TRADE AND FINANCIAL FLOWS IN A WORLD ACCOUNTING FRAMEWORK: A BALANCED WAM FOR 1990

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How accurately do we measure the external deficit of the U.S. or the surplus of Japan? If checked at the global level, statistics on international trade and finance show large discrepancies. Such global statistical discrepancies hamper the analysis and understanding of world economic developments. An accounting framework—labelled World Accounting Matrix (WAM)—is proposed to cross-check the statistical consistency of commodity flows, international payments and internal balances across countries. The framework is applied to data for 1990. To obtain global consistency, substantial adjustments had to be made to the estimates of the external balances of the U.S. and Japan. The implications for global modelling work are potentially vast.

1. INTRODUCTION

Disraeli's complaint that "there are lies, damned lies and statistics," appears to apply very much to data on international trade and payments. The large global discrepancies that emerge when adding together the balances on current account and financial transactions across the world using existing data sources, seem to severely hamper our understanding of world economic developments. These discrepancies could be reduced if more standardized concepts would be used by the various providers of international economic data and if in the collection of data there were to be checks within a global accounting framework. With the harmonization of the UN's Revised System of National Accounts (SNA) and the IMF's Balance of Payments Statistics (BOPS) a major step in this direction has been set (see UN 1993 and IMF 1993). However, the SNA/BOPS framework still lacks an essential extension in the form of a set of global accounting constraints which could help improve the accuracy of the measurement of the external

accounts of individual countries and, moreover, provide a consistent data base for the study of global economic interactions.

Following the basic methodology outlined in a previous article published in this journal (Vos, 1989), this paper further elaborates the *World Accounting Matrix* (WAM) framework and presents the results of a WAM for 1990. Application of an integrated set of global accounting constraints to existing data on external accounts leads us to believe that particularly the external balances of the major economies require major revisions: the U.S. current account deficit would seem grossly overestimated in official data sources when implying the WAM framework; the Japanese surplus may be smaller than recorded in the available sources; and the deficits of groups of developing countries (Latin America, Sub-Saharan Africa) may in fact be smaller than we think. Such major revisions suggest that the use of WAM-based data, instead of the existing data, could affect outcomes of quantitative assessments of world trade and investment. Such an evaluation is not the objective of this paper, as the focus will be on the world accounting methodology and its application.

The outline of this article is as follows. In section 2 the appropriate accounting framework is defined. In section 3 a reconciled WAM for 1990 is presented. Section 4 discusses the classifications adopted in the presented WAM and further identifies the main data sources and describes the principal steps in the construction of the WAM. In section 5, the final steps of the reconciliation procedure are discussed. An analysis of adjustments of the original data is the subject of section 6. Finally, suggestions for further work and the conclusions for the analysis of the world economy are discussed in section 7.

2. THE WORLD ACCOUNTING MATRIX (WAM)

2.1. *A Summary of the Accounting Relationships*

Accounting rules command that commodity and financial flows should balance at the global level. The WAM furthermore connects international transactions of each economy with the internal balance (reflected in the savings-investment balance) and identifies the interactions between economies. The WAM framework rests on the following basic accounting relations for each country group i:[1]

(1) $$S_i - I_i \equiv E_i - M_i + R_i \equiv \Delta FA_i - \Delta FL_i + (\Delta RES_i + EO_i).$$

Since at the world level all incoming and outgoing flows must balance, it should hold that:

(2) $$\sum_i^n (S_i - I_i) \equiv \sum_i^n (E_i - M_i + R_i) \equiv 0$$

(3) $$\sum_i^n [(\Delta FA_i - \Delta FL_i) + (\Delta RES_i + EO_i)] \equiv 0$$

[1]See Vos (1989, 1994) for the original elaboration of these basic accounting identities. In the ccurrent presentation we leave out, for simplicity, new variables incorporated in the revised SNA and BOPS for "capital transfers" and "acquisition of non-produced, non-financial assets/liabilities."

For other, but less comprehensive attempts to achieve a global accounting framework, see Weale (1984), McCarthy *et al.* (1989) and Gray and Gray (1989).

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where: S = Gross national savings, I = Gross domestic investment, E = Exports of goods and services, M = Imports of goods and services, R = Net factor income and current transfers from abroad, ΔFA = Change in total external financial assets, ΔFL = Change in total external financial liabilities, ΔRES = Change in reserves, EO = Errors and omissions.

The global savings-investment account should balance. Similarly, the global current account balance and the aggregate change in *net* external asset position should both be *zero, ex post*. Since reserves may be held abroad in various forms of financial assets, one can write:

$$(4) \qquad \sum_i^n (\Delta FA_i - \Delta FL_i + \Delta RES_i) \equiv 0.$$

According to the accounting procedures of international data sources, particularly those of the IMF Balance of Payments Statistics (BOPS), countries usually hold part of their reserves as Portfolio Investment and Other Financial Assets. In the BOPS, such reserve holdings can in principle be identified as Liabilities Constituting Foreign Authorities' Reserves (LCFAR) in the recordings of the countries where such reserve assets are held. Other international reserves transactions, which for each country (group) are the closing item of the balance of payments, cannot be identified by origin and destination. In principle, changes in these reserves should add to zero at the global level. Due to the asymmetry in the accounting of part of the reserve holdings, it is accounting identity (4) that is in practice applicable to existing data sources.[2] Given equation (4), in principle the global estimate of net errors and omissions should sum to zero as well:

$$(5) \qquad \sum_i^n EO_i \equiv 0.$$

Matrix presentation (Table 1) permits the identification of the origin and destination of each transaction included in the accounting identities of equation 1. This has a number of advantages:

(1) it allows to obtain a more detailed picture of the structure of international trade and finance useful for analytical purposes is able to be obtained;

(2) at the same time it allows for a detailed and systematic cross-check of the statistical consistency of commodity flows, international payments and internal balances across countries; and

(3) since various data sources are required to construct a data base in this way, it allows for a systematic identification of discrepancies between different data sources.

The rows of the CA (Current Account) quadrant in Table 1 define exports of goods and services plus all factor income and current transfers received from abroad for country (group) $i = 1 \ldots n$; the columns in CA define commodity imports plus factor and current transfer payments to abroad. The CA block is a consolidated matrix which is decomposed of a set of transactions matrices with the same dimensions. The S and I blocks are *diagonal* matrices, defining national

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[2] In the WAM, framework adjustments have been made to adjust for this asymmetry (see Appendix A.1 of De Jong, Vos, Jellema and Zebregs 1993a).

