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Measuring global flow of funds: focus on China, Japan, and the United States

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ABSTRACT

This paper aims to establish a new statistical framework for measuring global flow of funds (GFF) based on its inherent mechanisms. It advances a previous theoretical discussion and develops a practical operational statistical matrix. Based on theoretical and practical possibilities the paper gets existing data from the International Investment Position, the Coordinated Direct Investment Survey, the Coordinated Portfolio Investment Survey, and International Banking Statistics are integrated for measuring GFF. The main outcome is a prototype GFF matrix that includes stock data geographically disaggregated by country/region and selected financial instruments. The paper presented GFF Matrix compiled with the pattern of 'Country vis-à-vis Country' matrix, and through using the GFF matrix to analyze the basic status, mutual relationship and existing problems between China, Japan, and the United States in the external financial positions.

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Global flow of funds; statistical framework; data sources; statistical matrix; financial crisis

1. Introduction

The global flow of funds (GFF) concept is an extension of that for the domestic flow of funds first developed by Copeland (1952). It connects domestic economies with the rest of the world. GFF data can provide valuable information for analyzing interconnectedness across borders and global financial interdependencies. Corresponding to the deregulation of the financial market, researchers began exploring the GFF in the 1990s. Ishida (1993) put forward the notion of GFF analysis, discussed the concept, and then measured the international capital flows among Japan, the United States (U.S.) and Germany. Drawing on this research, Tsujimura and Mizosita (2002a; 2003) used the perspective of GFF to analyze European financial Integration. Zhang (2005; 2008) linked real transactions with financial transactions based on the dynamic flow of funds and established a theoretical framework for GFF analysis through three factors: domestic savings–investment, foreign trade, and international capital flows. He then also built an econometric model of GFF. Based on the GFF concept, Tujimura and Tujimura (2008) conducted pioneering research that used financial matrix methods to test the transmission of financial policy and the

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effects of the international flow of funds in the Euro area using data from Coordinated Portfolio Investment Survey (CPIS) and Consolidated Banking Statistics (CBS).

Allen et al. (2002) proposed a statistical framework for understanding crises in emerging markets based on examination of stock variables in the aggregate balance sheet of a country and the balance sheets of its main sectors (assets and liabilities). This framework is consistent with the 2008 System of National Accounts (SNA in ISWGNA, 2009) and is very instructive for establishing GFF matrix based on 'from-whom-to-whom' (W-to-W) format (Cerutti et al., 2017).

The International Monetary Fund and the Financial Stability Board (IMF and FSB, 2009) identify information gaps and proposals to strengthen data collection and reporting. The principal focus in that report is *Recommendation 15*'s reference to compiling 'flow of funds' statistics. *Recommendation 15* also suggests the compilation of sectoral financial positions and flows. Still, we also need to understand and measure the flow of funds among countries – namely the GFF.

Shrestha et al. (2012) noted the importance of using an integrated approach for the compilation of financial flows and positions on a W-to-W basis, one of the main components of *Recommendation 15* of the G20 Data Gaps Initiative (DGI). The 2008 global financial crisis highlighted the need to understand financial interconnectedness among various sectors of an economy and their counterparties worldwide. But analytical applications have been hampered by data limitations.

Stone (1966a; 1966b) set up the balance sheets of a closed economy in a standard matrix form, distinguishing between financial assets and real assets on the assets side and liabilities side, try to convert the Use (**U)** and Make (**V)** tables of input–output analysis into a Flow of Funds Table by referring to Stone's method. His paper considers that Flow of Funds Table can also be a matrix based on the W-to-W format.

There is international awareness of information limitations vis-à-vis the problem that existing data do not describe the risks inherent in a financial system. Previous research has evolved into a discussion of the basic concept of GFF and a proposal to establish a statistical framework for GFF. Therefore, the IMF's Statistics Department has organized seven economies with systemically important financial centers to construct a geographically disaggregated GFF mapping of domestic and external capital stocks (Errico et al., 2013). Those authors delineate key concepts and existing data sources, used the Balance Sheet Approach (BSA) to break down the rest of the world by international investment position (IIP) components. An external statistics' matrix (metadata) shows external-sector financial data are available by using the IIP concept. The main outcome is a prototype template of stock and flow data, geographically disaggregated by national/regional economies.

