefore do not have discernable impact on the direct coefficients.

Table 12.-- Total Requirements Coefficients Tables, Comparison at Producers' Prices and Basic Prices

Producers' Prices (A)	Commodity-by-Commodity				Industry-by-Industry				Industry-by-Commodity			
	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total
	Goods	1.6587	0.1960	0.1389	1.9935	1.6590	0.1954	0.1388	1.9932	1.6549	0.1987	0.1393
Services and other	0.3793	1.4339	0.3447	2.1579	0.3815	1.4340	0.3443	2.1599	0.3845	1.4316	0.3535	2.1696
Trade and transport	0.1679	0.0581	1.0869	1.3130	0.1668	0.0574	1.0864	1.3107	0.1665	0.0576	1.0778	1.3019
Total	2.2059	1.6880	1.5705	5.4644	2.2074	1.6868	1.5695	5.4637	2.2059	1.6880	1.5705	5.4644

Basic prices (B)	Commodity-by-Commodity				Industry-by-Industry				Industry-by-Commodity			
	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total
	Goods	1.6546	0.1966	0.1545	2.0057	1.6549	0.1960	0.1546	2.0055	1.6508	0.1994	0.1549
Services and other	0.3784	1.4333	0.3809	2.1927	0.3808	1.4335	0.3808	2.1951	0.3838	1.4310	0.3908	2.2056
Trade and transport	0.1623	0.0562	1.0898	1.3084	0.1610	0.0555	1.0893	1.3058	0.1607	0.0557	1.0795	1.2960
Total	2.1953	1.6861	1.6253	5.5067	2.1968	1.6850	1.6247	5.5064	2.1953	1.6861	1.6253	5.5067

Differences (A) - (B)	Commodity-by-Commodity				Industry-by-Industry				Industry-by-Commodity			
	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total
	Goods	0.0041	-0.0006	-0.0156	-0.0122	0.0041	-0.0006	-0.0158	-0.0123	0.0041	-0.0006	-0.0157
Services and other	0.0008	0.0006	-0.0362	-0.0348	0.0007	0.0005	-0.0366	-0.0353	0.0007	0.0006	-0.0373	-0.0360
Trade and transport	0.0057	0.0019	-0.0029	0.0047	0.0058	0.0019	-0.0029	0.0049	0.0058	0.0019	-0.0018	0.0060
Total	0.0106	0.0019	-0.0548	-0.0423	0.0106	0.0019	-0.0552	-0.0427	0.0106	0.0019	-0.0548	-0.0423

Percent differences [(A) - (B)] / A]	Commodity-by-Commodity				Industry-by-Industry				Industry-by-Commodity			
	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total	Goods	Services and other	Trade and transport	Total
	Goods	0.25%	-0.32%	-11.26%	-11.33%	0.25%	-0.32%	-11.36%	-11.44%	0.25%	-0.32%	-11.26%
Services and other	0.22%	0.04%	-10.51%	-10.25%	0.19%	0.04%	-10.62%	-10.39%	0.19%	0.04%	-10.56%	-10.33%
Trade and transport	3.38%	3.26%	-0.27%	6.37%	3.48%	3.36%	-0.26%	6.58%	3.48%	3.36%	-0.16%	6.68%
Total	3.85%	2.98%	-22.04%	-15.21%	3.92%	3.08%	-22.25%	-15.25%	3.92%	3.07%	-21.99%	-15.00%

IV Summary and Conclusions

The proposed framework will enable enhanced international comparability of BEA's U.S. I-O accounts. As indicated in this paper, the basic price is the sales value retained by the producer and is relevant to the producer's decision-making process. By adopting basic price valuation of output and value added in the U.S. I-O accounts, the proposed framework would also provide a more accurate measure of producers' contributions to the economy. The framework improves the presentation of the sources of supply to the U.S. economy by showing both domestic production and imports in a single supply table.

This paper has demonstrated that the underlying data in the U.S. I-O accounts are sufficient to prepare I-O tables following the recommendations of the SNA93. The proposed SNA93 framework for the U.S. I-O accounts has several advantages:

- Production is valued at prices relevant to the producer, basic prices,
- Use table expenditures are valued at prices relevant to the user, purchasers' prices,⁹
- The sources of supply for goods and services used by the economy are presented more clearly than in the SNA68 framework, and
- The wedge between what producers receive and what users pay (commodity taxes, transportation costs and trade margins) is clearly shown.

The presentation, though, is not without disadvantages. These disadvantages include the inclusion of subsidies in basic prices, the use of basic prices for the analytical tables, and the increased information required by users of the tables.

Subsidies, though relatively small in the U.S. I-O accounts, pose several problems. First, including subsidies in transactions and output introduces a source of instability into the accounts over time, as subsidies are subject to changes in government policy.¹⁰ Second, several U.S. agriculture subsidies are used to discourage production; it is inappropriate to include these subsidies in value of farm products used. Third, the inclusion of subsidies in transactions moves transactions away from market prices, thereby making deflation very difficult. Price indices for subsidies are not available.