TABLE 1

WAM—SCHEMATIC PRESENTATION OF THE WORLD ACCOUNTING MATRIX

	Current Account Country Groups (1 . . n)	Capital Account Country Groups (1 . . n)	Total
Current Account Country Groups (1 . . n)	CA (Matrix of current account transactions)	I (Diagonal matrix of domestic investment)	$(E + R^R + I)_i$ (Total current receipts)
Capital Account Country Groups (1 . . n)	S (Diagonal matrix of national savings)	$\Delta FA - \Delta FL$ (Flow of funds matrix, liabilities in rows, assets in columns)	$S_i + \Delta FL_i$ (Total Investment finance)
Change in Reserves and Errors and Omiss.		$\Delta RES + EO$ (Row vector of adjusted net changes in reserves[1] and E&O)	$\sum (\Delta RES_i + EO_i) = 0$ (Global net change in reserves and E&O)[1]
Total	$M_i + R^P_i + S_i$ (Total current payments to abroad and national savings)	$I_i + \Delta FA_i + \Delta RES_i + EO_i$ (Total investment, domestic and foreign)	

[1] The accounting of (changes in) reserve assets contains adjustment with respect to the standard balance-of-payments accounting rules to obtain symmetry in the recording of those reserve assets held abroad in the form of portfolio investment and other financial assets. The reserve holdings are a separate item in the flow of funds matrix, the remaining reserve transactions (gold, SDRs and use of IMF credits) are in the special account for reserve changes. See De Jong, Jellema, Vos & Zebregs (1993a: Appendix A.1) for further details on this adjustment.

savings and domestic investment per country group. The FOF (Flow of Funds) block defines the total international financial transactions between countries. The change in external liabilities are to be read in the rows and the change in external assets in the columns. The FOF block is also built up from a set of matrices that identify origin and destination of different types of international capital flows (direct investment, long-term capital, short-term capital, etc.). An exception to this form of presentation concerns the net changes in international reserves (net of LCFAR) and errors and omissions, which for each country (group) are the closing item of the balance of payments, but—as indicated—cannot be identified by origin and destination. These are presented in the FOF in a separate row vector with counterpart values only recorded where applicable (e.g. SDR creation with the IMF). The WAM as presented in Table 1 redefines the accounting rule of equation 1 as follows, whereby the superscripts R and P refer to respectively receipts and payments of factor income and transfers:

$$(6) \quad [\sum_{j}^{n} \sum_{k}^{o} E_{ijk} + \sum_{j}^{n} \sum_{l}^{p} R^R_{ijl}] + I_i \equiv [\sum_{j}^{n} \sum_{k}^{o} M_{ijk} + \sum_{i}^{n} \sum_{l}^{p} R^P_{ijl}] + S_i$$

$$(7) \quad S_i + \sum_{j}^{n} \sum_{m}^{q} \Delta FL_{ijm} \equiv I_i + \sum_{j}^{n} \sum_{m}^{q} \Delta FA_{ijm} + \Delta RES_i + EO_i$$

where: $i = 1 \ldots n =$ country (group), $k = 1 \ldots o =$ type of goods and services trans-
action, $l = 1 \ldots p =$ type of factor income and current transfer, $m = 1 \ldots q =$ type
of external asset (liability).

Aggregating over all (groups of) countries gives the global current account
and capital account transactions.

2.2. *Financial Flows: Concepts and Relation to the WAM*

The FOF block in Table 1 refers to international financial transactions, i.e.
to changes in external ("cross-the-border") assets and liabilities. The conceptualiz-
ation of foreign assets and liabilities is consistent with that of the Revised System
of National Accounts (SNA) of the UN (UN 1993) and the new manual of the
BOPS (IMF 1993). SNA and BOPS have now been fully harmonized, except that
the SNA basically follows a classification of transactions by financial instruments
(currency, equity, securities, loans, etc.), whereas the BOPS follows a functional
classification (direct investment, portfolio investment, other capital, reserves). The
two classifications can be abridged, but this would require that both systems
report all data at its full detail by institutional sector. On the whole, both systems
are now conceptually fully compatible, although in practice there is still much to
be done to meet these standards.[3] Harmonization of concepts is also being sought
with less comprehensive statistical systems like external debt statistics, as reported
by an inter-institutional Working Party of several international organizations.[4]

The national balance sheets of the SNA cover all (domestic and foreign)
financial assets and liabilities and provide consistent links to both savings and
investment balances and goods and services transactions. The balance of payments
records all foreign transactions. Since the WAM uses the same definitions as SNA
and BOPS, the core table should record transactions (*flows*) to which beginning
and end-of-period asset and liability positions (*stocks*) are attached with the same
format as the flow of funds tables for each financial instrument. The correspond-
ence between stocks and flows is not immediate, i.e. the change in assets and
liabilities between the beginning and end of period need not correspond to the
flows, due to revaluation of claims (liabilities) on account of currency exchange
rate changes, written-down values, capitalization of interest arrears, swap arrange-
ments, etc. Since all transaction and stock values in the WAM are denominated
in the same currency (U.S. dollars), currency conversions and exchange rate shifts
provide a critical valuation problem and explain a large part of revaluation of
the stocks of external claims and liabilities.

The new SNA and BOPS have now clearly defined concepts for the asset/
liability revaluation accounts, but these are as yet not accessibly available for any
country. For some data entries of the WAM, flow estimates had to be derived
from stock matrices where only primary data on stocks of assets and liabilities
are available. The matrices of external financial assets positions also serve to
check, complement and correct investment income and payments estimates in the
current account. If appropriate average rates of return (r_{ijm}) for each financial

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[3]See Vos (1995) for a discussion on the new SNA and BOPS manuals in relation to the world
accounting framework.
[4]See World Bank/IMF/BIS/OECD (1988) and Galbis (1991).

asset/liability are known and if it is reasonable to assume that all investment income is transferred back to the country of residence of the owner, then, in principle, there should exist a direct relationship between the matrix of current investment income-payments and the matrix of outstanding assets and liabilities:

$$(8) \qquad\qquad R_{ijm_t} = r_{ijm_t} \mathrm{FA}_{ijm_{t-1}}.$$

However, both the information on appropriate average rates of return and the assumption about investment income remittances are problematic in practice. These specific elements of the construction methodology will be detailed in section 4.