Errico et al. (2014) present an approach to understand the U.S. shadow banking system using a new GFF conceptual framework developed by the IMF's Statistics Department. Their GFF uses external stock and flow matrices to map claims between sector–location pairs. This work highlights the large positions and gross flows of the U.S. banking sector and its interconnectedness with the banking sectors in the Euro area and the United Kingdom (U.K.). Zhang (2017) discussed related problems, such as GFF's data sources, its statistical framework, and the analysis method (Zhang, 2015; 2016), and discussed how to apply big data to measure GFF (Zhang, 2018).

The growing incidence of financial crises and their damage to economies has led policymakers to sharpen their focus on financial stability. Recently, Heath and Goksu (2017)

noted that statisticians are responding to the growing interest in this topic by calling for measuring GFF. The DGI has not made a specific recommendation to develop a GFF; the work is still in an embryonic stage.

In light of earlier work, we present a new statistical approach to measuring GFF and provide an empirical example. In order to use GFF to measure financial stress, to observe the spillover effect of systematic financial crises, as well as to observe the situation triggering an international financial crisis, it is necessary to strengthen research on GFF statistical methods. As a step toward this, this paper first sets out an integrated framework based on the W-to-W, using the accounts that are set in the SNA, which are the balance of payments (BOP), the IIP (IMF, 2013), the Flow of Funds Accounts (FFA), and the International Banking Statistics (IBS) which is published by the Bank for International Settlements (BIS, 2013). Second, the paper sets out and integrates the existing data sources for measuring GFF, which are available largely in the Coordinated Direct Investment Survey (CDIS), CPIS (Joisce et al., 2002), IIP data, and Locational Banking Statistics (LBS) that are part of BIS statistics. There is also a need to configure GFF accounts to the SNA. This, however, requires additional external financial positions in the new data collection systems. Third, we try to compile a statistical matrix of eleven countries, including the U.S., Japan, and China. The U.S., Japan, and China are the three largest economies in the world, and financial risk therein has increased recently making it a salient example. In addition, in January 2016, the State Administration of Foreign Exchange (SAFE) of China released CPIS and LBS data for the first time covering through the end of June 2015. It makes a possible for international comparisons under a common international statistical standard. Using the GFF's statistics, we demonstrate how countries and specific instruments of financial positions and flows on a W-to-W basis could ideally be moved from aggregated country and instrument details toward disaggregated country and instrument details. We then wind up using the GFF matrix to empirically analyze the fundamental observed facts of China, Japan, and the U.S. and explore the analysis method of the GFF matrix.

2. A statistical framework for global-flow-of-funds

GFF is an external flow of funds that relate to domestic and international capital flows. Our aim is to map domestic and external capital stocks to show the characteristics and structure of external flows of funds, including the flows of all domestic funds with investment-savings, current balances, and connected international capital stocks and flows. Using GFF statistics, we can observe interlinkages of counterparties and transmission channels of cross-border capital flows to analysis the vulnerabilities from financial positions, risk build-up, and causes and effects of imbalances. This can provide a basis for decision making for financial policy authorities.

In order to measure financial stress and observe the spillover effects of systematic financial crises through GFF, a new statistical framework is needed that corresponds to the operational structure of GFF. It is important that an integrated framework is used as the foundation of a statistical monitoring system. When the flow of funds in financial markets is tied up with the BOP, the rest of the world has an excess of outflowing funds (net capital outflows) if the current account is in surplus. Conversely, the domestic sector will have an excess of inflowing funds. Therefore, when the real economic side of the domestic and overseas economy is analyzed under an open economic system, the balance

Table 1. External assets and liabilities matrix by balance sheet approach.