The basic value analytical tables, because they leave out taxes and include subsidies, do not include the full costs of production. Taxes, in the U.S. accounts make up a significant cost of production. Omitting these costs may not be appropriate for certain types of analysis that investigate the generation of product taxes.

⁹ Dale W. Jorgenson and J. Steven Landefeld, "Blueprint for Expanded and Integrated U.S. Accounts, Assessment, and Next Steps," Conference on Research in Income and Wealth, New Architecture for the U.S. National Accounts, Washington, D.C. April 16-17, 2004: page 15.

¹⁰ One of the arguments for removing taxes from the input-output accounts is to reduce instability in the accounts. Taxes are subject to changes in government policy and do not necessarily reflect technological change.

Finally, using basic value tables will require substantially more information by the user. Impact analysis will require the analyst to convert final demand estimates from purchasers' prices to basic prices. The analyst will need to know the transportation costs, margins included in the purchaser price, as well as taxes and subsidies included in the final product.

The presentation of the I-O accounts following the recommendations of SNA93 has several advantages, but poses some problems for users of the accounts. To facilitate the use of the U.S. I-O accounts it is recommended that the U.S. I-O accounts be available in a variety of formats enabling the user to decide which valuation is appropriate for the particular analysis being undertaken. The data files released with the I-O accounts should include information enabling the user to calculate the supply and use tables in basic prices, producers' prices or purchasers' prices.

The proposed U.S. I-O accounts do not include all of the SNA93 recommendations. One principle difference is use of the "commodity technology assumption" to convert supply-use tables to analytical I-O tables. The SNA93 recommends the application of this assumption while the authors believe the "two-step" process BEA has been using beginning with the 1972 I-O tables is a better approach.

Appendix A

Key Terms

Key Terms	Definition
Basic prices	The amount received by producer from the purchaser for a good or service minus any tax payable plus any subsidy receivable as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer.
Producers' price	The amount received by the producer for a good or service produced minus any commodity tax. $\text{Producers' price} = \text{basic prices} + \text{commodity taxes on production and imports} - \text{subsidies}$
Purchasers' price	The amount paid by the purchaser, in order to take delivery of a unit of a good or service at the time and place required by the purchaser. $\text{Purchasers' price} = \text{producers' price} + \text{transportation costs} + \text{trade margins}$
Commodity tax	Sales or excise tax collected by the seller
Transportation costs	Cost of transporting a good from the producer to the purchaser
Trade margins	Cost of marketing goods.
Free on board (f.o.b.) imports	Value of the import exiting the foreign country (foreign port value). The value excludes duty and transportation and insurance charges.
Customs value including freight (c.i.f.)	Value of the import entering the country including transportation and insurance charges, $\text{c.i.f.} = \text{f.o.b.} + \text{transportation and insurance}$. The value excludes duty.
Domestic port value (DPV)	Value of imports including transportation, insurance and duty. $\text{DPV} = \text{c.i.f.} + \text{duty}$
Subsidy	Monetary grants paid by government agencies to private business or to government enterprises at another level of government.

Appendix B

Define:

- m: Number of commodities
- n: Number of industries
- U_{cxi} : Intermediate use, commodity-by-industry
- M_{cxi} : Make matrix, commodity-by-industry. It is part of the supply matrix describing domestic production.
- V_{kxn} : Value added by industry
- E_{mxk} : Final demand by commodity
- X_n : Industry output vector
- Q_m : Commodity output vector

Direct requirements coefficients, commodity-by-industry (B_{cxi})

$$B = U\hat{X}^{-1}$$

The Industry technology assumption (market share): it is assumed that an industry uses the same technology to produce all its products – including secondary products.

$$D = V'\hat{Q}^{-1}$$

D is referred to as the *commodity output proportion*.

Commodity-by-commodity

- Direct requirements coefficients, commodity-by-commodity (A_C)

$$A_C = BD$$

- Total requirements coefficients, commodity-by-commodity (T_C)

$$T_C = [I - A_C]^{-1} = [I - BD]^{-1}$$

- Intermediate output matrix (Z_C)

$$Z_C = A_C\hat{Q} = BD\hat{Q}$$

- Value added by commodity (V_C)

$$V_C = VD$$

Industry-by-industry:

- Direct requirements coefficients, industry-by-industry (A_I)

$$A_I = DB$$

- Total requirements coefficient, industry-by-industry (T_I)

$$T_I = [I - A_I]^{-1} = [I - DB]^{-1}$$

- Intermediate output matrix (Z_I)

$$Z_I = A_I \hat{X} = DB\hat{X}$$

- Final demand by industry (E_I)

$$E_I = DE_C$$

Industry-by-commodity total requirements ($T_{I,C}$)

- Total requirements coefficients matrix ($T_{I,C}$)

$$T_{I,C} = [I - DB]^{-1} D$$