3. An Aggregated Reconciled WAM for 1990

By way of illustration, an aggregated reconciled WAM for 1990 is presented in Table 2.[5] The WAM has been aggregated to 9 countries and country groups, based on a fully balanced WAM for 23 country groups. The table shows full consistency with the accounting rules defined above. That is, row and column totals are equal for each account, but it can also be checked that the current account balance of each country equals the savings-investment balance and the net change in external assets. For instance, identity (1) holds as follows for respectively the U.S.A. and Japan (in billions of U.S.$):

	Current Account Balance	Savings-Investment	Change Foreign (Assets − Liabil.) + (RES. & EO)	Total
U.S.A.	668.1 − 733.1	= 814.0 − 879.0 =	67.4 − 100.3 − 0.2 − 32.0	= −65.0
Japan	421.8 − 402.4	= 993.8 − 974.4 =	107.5 − 114.5 − 0.3 + 26.8	= 19.4

Comparing Table 2 with Table 1, it can also be read that in accordance with the accounting rules in equations 6 and 7 (in the case of the U.S.A.):
1. the sum of export receipts, transfers and factor receipts from abroad and gross domestic investments (668.1 + 879.0 = 1547.1) equals the sum of payments for imports, transfers and factor payments to abroad and gross national savings (733.1 + 814.0 = 1547.1); and
2. the sum of gross national savings and changes in external financial liabilities (814.0 + 100.3 = 914.3) equals the sum of gross domestic investments, changes in external financial assets and net changes in reserves and errors and omissions (879.0 + 67.4 − 0.2 − 32.0 = 914.3).

The WAM also allows for a rapid identification of the bilateral balances on current and capital account transactions. Summarizing these balances for

[5]The WAM for 1990 is part of a series of WAMs constructed with the same methodology for 1985–90, with matrices for more recent years being underway. See De Jong, Jellema, Vos and Zebregs (1993a, b). WAMs for 1970, 1975, 1980, and 1985 with different country classifications and a slightly more reduced data coverage are documented and analyzed in Luttik (1992).

TABLE 2
BALANCED WORLD ACCOUNTING MATRIX FOR 1990 (US$ billions)

	Current Account										Capital Account										
	USA	JAP	DEU	GBR	ODC	EEU	LDC	OBC	INT	Subtot	USA	JAP	DEU	GBR	ODC	EEU	LDC	OBC	INT	Subtot	Total
Current Account																					
USA	0.0	106.6	40.0	60.7	248.6	6.0	181.7	22.4	2.1	668.1	879.0									879.0	1547.1
JAP	103.7	0.0	24.8	27.3	107.9	4.0	119.3	25.4	9.3	421.8		974.4								974.4	1396.2
DEU	51.4	18.0	0.0	52.8	305.6	19.1	63.0	6.0	6.8	522.8			349.1							349.1	871.9
GBR	67.3	39.7	39.2	0.0	184.2	6.8	44.4	6.7	2.2	390.5				174.0						174.0	564.5
ODC	240.8	95.1	286.3	196.0	735.7	34.2	219.2	26.4	23.1	1856.8					1196.8					1196.8	3053.7
EEU	4.8	4.7	16.7	3.9	37.3	38.6	29.3	0.6	0.2	136.1						316.5				316.5	452.6
LDC	218.1	118.1	67.5	38.1	228.4	24.1	154.5	62.5	11.5	922.8							777.0			777.0	1699.8
OBC	40.8	17.5	10.6	13.9	17.3	1.2	55.6	8.1	3.9	168.9								34.2		34.2	203.1
INT	6.0	2.7	6.1	4.1	24.1	0.3	15.3	0.5	16.2	75.3									0.0	0.0	75.3
Subtot	733.1	402.4	491.1	396.8	1889.1	134.5	882.1	158.7	75.3	5163.2	879.0	974.4	349.1	174.0	1196.8	316.5	777.0	34.2	0.0	4701.0	9864.2
Capital Account																					
USA	814.0									814.0	0.0	15.0	9.5	28.5	44.7	0.7	3.4	−3.2	1.7	100.3	914.3
JAP		993.8								993.8	2.6	0.0	16.3	32.8	50.8	1.3	10.5	1.4	−1.2	114.5	1108.3
DEU			380.8							380.8	3.2	−0.0	0.0	21.2	31.6	0.0	2.9	3.9	1.3	64.2	445.1
GBR				167.6						167.6	4.5	6.9	25.5	0.0	89.4	−0.0	10.5	3.3	1.0	141.1	308.7
ODC					1164.5					1164.5	29.7	62.0	50.4	55.4	176.4	0.8	79.8	11.9	6.9	473.4	1637.9
EEU						318.1				318.1	0.0	−0.1	4.5	−2.3	−1.6	−0.4	0.1	−0.1	0.6	0.6	318.7
LDC							817.7			817.7	20.9	16.6	2.2	4.2	19.2	−0.5	0.6	2.4	14.2	79.8	897.5
OBC								44.4		44.4	4.5	2.0	0.4	0.9	4.0	0.0	0.4	0.1	0.2	12.4	56.8
INT									0.0	0.0	2.1	5.1	2.8	4.1	11.0	0.1	3.1	0.3	0.6	29.2	29.2
Subtot	814.0	993.8	380.8	167.6	1164.5	318.1	817.7	44.4	0.0	4701.0	67.4	107.5	111.6	144.7	425.5	2.2	111.2	20.0	25.4	1015.5	5716.6
Other Reserves											−0.2	−0.3	−0.7	0.0	0.1	1.0	−2.1	−0.1	2.3	0.0	0.0
Errors & Omissions											−32.0	26.8	−15.0	−10.0	15.5	−1.0	11.3	2.8	1.5	0.0	0.0
Total	1547.1	1396.2	871.9	564.5	3053.7	452.6	1699.8	203.1	75.3	9864.2	914.3	1108.3	445.1	308.7	1637.9	318.7	897.5	56.8	29.2	5716.6	15580.7

Note: USA = United States; JAP = Japan; DEU = Germany; GBR = United Kingdom; ODC = Other Developed Countries (Groups 2, 5, 6, 8 to 11); EEU = Eastern Europe (Groups 12 and 13); LDC = Developing Countries (Groups 14 to 21 and 99); OBC = Offshore Banking Centers (Group 22); INT = International Organisations (Group 23)

U.S.-Japan and U.S.-LDCs, one can read from Table 2:

	Current Account Balance	Capital account Balance (net acquis. of assets)
U.S.–Japan	$103.7 - 106.6 = -2.9$	$2.6 - 15.0 = -12.4$
U.S.–LDCs	$181.7 - 218.1 = -36.4$	$20.9 - 3.4 = +17.5$

We can thus directly read from the WAM that the U.S. runs current account deficits with both Japan and the group of developing countries, that it borrows from Japan to finance its external deficit, but that it nevertheless remains a net creditor to developing countries. These numbers suggest a significantly smaller U.S. deficit in trade and factor payments with Japan than officially recorded and also a smaller inflow of Japanese capital.