	Country														
	Country A			Country B			Country . . .			All other Economies			Total of the World		
Financial Instrument	A	L	NP	A	L	NP	A	L	NP	A	L	NP	A	L	NP
Direct Investment															
Portfolio Investment															
Equity Securities															
Debt Securities															
Long-time debt securities															
Short-time bebt securities															
Financial Derivatives															
Other Investment															
Other equity															
Debt instruments															
Reserve Assets															
Total of the World															

Notes: All other economies = Total sum of the World − Total sum of the observed countries.

of savings–investment corresponds to the current account balance. However, the outflow of domestic net funds corresponds to the capital account balance when we examine the financial relationship between the domestic and external flows of funds. For this reason, relationships among the domestic savings-investment balance, financial surplus or deficit, current account, and external flow of funds should be expressed in an integrated framework to enable comprehensive and regular monitoring of GFF.

The integrated framework is based on the BSA, using stock data. The financial data category includes financial assets, liabilities, and net position, it can be monitored two aspects of external financial positions and flows. Using the integrated framework to construct GFF statistics would provide valuable information for the analysis of interconnectedness across borders, global liquidity flows, and global financial interdependencies. Furthermore, the framework could also be extended to flow data. For this next step, we then disaggregate the data sources by sector and counterpart country.

As a transitional preparation for producing the GFF matrix, we need to use External Assets and Liabilities (EAL) matrix. Through Table 1, we can connect the relevant information between the rest of the world sector of flow of fund account with other countries to construct the GFF matrix. The EAL matrix is also based on the BSA. It depicts for the rest-of-world sector, the main countries for observation and all other economies, with each financial instrument/stock of the issuer of liability (the debtor) on the horizontal axis and stocks of the holder of liability (the creditor) on the vertical axis. This table depicts the external flow–of-funds matrix for the observed countries or regions, where the EAL has been disaggregated into the counterpart country, by the instrument.

The EAL matrix identifies particular sectors, which, like countries, show data for the rest of the world and how this relates to other economies or regions. Each column corresponds to the balance sheet of the sector in question, with assets and liabilities listed per row by instrument, with counterparty sectors identified for each cell.

Table 1 provides a statistical framework for presenting cross-border stocks by counterpart country and sector and instrument. It shows available external-sector financial assets and liabilities' stock data broken down by country. Data in Columns 2–4 of the

Table 2. Financial instrument matrix on a W-to-W basis.

	Counterpart Countries (Investment in)				
Counterpart Countries (Investment from)	Country A	Country B	. . .	All other Economies	Total of the World
Country A					
Country B					
. . .					
All other Economies					
Total of the World					

EAL matrix shows the assets, liabilities and net assets of county A's external financial, as well as the major financial instruments used by Country A. This is a statistical table of a two-dimensional structure, that is, we can know who did what. The matrix presents external financial asset and liability positions, showing available data by IIP category and instrument: direct investment, portfolio investment equity and debt securities (the latter displayed separately for long- and short-term debt), other investment (separately for banks and others, using the BIS IBS), and reserve assets. Table 1 shows what may be possible in a GFF framework for a country that permits the monitoring of both regional or national and cross-border (by country and sector) financial positions. However, we haven't been known the funds from whom to whom (W-to-W) by what instruments, which is as a statistical matrix of the three-dimensional structure.

Although Table 1 is modeled after a traditional account format, it cannot show the intersectoral W-to-W relationships needed to measure financial positions and flows. Therefore, in order to know 'who is financing whom, in what amount, and with which type of financial instrument,' we constructed the GFF matrix on a W-to-W basis. Table 2 reflects this approach and shows the financial instrument categories.

Table 2 is based on a specific analysis, namely the matrix of a financial instrument designed in accordance with the W-to-W form. According to the specific analytical purpose, the statistical scope can cover only certain relevant countries or regions as the observation object. The columns show a country's fund used by other countries (assets), and rows show if a country should raise funds from other countries (liabilities). Table 2 accurately reflects the relationship between empirical data and the underlying structure. By setting up a sector as the other economies, the relationship of a financial instrument and the GFF is as follows: other economies = the total for all countries in the world – the total for all countries being analyzed. We can use Table 2 to speculate the corresponding input coefficient, observe the impact of changes in the financial instruments on the financial markets, and determine the extent of the impact on other related countries.