4. Classifications, Data Sources and Construction Methodology

4.1. Classification of Country Groups

In the present WAM, the main classification criterion for the country groups for the developed countries is the nature of their insertion into platforms of international policy making: the G-7 countries are included separately; the rest of the EC members and the EFTA countries form two complementary groups and the rest of OECD (Australia and New Zealand) complete the OECD bloc. The (former) CMEA is taken as a separate bloc, though the former U.S.S.R. is singled out. Developing countries are classified conventionally by geographical location. In addition, there is a group of "Offshore banking centres," comprising small economies by themselves, but with a disproportional share in international financial transactions. Finally, an international unit of analysis is singled out in the form of multilateral financial institutions.[6]

4.2 Classification of Transactions and Identification of Data Sources

The domestic transactions included are *Gross National Savings* (GNS) and *Gross Domestic Investments* (GDI). The World Bank's World Tables (WT) serve as the main data source for these transactions. A complementary source for countries not covered in the World Tables is the DEC analytical data base (DAD) of the World Bank.[7] The classification of international transactions largely follows that of the BOPS, which is also the main data source for most of these transactions. Capital flows are distinguished into the following categories: direct foreign investment (DFI); portfolio investment, including foreign-exchange reserves held abroad in this form (PFI); other capital, comprising long-term and short-term

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[6]The classification was defined to match existing classifications for the Project LINK. See Luttik (1992) for a more analytical classification of countries, i.e. by the structure of external finance and access to international capital markets.

[7]In practice, the additional figures for GDI are taken from the indicated source, while GNS estimates are derived as a residual. DAD was not used for the other countries, since this data system is an *analytical* system by itself has procedures of its own to adjust and reconcile primary data from different sources.

debt-creating capital flows, including reserve position in IMF and foreign-exchange reserves held in this form (OC); monetary gold, SDRs, use of IMF credit and other net changes in reserves n.e.c. (RES); and net errors and omissions (EO).[8] Each broad category (except RES and EO) should for each country (group) define the change in corresponding *asset* and *liability* positions, corrected for asset/liability revaluations. In the case of Eastern Europe and developing countries, the *Debtor Reporting System* (DRS) of the World Bank, instead of the BOPS is the principal data source for the changes in liabilities of OC and PFI. Conceptually, apart from bonds, the DRS and the world debt tables (WDT) that are derived from that system are consistent with the balance of payments concept of "other long-term and short-term financial liabilities."[9] The DRS data are available for flows and stocks (as well as for investment income and interest arrears), with a breakdown into (bilateral and multilateral) official capital and private (publicly guaranteed and non-guaranteed) capital. These data are also reported by the country of origin of creditors. Hence the DRS also forms a major data source for the construction of the interior of the sub-matrices for OC and PFI. WDT data was used for the liabilities of the former U.S.S.R., and BIS data for assets. BIS data was also used for claims and liabilities of other capital of the Offshore Banking Centres. Asset and liability positions of international organizations were taken from IMF (1992).

The current account transactions distinguished in the WAM are: trade; shipment, passenger services and other transportation; travel; inter-official transactions; direct foreign investment income; other investment income; labour and property income; other goods, services and income; private transfers; and, official transfers.[10] For *Merchandise Trade*, the principal source is provided by the UN *Trade Matrices* (UNTMS), which provide bilateral export and import flows (based on recordings of imports) for 79 countries and country groups with close to full world coverage.[11] The UNTMS form by themselves already reconciled data sets with many adjustments to the primary data. For the future it would be recommendable to use the original merchandise trade data as an input to the WAM framework and balance the trade matrices along the other transaction matrices.

Investment income and payments (including interest arrears) are detailed by type of financial assets and liabilities as defined in the DRS. The OECD *Geographical Distribution of Financial Flows to Developing Countries* forms a basis for the interior of the sub-matrix of official transfers. Data on shipment, passenger services and other transportation from BOPS have been adjusted by using UNCTAD

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[8]For details, see De Jong, Vos, Jellema and Zebregs 1993a, Appendix A.1.

[9]See World Bank/IMF/BIS/OECD 1988: 7; and World Bank, *World Debt Tables, 1990–91*, Vol. I: 2. For the correspondence to the items of the Balance of Payment Statistics, see De Jong, Vos, Jellema and Zebregs 1993a, b. In the case of Latin America and Southeast Asia equities have begun to form a substantial part of total PFI, so the BOPS changes in liabilities of equity investment have been added to the *DRS* total of bonds.

[10]See De Jong, Vos, Jellema and Zebregs, 1993b, for the corresponding items in the Balance of Payments.

[11]Some corrections were made to the UN trade matrices using the IMF's Direction of Trade Statistics (DOTS) in order to adjust for country coverage deficiencies

data on shipment tonnage, based on the approach followed in IMF (1987), whereby the discrepancy is assumed to be related to the "missing" fleet.[12] Data on bilateral flows of *other current account transactions* (travel, direct investment income, other investment income and transfers) have, to the extent available, been taken from individual country sources, except for interest income covered by the DRS.

Additional estimates for Other Asia, Other Africa, Eastern Europe and Middle East as well as for International Organizations have been obtained on the basis of BOPS Yearbook 1992, Part 2.