According to analytical need, a GFF matrix resulting from the from-whom-to-whom table can be created to illustrate country vis-à-vis country through each financial instrument. These instruments show the connections between financial positions, such as direct investment and portfolio investment. Likewise, every financial instrument can be disaggregated within the matrix on a from-whom-to-whom basis. Instruments located in the rows of the table describe a country relative to the counterpart country's assets, while instruments located in the columns describe a country relative to the counterpart country's liabilities. If all the financial instruments are totaled, that amount will equal the sum total of external financial assets and liabilities in the given country. In this way, EAL will have

been disaggregated into the counterpart country, as well as by main instruments, based on the IIP.

Table 3 is in accordance with IIP statistical standards and is based on a structure wherein the from-whom-to-whom data are used to establish the GFF statistical framework and is in keeping with the double-entry principle. According to the statistical standards of IIP, which are based on BOP and International Investment Position Manual, sixth edition (BPM6), the IIP can be set as foreign financial assets and external debt. Each column corresponds to the balance sheet of a country in question, with country, assets, and liabilities then listed in rows by an instrument with the counterparty country identified for each cell.

Table 3 provides a statistical framework for deriving the GFF matrix. Assets are subdivided into five parts: direct investment, portfolio investment, financial derivatives, other investments, and reserve assets. Liabilities are divided into four parts: direct investment, portfolio investment, financial derivatives, and other investments. The net financial position is external financial assets plus reserve assets minus liabilities. By this statistical framework, the GFF statistics can reflect stock information of financial assets and liabilities between the world and a region at a particular time. Importantly, the GFF statistics remain consistent with IIP Statistics Standard, while also exhibiting unique methodological characteristics, which can be summarized as follows:

(1) In order to reflect the relationship between W-to-W, GFF statistics use the parallel processing method wherein transaction and countries (sectors) are rows, namely, by putting the transaction items that direct investments, securities investments, financial derivatives, and other investments to countries (sectors) in the rows, whereas each country (sector) is in the columns. Accordingly, we can determine the dual relationship of a transaction item in countries (sectors), which can show the scale of the position item and reflect from-whom-to-whom-by-what relationships in a two-way format. For example, a5–a8 (see column a and row 5–8, direct investment can be represented as a5, portfolio investment as a6, financial derivatives as a7 and other investment as a8) in the table shows Country A transactions in the columns by showing which financial instruments are used for transactions bringing how much funds to country B. As this can provide two-way information about the financing structure of Country A with country B, we also can identify and understand the financing scale and corresponding information on counterparties. At the same time, we can also capture information of where country A is located in the row vectors from other countries to raise funds. We can also acquire relevant information on country B in the row vectors on its fund-raising from Country A, Country C, etc.
(2) To reflect the actual situation of international capital in a country or a region, and in order to establish the GFF matrix table for the application analysis, we set countries (sectors) in rows and columns by the principle of W-to-W tabulating. We also designed an 'all other economies' sector (see column e and row 9–12 that can be represented as e9, e10, e11, e12). The relationship of these 'all other economies' and the world total can be expressed as follows: 'liabilities of all other economies' = total liabilities – liabilities of the total for specific countries. That is, $e9 = f9 - (a9 + b9 + c9 + d9)$, ..., $e12 = f12 - (a12 + b12 + c12 + d12)$.
(3) Each 'column' shows a country how to use funds by transaction item, namely, who outputs how much funds by what item; each 'row' represents how a country raises

Table 3. Global flow of funds matrix for a country.

		Holder of liability (creditor)						
		a	*b*	*c*	*d*	*e*	*f*	*g*
Issuer of liability (debtor)	Financial instruments	Country A	Country B	Country C	. . .	All Other Economies	Total Liabilities of Financial Instruments	Total Liabilities
Country A	Direct investment							1
	Portfolio investment							2
	Financial derivatives							3
	Other investment							4
Country B	Direct investment							5
	Portfolio investment							6
	Financial derivatives							7
	Other investment							8
Country C	Direct investment							9
	Portfolio investment							10
	Financial derivatives							11
	Other investment							12
. . . . .	. . . . .							13
All other economies	Direct investment							14
	Portfolio investment							15
	Financial derivatives							16
	Other investment							17
Total Asset of Financial Instruments	Direct investment							18
	Portfolio investment							19
	Financial derivatives							20
	Other investment							21
Total Assets								22
Net Worth								23
Reserve assets								24

(*continued*).