4.3. *Initial Reference Totals and Discrepancies*

After identification of the principal data sources, the initial reference totals for the variables of the accounting framework are considered, i.e. the global aggregates of GNS and GDI taken from the World Tables 1992 and the aggregates of international transactions taken from the Balance of Payments Yearbook 1992. Table 3 shows the global discrepancies between GNS and GDI, between exports and imports plus net factor payments and transfers, and, finally, between the change in financial assets and the change in financial liabilities, in line with the accounting identities of section 2. It can be seen, for instance, that the global savings-investment balance was 47.9 billion dollars in 1990. The global current account discrepancy, which more or less equaled the capital account discrepancy in the BOPS, was 106.0.[13]

The table also clearly indicates that the observed global current and capital account discrepancies are the balance of deficits and surpluses in the various transaction accounts. The major discrepancy on the current account is found in other investment income (mainly interest income on external financial assets), which is larger than the aggregate current account deficit and which corresponds to a higher estimate of the recordings of interest payments vis-à-vis receipts. This current account discrepancy corresponds to the apparent tendency to under-record foreign financial asset acquisitions, as the global deficit on "Other Capital" in the capital account indicates.

4.4. *Use of Additional Data Sources for Reference Totals*

The next step is to adjust the original BOPS reference totals along the criteria indicated in sub-section 4.2. This leads to the "adjusted" global discrepancies given in the second column of Table 3. The adjustments have led to higher values for both savings and investment, but on balance to a reduction of the global savings gap from U.S.$ 47.9 to 20.5 billion in 1990. The global current account deficit is reduced initially from U.S.$ 106.0 to 101.6 billion. By definition, the

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[12]In IMF (1987:90) it is concluded that "...the relative stability over time of the ratio between the discrepancy on shipment and total 'shipment' debits indicates that the principal cause of the discrepancy has prbably been correctly identified as the 'missing' fleets."

[13]The primary data source for the world current and capital account balances is the BOPS. Since the balance of payments for each country is consistent in this source, the global current and capital account discrepancies should be equal. The small difference in Table 3 is due to incompleness of the balance of payments for a few countries.

TABLE 3

SUMMARY TABLE OF GLOBAL DISCREPANCIES 1990 BEFORE AND
AFTER INITIAL ADJUSTMENTS ·
(billions of U.S.$)

		Before	After
GNS–GDI		−47.9	−20.5
Current Account		−106.0	−101.6
TX	Trade Balance	2.0	−0.0
C1X	Shipment and other transportation	−35.2	0.0
C2X	Travel	3.2	1.0
C3X	Interofficial	−0.0	−11.3
C4X	DFI income/payments flows	45.5	44.3
C5X	Other investment income	−108.3	−121.1
C6X	Labour and property income	−5.4	−5.9
C7X	Other goods, services and income	20.5	14.2
C8X	Private transfers	6.6	5.8
C9X	Official transfers	−34.8	−28.7
Capital Account[1]		−105.6	−83.0
K1X	DFI Net	33.7	37.2
K2X	Portfolio Investment	−5.7	42.7
K3X	Other Capital	−210.6	−135.6
K4X	Reserves: Net[2]	104.7	−2.2
EOX	Net Errors & Omissions	−27.8	−25.1

Source: IMF, Balance of Payments Statistics, computer tapes and World
Bank, World Tables, for column 1 (before adjustments) and De Jong, Jellema,
Vos and Zebregs (1993b) for adjusted data (column 2).
[1] Capital account balance defined as change in assets *less* liabilities, i.e. nega-
tive figure means that existing data record a global excess of outward capital
flows over inward flows.
[2] Including foreign exchange holdings and reserve position in IMF.

replacement of the BOPS totals for merchandise trade by those of the consistent
trade matrix renders a zero global discrepancy on merchandise trade. The remain-
ing discrepancy on the current account thus stems from the, partially offsetting,
imbalances on non-merchandise trade current account transactions, especially on
the account for other interest incomes. The indicated adjustments for the capital
account items have led to a reduction of the global discrepancy (showing an excess
of the change in liabilities over that in assets) from U.S.$ 105.6 to 83.0 billion.

4.5. Construction of Interiors of Sub-Matrices

The following step is to cross-check these global inconsistencies with data by
origin and destination. Whenever no direct data was available, the interiors of
sub-matrices had to be derived indirectly from several sources and on the basis
of specific construction methodologies, building on other variables in the system.
As a result of this approach, discrepancies arise between the *column* (row) totals
of the derived matrix and the reference totals for the rows (columns). These are
adjusted later as part of the overall balancing procedure. For example, the interior
of the shipment services matrix has been constructed by using the reference totals
for receipts (row total in the WAM) and assuming a direct relationship between
the geographical pattern of merchandise trade and services in shipment. It is thus

implicitly assumed that *exporting* countries also carry out the transportation of the merchandise.

The sub-matrices for direct investment income and for other investment income have been constructed on the basis of an assumed link between the geographical distribution interest payments with the distribution of the end-of-1989 outstanding stocks of DFI, PFI and OC.

In the capital account sub-matrices, the apportionment of unallocated totals and unknowns has been made by distributing the unallocated part of total asset changes of country i in correspondence with the distribution of total changes in liabilities of countries j. In the case of DFI, the matrix of primary estimates is based on outward DFI, because these are considered to be recorded with a higher degree of accuracy than inward DFI (see also Dunning and Cantwell, 1987; IMF, 1987). In contrast, except for the parts based on DRS data, the data on inward flows are the starting points in the construction of the matrices of PFI and OC, on the assumption of better recording on the liability side.[14] A significant part of portfolio investment consists of international bonds. Bond issues are presumably recorded better on the debtor side, as purchases may be spread over many creditors. Also for other equity investment, it may be held that there is greater accuracy in the recording on the liability side. The geographical distribution of other capital flows for the industrialized countries were derived from official data sources of the major OECD countries. Most of these sources only provide *stock* data with a geographical breakdown. Due to a lack of information it was not possible to single out changes in assets and liabilities due to new transactions (flows) and other than revaluation of stocks due to exchange rate changes and other value adjustments. The difference between end-of-year stocks had to be taken as a proxy for the distribution of the flow during the year. The geographical breakdown of the changes in stocks served as proxy distributions of the flows and have been applied to the relevant reference total of flows.[15]

5. Reconciliation of the Data within the WAM Framework

The process of data reconciliation involved two steps. Firstly, manual adjustments were introduced to complete and adjust the capital transactions matrices using complementary data sources, most of which derived from official statistics for individual countries. The nature of these adjustments was already discussed above. Secondly, as a final procedure a mathematical balancing technique was applied, adapting the Stone-Byron methodology developed for balancing input-output tables and social accounting matrices. This methodology adapted to the WAM is outlined in Appendix A.1.

Obviously, given the large remaining discrepancies, mathematical balancing procedures of this kind should be used with extreme caution. Nevertheless, the results may be considered to be an advance, since data are adjusted within a narrowly defined system of accounting identities and constraints. Further, the

[14]Cf. IMF; 1987, 1992.

[15]See Appendix A.2 of the report on the WAMs for 1985–88 for the details on this methodology (De Jong, Vos, Jellema and Zebregs, 1993a)

adapted balancing method takes account of the full information incorporated in the overall WAM database, including the use of more than one observation per cell, and allows the manipulation of pre-set degrees of reliability for each observation. The latter should be (and has been) based on a cautious assessment of the nature and quality of the different data sources used in the WAM. In broad terms, the following main assumptions about the reliability of the data sources and primary estimates were used:[16]

————Merchandise import recordings are considered more reliable than export recordings.

————Recordings of outward direct foreign investment (stocks and flows) and related income flows are considered more reliable than inward recordings following assessments of other studies (IMF, 1987, 1992 and related background papers). One reason behind this assumption is that the largest foreign investors reside in the major industrialized countries (U.S., Japan, Germany, U.K.), which have detailed and, seemingly, reasonably accurate DFI data. Further, a major component of DFI flows consists of "reinvested earnings" which tend to be recorded with greater reliability in the country of origin (IMF, 1987).

————In contrast, recordings of capital *inflows* related to portfolio investment, bank lending and other capital and related flows of interest payments are generally considered more reliable than the recording on the asset side (*Ibid.*). Bond issues as well as external debt data tend to be better recorded at the debtor side, since purchases may be spread over many creditors.

————Several exceptions to these rules are made for the entries for specific (groups of) countries, as detailed in De Jong, Vos, Jellema, & Zebregs (1993a, b).

Sensitivity analysis for these data source reliability assumptions indicates that results may differ significantly if the broad assumptions would be reversed, that is if one would assign higher reliability to inward rather than to outward recordings, and so on. Altering the degree of differential reliability within a given broad assumption, for instance assuming that inward recording is twice rather than four times as reliable, would not yield significantly different results.

Table 2 presents the balanced accounts of the WAM for 1990 in an aggregate form. For the WAM presentation at its full breakdown for 23 country groups and a sector of international organizations and all indicated transaction items, see De Jong, Vos, Jellema and Zebregs (1993b).[17] The principal adjustments of the reconciled WAM data with respect to the primary data are discussed in the next section.

As a general comment to the overall results, we would like to state that if one can accept the general assessment of the quality of the various data sources, then the WAM balancing procedure should adjust the global discrepancies—roughly speaking—in the right direction. Roughly, because the indicated shortcomings in the primary data would still leave a potentially significant margin of

[16]See De Jong, Vos, Jellema and Zebregs (1993a: Section 6.4 and Appendix A.3) for a detailed description of the methodology and the assumptions on data source reliability used in the reconcilliation procedure.
[17]This working paper can be ordered from the Institute of Social Studies, Publications Office, P.O. Box 29776, 2502 LT The Hague, The Netherlands. A diskette with the detailed WAM data can be obtained from the authors on request.

error. However, as is generally also the case with input-output tables and social accounting matrices, cross-checking data as in the WAM framework not only helps to detect the flaws in the data on international trade and payments, but also allows for well-informed adjustments.

6. The Balanced WAM for 1990 and the Adjustment of the Global Statistical Discrepancies

Table 3 showed the large global discrepancies on the various items of the external current and capital accounts. The WAM has reconciled inward and outward recordings at the global level. To achieve this global consistency, major adjustments have been made to all accounts, affecting the size and structure of the external balance of the major economies in the global system. Since the underlying causes of the discrepancies on the various components of the external account differ, as explained above, the adjustments do not follow a clear-cut and unidirectional pattern towards the elimination of the officially recorded global current account deficit. A summary of the adjustments to the current account balances of the 23 country groups of the disaggregated WAM is shown in Table 4. It should be emphasized that the adjustments shown in the table are *net*, that is the balance of positive and negative adjustments in the various debit and credit transaction items of the current account balances. Without entering in great detail here, the major adjustments to deal with the (*net*) world current account deficit of U.S.$ 106 billion in 1990 include the following.[18]

———A substantially lower current account deficit for the U.S.A. than that is recorded. The U.S. external deficit as (re)estimated by the WAM is U.S.$ 65 billion in 1990, which is about U.S.$ 20 billion lower than the recorded deficit after the first corrections and combination of data sources. National accounts estimates already indicate a much lower savings-investment gap for the U.S.A., but according to the global consistency check of the WAM this source seems to *underestimate* the U.S. deficit and the savings-investment gap is adjusted upward by about U.S.$ 30 billion. The main adjustments on the external account occur in the accounts for profit earnings from DFI and other investment income. The balanced world asset/liabilities matrix indicates a smaller net debtor position for the U.S.A. and a lower estimate of interest payments on external liabilities and a higher income on external assets (partly, related to under-recording of asset holdings of residents from developing countries). On the other hand, the WAM gives a lower estimate for U.S. earnings on DFI, but this correction is less than the downward adjustments on the expenditure side. The capital account counterpart to these current account adjustments is principally an upward correction of U.S. external lending (OC).

———The *Japanese* external surplus in fact may have been much smaller in 1990 than officially recorded. The WAM estimates a surplus of about U.S.$ 20 billion, some U.S.$ 37 billion less than according to the (adjusted) primary data. The adjustments appear principally on the account for merchandise trade, as the UN

[18]See De Jong, Jellema, Vos and Zebregs (1993a, b) for detailed accounts of the adjustments in the WAMs for 1985–90.