Table 3. Continued.

		Holder of liability (creditor)						
		a	*b*	*c*	*d*	*e*	*f*	*g*
Issuer of liability (debtor)	Financial instruments	Country A	Country B	Country C	. . .	All Other Economies	Total Liabilities of Financial Instruments	Total Liabilities
Monetary gold								25
Special drawing rights								26
Reserve position in the fund								27
Other reserve assets								28
Adjustment item								29
Net Financial Position								30

Notes: (i) Net worth is the difference between assets and liabilities (ISWGNA, 2009, p. 29).
(*ii*) Adjustment item is an item for balancing the net worth, reserve assets and net financial position in Global Flow of Funds Matrix (GFFM), and put it in row 29. It is derived from the net worth of each county by:
a. Adjustment item = Net Financial Position − Net Worth − Reserve assets, and
b. Net Financial Position = Net Worth + Reserve assets + Adjustment item

funds through four financial instruments, namely, who inputs how much funds by what item. The difference between the total of the row and column in row 23, which shows the balance between the use of external funds financing for a certain country at a particular point in time, that is, the net output of funds. For instance, Country A's net worth equals country A's total assets minus its total liabilities, that is, a23 = a22 − (g1 + g2 + g3 + g4).

(4) Corresponding to the various transaction instruments of various countries rows 24–28 show part of the reserve assets, specifically monetary gold, special drawing rights, reserve positions in the fund, and other reserve assets. Denoting reserve assets as an instrument in Table 3 shows a balanced relationship between net worth and net financial position and the components thereof. For example, country A's component of reserve assets can be shown as a24 = a25 + a26 + a27 + a28.

(5) The bottom row in Table 3, namely rows 30, reflects net IIP, corresponding to Table 3's Net Financial Position that obtained each country. These data are taken from IIP and reflect overall equilibrium conditions of national external financial positions. Theoretically, adding reserve assets to the net worth of the financial assets of a country should reveal the external net financial position of the country. For example, a30 = a23 + a24, and b30 = b23 + b24 . . . , etc. However, since there are factors, like the non-compatibility of IIP data and other datasets and the difficulty in selecting the financial-investment item, the actual external net financial investment figures are inconsistent with the above theoretical relationship. Therefore, in order to attain balance when adding the net worth in row 23 to the reserve assets in row 24 so they are equal to the financial position in row 30 of Table 3, we need to set up an adjustment item for balancing the net worth, the reserve assets and net financial position in GFF Matrix, and put it in row 29. Net financial position of each country is calculated using net worth, i.e. net financial investment plus reserve assets and adjustment item is equal to net financial position, such as a30 = a23 + a24 + a29, b30 = b23 + b24 + b29, . . . , e30 = e23 + e24 + e29.

(6) Because the main purpose of compiling the GFF matrix table is to observe cross-border capital positions, the diagonal line elements in the matrix are zero. Each position is the result of financial investment between the domestic and foreign countries and does not include a country's internal financial investments.

(7) In the thick line box at the top half of Table 3, if the financial instruments of each country in rows are merged, we can get a square matrix, with the same number of rows as columns, and an orthogonal matrix can be obtained. So we can use this orthogonal matrix to make some statistical inferences about actual cases.

The statistical framework delineated in Table 3, and the corresponding data sources can provide information about fund-raising. It can indicate financial stability, comparability across GFF within a country and across countries, and the spread effect for taking corresponding financial policies on domestic and global financial markets. On the basis of this, Table 3 can also break down further some special needs of financial supervision, based on the W-to-W, to compile a separate matrix for measuring each financial instrument, such as the Table 2.