TABLE 4
CURRENT ACCOUNT BALANCES IN 1990 BEFORE AND AFTER INITIAL ADJUSTMENTS AND
ACCORDING TO WAM RECONCILIATION

	Balances Before Initial Adjustments	Balances After Initial Adjustments	WAM-reconciled Balances
Major developed	−37.7	−52.2	−20.2
USA	−90.5	−85.7	−65.0
Japan	35.9	56.5	19.4
Germany	46.3	18.9	31.7
UK	−29.4	−41.8	−6.3
Other developed	−69.5	−66.7	32.3
Canada	−22.0	−22.9	22.3
France	−13.8	−12.6	−13.0
Italy	−14.4	−20.6	−24.4
Other EC	−4.2	−1.9	−2.6
Other Europe	−2.0	8.1	42.1
Other OECD	−16.0	−16.6	−15.1
Israel & South Africa	2.8	−0.1	3.0
Eastern Europe	0.2	−5.9	1.6
U.S.S.R.	0.0	−13.8	2.2
Other Eastern Europe	0.2	7.9	−0.6
Developing countries	−1.4	47.4	40.7
LDC Europe	−5.0	−3.3	−3.9
North Africa	15.8	21.5	10.4
Sub-Sahara Africa	−0.3	−18.7	−2.0
Latin America & Caribbean	−2.8	9.4	26.6
Middle East	−1.5	0.6	8.4
South Asia	−2.6	−4.6	7.0
China	12.0	37.0	16.3
South-East Asia	−16.9	2.6	−8.0
Other, n.e.c.	−0.2	2.9	−0.1
Offshore banking centres	2.5	−31.9	10.2
International and multilateral organizations	0.0	7.7	0.0
World	−106.0	−101.6	0.0

Source: De Jong, Vos, Jellema and Zebregs (1993b).

trade matrices give a lower estimate for Japanese exports, and on the investment income account, which relates to the smaller net creditor position for Japan through WAM measurement. Lower estimates for Japanese portfolio investment abroad (PFI) and external lending (OC) form the counterpart to the trade and income adjustments.

——For the U.K., the WAM records a smaller external deficit for 1990, principally resulting from a higher estimate of interest incomes on outstanding portfolio investment and other foreign financial assets. This probably has to do with inadequate official recording of the capital movements in the international financial market in London. After cross-checking the origin and destination of global capital flows, the WAM produced a more favourable net investment position for the U.K., which—in part—formed the basis for the adjustments in the investment income data.

————*Other industrialized countries* show on balance larger current account surpluses (or smaller deficits), particularly where large financial centres reside (such as in Switzerland). Adjustments concentrate again in the investment income account.

————External accounts of some developing country groups also required major adjustments. For *Latin America*, the WAM shows a higher current account surplus in 1990: U.S.$ 27 billion compared to U.S.$ 10 billion according to primary data (after the first round of corrections). The WAM gives a higher estimate for Latin American merchandise exports, as the cross-checking by origin and destination may have corrected for some of the measurement errors in official sources due to under-invoicing of exports and illegal trade. One cannot be sure, however, that this adjustment fully captures drugs trade and other illegal exports, as such transactions are typically poorly recorded at both the origin and the destination. Another major adjustment in the Latin American accounts is for under-recorded earnings on external asset holdings, likely related to "capital flight" money. The WAM further gives a significantly lower estimate of merchandise exports from China (down by about U.S.$ 15 billion), but—for possibly similar reasons as in the Latin American case—gives a somewhat higher estimate for commodity exports of *Sub-Saharan Africa*. The external (current account) deficit of the latter region is adjusted further downward as the WAM estimates, after cross-checking with OECD data, that official transfers to the region may be underestimated in the BOPS. Finally, *East Asian* trade surpluses are slightly scaled down in the WAM compared to the individual country recordings in the BOPS.

————Finally, an important part of the adjustment in the global discrepancy in the investment income account takes place in the books of the *Offshore banking centres*. Many of the capital that finds a (temporary) haven in these usually small countries goes unrecorded in the BOPS and other data sources. For some of these countries BOPS and national accounts data are incomplete or not available. Combining international banking statistics and origin-destination estimates leads us to believe, through the WAM, that these centres have a strong positive net investment position and larger current account surpluses due to investment income than officially recorded.

7. CONCLUSIONS

The full harmonization of the SNA and the BOPS is good news for students of problems of international trade and payments. With the two revised systems, the construction of consistent balance sheet accounts by institutional agents will become, hopefully soon, widespread and standardized practice and will allow for improved applied analysis of the impact of (domestic and international) portfolio adjustments on production and income distribution. Yet, many of the practical problems in the measurement of trade and payments will not automatically disappear with the revised SNA/BOPS. The existing data frameworks still show huge discrepancies when set to a test of global accounting consistency rules. The main proposal of this paper is that the revised SNA/BOPS should be extended towards a system of integrated accounts for the world economy. This could be done along the lines of the WAM framework outlined in this paper. The reconciled

global accounts yield substantially revised estimates for the external accounts of the major economies: a U.S. deficit much lower than shown in the BOPS and U.S. national data sources, but the WAM also suggests that the Japanese savings surplus is grossly overestimated, while groups of developing countries may have had smaller external deficits in 1990 than recorded by the official data.

This has potentially large implications for the analysis of trade, finance and global macroeconomic interactions. As indicated in section 6, the results of the WAM still have to be taken with great caution given the prevailing data weaknesses and the assumptions required to balance the global accounts. Yet, one is inclined to believe that the accuracy of the data can be enhanced this way, as the information of the global accounting constraints is added to the external accounts of individual countries.

Global model systems which have some influence in international policy decision making, such as Project LINK (see Pauly, 1993), MULTIMOD (Masson *et al.*, 1990), INTERLINK (Richardson 1988), the World Bank's GEM (see Petersen *et al.*, 1991) and the MSG model (McKibbin and Sachs 1991), generally ignore the global inconsistencies or have implicitly residualized them in a "rest of the world" country group, or otherwise.[19] These models obviously require working from a consistent set of global accounts, which could be provided through the WAM. In the case of the Project LINK, for instance, the global linkages are in fact only defined through trade matrices. The system specifies import demand and export supply functions for the countries in the system, which implies that trade balances are endogenous and, *ex hypothesi*, capital flows are accommodating. The WAM would allow for a consistent data base for all current account and capital account components, thereby providing a starting point for the explicit modelling of capital flows and asset demand and for the introduction of a distinct, and possibly more realistic, modelling of the global adjustment process which gives greater importance to capital movements. The MSG model gives greater weight to global financial linkages and even presents a consolidated asset/liability matrix for a reduced number of country groups, providing the base year values of international asset positions. McKibbin and Sachs (1991) acknowledge that their matrix was constructed with little scrutiny. Their estimates deviate widely from the balanced asset/liability matrices that form part of the WAM data base. The WAM provides a more carefully constructed and more disaggregated matrix of international asset positions and, moreover, distinguishes between various types of assets. This way, the WAM may provide the basis for a more comprehensive modelling of the global linkages.

Even so, much more work needs to be done to improve the system and allow for wider applicability. We would like to mention a few priority areas:

(a) WAMs are now available for 1985-90, but with longer time series econometric modelling directly based on WAM data would become feasible.

(b) Much of the international flow-of-funds matrix reflects net acquisitions of assets or liabilities (e.g. disbursements less repayments, etc.) and not all sources produce simultaneously consistent stock and flow data. The existence of negative entries in the flow of funds creates difficulties in the balancing procedure. It should

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[19]See Vos (1993 and 1994) for a review of existing model systems and their policy relevance.

be recommended that primary data sources (including SNA and BOPS) produce all data in gross terms and insist on a full-fledged stock-flow accounting. Further, data on the currency composition are only partly available, that is only for certain assets and certain country groups (e.g. for the debt data comprised in the World Bank Debtor Reporting System). Currency composition will be an important input in obtaining a more accurate estimation of asset/liability revaluations. At present, the WAM system can only produce revaluation accounts as the residual of the change in assets/liabilities (stocks in year t *less* year t-1) and the flow-of-funds matrix. However, derived this way the revaluation accounts do not distinguish between exchange rate changes and other revaluations and moreover may incorporate estimation errors resulting from the balancing procedure.

(c) Some initial assessment of WAMs valued at constant prices has been undertaken (FitzGerald and Vos, 1991; De Jong and Vos, 1994), but many data and methodological issues remain. Data limitations involve the earlier mentioned lack of data on the currency composition of international financial transactions, as well as of current account transactions. Such information would be needed to estimate matrices at constant exchange rates. The choice of appropriate deflators is a central methodological problem in estimating WAM entries at constant prices. The deflator choice will depend in part on the analytical purpose. Import or export price deflators could be used for studies of trade or foreign exchange constraints (import capacity) on real economic growth. These would then also be applied to flow of funds data on the assumption that these transactions represent the financing of import capacity or the purchase of "options" on future commodity flows. In this procedure, terms of trade effects would result as a balancing item of the constant price WAM. However, for international portfolio analysis the use of other deflators (GDP deflator or CPI of major currency countries) and asset prices may be more relevant. Hence, this is an area for further exploration.

Clearly, the work presented here is just a beginning. One would hope that the UN, the IMF, the World Bank and other international organizations will take up this challenge and expand the SNA/BOPS framework into a true system of consistent global accounts. In this paper we have tried to lay the foundations for such a system.

APPENDIX A.1: THE BALANCING METHOD

This Appendix briefly describes the balancing technique used for the reconciliation of the WAM, which is an adaptation of the technique proposed by Stone (1977) and extended by Byron (1978). The method was developed for application to large data systems such as Social Accounting Matrices and Input–Output tables, which have less complex and smaller accounting structures than the WAM.

The balancing method is based on the Lagrangian multiplier technique, which provides a consistent method of obtaining balanced accounting structures. This allows for the specification of prior information concerning the reliability of the various estimates, as well as the use of multiple estimates and, in principle, the estimation of cells in the accounting structure for which no prior information is

available. It does not require the use non-negative data in cells, nor the use of reference totals.

Consider a set of *a priori* estimates, which can be represented by a vector x^0. Corresponding to each of the elements of x^0 a measure of reliability can be established, such that there is also a vector of weights v. The accounting structure which provides the constraints can be expressed by a matrix G, such that:

(A.1) $$Gx - h = 0$$

where x depicts a vector satisfying the accounting constraints, and h represents a vector of constants in the constraints.

For any x^0 which does not satisfy $Gx^0 - h = 0$, a constrained optimization problem can be set up which can be represented by the following Lagrangian:

(A.2) $$\text{minimize } L = \tfrac{1}{2}(x^1 - x^0)'\hat{v}^{-1}(x^1 - x^0) + \lambda(Gx^1 - h)$$

where $\hat{v}^0$ denotes the diagonalized vector v^0, λ is a vector containing Lagrange multipliers. The first order conditions of this problem are:

(A.3)
$$x^1 = x^0 - \hat{v}G'\lambda$$
$$Gx^1 - h = 0$$

such that

(A.4) $$\lambda = (G\hat{v}G')^{-1}(Gx^0 - h).$$

For relatively small problems, such as the example given by Stone (1977), the inversion of (GVG') will not cause a problem, but for a large matrix it is likely to provide practical problems in terms of storage and time required to obtain a solution. A better way, due to Byron (1978), is to view (A.3) as a system of linear equations. This can be solved for λ without calculating the inverse using the *conjugate gradients algorithm*. The algorithm allows GVG' to be stored efficiently, because it preserves the original structure of the matrix. The efficiency of this approach comes in two parts. First of all, the storage requirements for this problem are now limited to GVG', and a number of vectors. Secondly, GVG' has a very sparse structure, due to the sparseness of G and V, and is symmetric positive definite.

The Lagrangian method offers great advantages when there are multiple *a priori* estimates for particular elements of x^0 (see Byron, 1978). Within the context of the WAM, this can be used to incorporate data by country of origin and by country of destination in the same sub-matrix.

In principle, in the WAM there are independent estimates for interiors and marginal elements of each sub-matrix. With n being the number of countries distinguished, each sub-matrix of the CA and FOF-blocks of the WAM specifies $2n + 1$ constraints, of which one is linearly dependent. So each of the sub-matrices has $2n$ independent constraints. In the cases of Other Reserves and of Net Errors and Omissions, the interior matrix cannot be formed, because no bilateral data are available. Then the remaining restrictions are zero global totals. The marginal totals of the entire WAM are however not obtained as independent data and can for this reason not enter the balancing process as *a priori* estimates. Instead, the

marginals from each sub-matrix form the basis of the constraints matrix for the entire WAM. The system of constraints is overdetermined, however: of the $2n$ global constraints of the WAM one is a linear combination of the others and needs to be dropped. The interrelated two-dimensional sub-matrices of the WAM are vectorized and a constraint matrix is constructed based on the vectorized representation of the data and the accounting constraints.

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