In addition, using the form of W-to-W to comply with the GFF matrix can also improve the quality and consistency of data, providing more opportunities for cross-checking and

balancing information. The GFF matrix, which is built using stocks data, can also be extended to flow data, to quantify bilateral flows of funds. Using Table 3, we can find that the previous statistical information cannot clear the synthesis problems, namely 'what is the main section on bilateral financing, what financial instruments are used, and what is the structure and scale of bilateral financing?'

3. Data sources for GFF

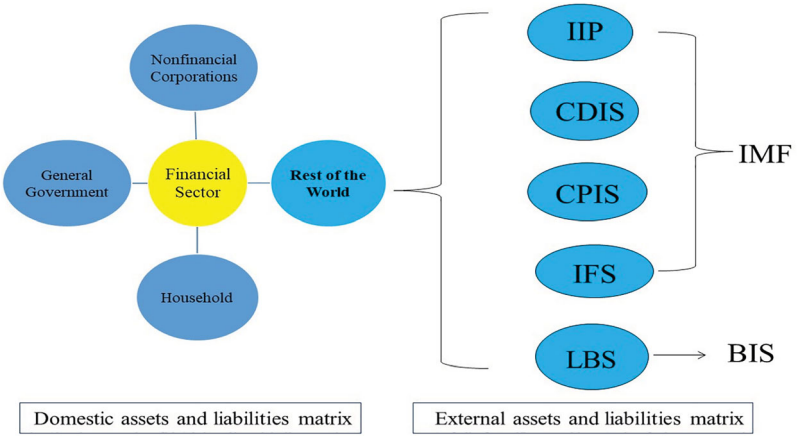
The GFF data should be based on existing statistical data and therefore share many similarities of approach with them (IMF, 2006). The GFF data sources include not only the rest-of-the-world account of national accounts but also monetary and financial statistics (IMF, 2016c), IIP statistics, and BIS IBS. The prototype template for the main data is shown in Figure 1. There are two data sources for measuring GFF: (1) data sources for operationalizing the Domestic Assets and Liabilities (DAL) matrix, and (2) data sources for establishing the EAL matrix. These two matrices could be extended to flow data.

The DAL matrix is based on the BSA, with Rest of world (ROW) data drawn from national accounts and IIP. The EAL matrix presents data on whatever external-sector financial stock data are available by IIP category, drawing on IMF and BIS data sources. The IIP is the link between domestic and external matrices. We focus on EAL data sources and integrate with the economic variables to establish the GFF matrix.

Data from IMF's Monetary and Financial Statistics, IIP, and national accounts are used to derive the BSA matrix. The BSA matrix can provide information about a country's or region's financial corporations' stock positions for residents and nonresidents. In the EAL matrix, the datasets with bilateral counterpart country details are collected by the IMF and BIS as follows:

(1) Foreign direct investment (see, e.g. Errico et al., 2013): The CDIS (Mesias et al., 2015) provides bilateral counterpart country details on inward direct investment positions (i.e. direct investment into the reporting economy) cross-classified by the economy of immediate investors. It also provides data on outward direct investment positions (i.e.

Figure 1. Prototype template for measuring GFF.



direct investment abroad by the reporting economy), cross-classified by the economy of immediate investment, as well as mirror data[1] for all economies.

(2) Portfolio investment: CPIS provides bilateral counterpart country details covering holdings of asset stock positions by reporting economies and derived (mirror) liabilities for all economies. The CPIS's purpose is to improve statistics on holdings of portfolio investment assets in the form of equity, long-term debt, and short-term debt. It is also used to collect comprehensive information, including geographical detail on the issuer's country of residence, the stock of cross-border equities, long-term bonds and notes, and short-term debt instruments, for use in the compilation or improvement of IIP statistics on portfolio investment capital.

(3) Other investment: Another investment is a residual category that includes positions and transactions other than those included in direct investment, portfolio investment, financial derivatives, and employee stock options, and reserve assets (Dippelsman and Shrestha et al., 2009). Other investment includes (a) other equity; (b) currency and deposits; (c) loans (including use of IMF credit and IMF loans); (d) nonlife insurance technical reserves, life insurance and annuity entitlements, pension entitlements, and provisions for calls under standardized guarantees; (e) trade credit and advances; (f) other accounts receivable/payable; and (g) Special Drawing Rights (SDR) allocations (SDR holdings are included in reserve assets). In order to reflect the bilateral counterpart country for loans, deposits, and other assets and liabilities, this paper uses the related dataset with BIS IBS instead of IIP statistics.

(4) The BIS compiles and publishes two sets of statistics on international banking activity, namely the LBS and CBS. This paper uses data on cross-border claims and liabilities from LBS[2] as our main source, because these statistics provide information about the currency composition of banks' balance sheets and the geographical breakdown of their counterparties. The LBS data capture outstanding claims and liabilities of internationally active banks located in reporting countries against counterparties residing in more than 200 countries. Banks record their positions on an unconsolidated basis, including intragroup positions between offices of the same banking group. The data are compiled following the residency principle that is consistent with the BOP statistics, and compatible with IIP, CDIS, and CPIS. In this regard, the major advantage of the BIS' LBS data, compared to the banking flows collected from the BOP statistics, is the detailed breakdown of the reported series by counterparty countries. This feature enables us to identify changes in the supply factors of banking flows from changes in demand for bank credit in counterparty countries.

(5) For data on reserve assets, we use the IIP as the basic data source and can reference the Currency Composition of Official Foreign Exchange Reserves (COFER). To supplement data on reserve assets, International Financial Statistics (IFS), which includes World Total Reserves, World Gold, World Reserve Position in the Fund, World SDR Holdings, and World Foreign Exchange, can also be used.

[1] The term 'mirror data' refers to the same data seen from different perspectives. For instance, banks' loans to households could be called mirror data of household debt to banks.

[2] The BIS locational banking statistics are reported by banking offices located in selected countries, including many offshore financial centers, and exclude the assets and liabilities of banking offices outside of these countries. The number of LBS-reporting countries increased from 14 in 1977 to 47 in 2017.

But no matter what kind of reserves assets data are not counterparty information, it cannot constitute a matrix form, and neither can it reflect the relationship between countries based on W-to-W form. Therefore, in order to observe the balance of a country's external assets and overall liabilities; as a reference, IIP data alone can be used to fill the cell on reserve assets.

In order to observe the overall net position, in this paper, IIP data have been used to supplement the data for constructing the EAL matrix. The IIP is a subset of a national balance sheet, the net IIP plus the value of nonfinancial assets equaling the net worth of the economy, which is the balancing item of the national balance sheet. The IIP relates to a point in time, usually at the beginning (opening value) or the end (closing value) of the financial year.

GFF can provide a statistical framework if concepts, definitions, and classifications underlying these statistics are standardized across economies. Fortunately, these standards can be obtained from the 2008 SNA, the IMF (2016c; Dippelsman and Shrestha, et al., 2009) and the BIS (2013). Table 4 shows the various data sources for measuring GFF, how to access them, and their basic features.

Through the above research for constructing the requisite statistical framework and arranging data sources, we can conclude that the key problem for establishing GFF statistics is the benchmark of data sources and timeliness of data reporting. Some data are compiled by the IMF and BIS, which are both based on the IMF's BPM6 (Dippelsman and Shrestha et al., 2009), but some data overlap. For example, CPIS is compiled by IMF, which mainly consists of securities statistics; but banking statistics emanate from BIS, and banking credit business includes some securities trading, so care must be taken to avoid double-counting.

4. Creating the GFF matrix

4.1. A matrix model for measuring a financial instrument

According to the framework of Table 2, in order to meet the special tracking analysis of a financial investment, first, we create a matrix for measuring a financial instrument, namely the matrix of portfolio investment, as shown in Table 5. Table 5 uses the data of *geographic breakdown of total portfolio investment* published by the IMF, which includes eleven countries and regions and 'Other Economies' that have a larger proportion of the global securities market and greater influence on international politics and economies. Table 5 includes 'Other Economies' defined as described above. It is a matrix based on a W-to-W benchmark: the columns show assets, and the rows represent liabilities. The matrix is a square matrix, with the same number of rows as columns, which is an orthogonal matrix. We can use the matrix to make various statistical estimates for meeting the needs.

Table 5 has the following four characteristics. First, by using the form W-to-W, we can observe and analyze the bilateral relations of relevant countries in portfolio investments; the elements on the diagonal are zero, which means that the matrix does not include domestic financial investment. Second, we can understand the structure of the global securities market, and the proportion and influence of relevant countries in the securities market. Third, using the securities assets located in a column and subtracting the liabilities in each row, we can see the net assets and the relevant information of the counterparty. Fourth, Table 5 shows the balance position on assets and liabilities for each country and

Table 4. Datasets for measuring global flow of funds.

Items	Data source	Frequency	Geographic coverage	Latest update	Temporal coverage	Benchmark	Web address
Direct Investment	CDIS (IIP)	Annual	106 reporters on Inwart 71 reporters on Outward Cross-classified	02/15/2018	beginning end-2009	BPM6	http://cdis.imf.org
Portfolio Investment	CPIS (IIP)	Annual	86 reporters	09/13/2018	beginning end-2001	BPM6	http://data.imf.org/
		Semi-annual	72 reporters Cross-classified	beginning end-june 2013			
Financial Derivative	CPIS	Annual & Quarterly		09/13/2018	beginning end-june 2013	BPM6	http://data.imf.org/
	IIP	Annual & Quarterly		08/22/2018			
Other Investment	LBS by BIS	Quarterly	46 reporters by locational basis	07/18/2018	Q1.1999-Q1.2018	SNA, BPM6	http://stats.bis.org/statx/toc/LBS.html
	CBS by BIS	Quarterly	31 reporters by ultimate risk basis	07/18/2018	Q2.1998-Q1.2018		http://stats.bis.org/statx/toc/CBS.html
	IIP	Annual & Quarterly					
Reserve Assets	IFS	Annual, Quarterly Monthly	194 reporters	05/24/2018	beginnng 1948	SNA, MFS, BPM6	http://data.imf.org/
	COFER	Quarterly	146 reporters	03/31/2018	beginning 1999	BPM6	http://data.imf.org/
	IIP	Annual Quarterly	152 reporters 152 reporters	08/22/2018	from 1945 onward from 2009 onward	BPM6	http://data.imf.org/

Notes: IMF (2016a, 2016b). BIS data were extracted from http://stats.bis.org/statx/toc/LBS.html and http://stats.bis.org/statx/toc/CBS.html, on September 13, 2018.

Table 5. Total portfolio investment matrix (as of end-2016, millions of USD).

	Holder of liability (creditor)														
Issuer of liability (debtor)	Canada	China	France	Germany	Italy	Japan	Korea	Netherlands	Switzerland	United Kingdom	United States	Other Economies	Total of World	Net Assets	Total Liabilities
Canada		5553	25,813	48,142	4041	70,860	4881	23,673	36,807	55,454	826,639	387,153	1,489,016	0	1,489,016
China	13,749		13,470	3510	436	15,445	11,522	12,020	4484	40,919	107,805	606,704	830,064	0	830,064
France	33,303	5431		359,306	150,859	252,108	12,083	179,248	76,318	202,251	482,972	1,159,813	2,913,691	0	2,913,691
Germany	35,534	6558	212,441		79,907	123,469	6158	215,459	83,842	200,214	372,832	1,405,912	2,742,327	234,460	2,976,787
Italy	6542	1079	253,093	159,755		53,148	1244	39,178	8835	63,398	92,112	472,337	1,150,721	135,055	1,285,776
Japan	60,270	11,894	98,948	23,920	5450		14,737	52,485	26,596	263,692	861,587	621,939	2,041,518	1,836,192	3,877,710
Korea	14,747	2700	8394	7836	549	23,934		11,696	9198	36,215	179,534	194,346	489,150	0	489,150
Netherlands	19,565	3100	258,758	238,844	54,492	116,360	4174		68,477	151,937	448,078	595,437	1,959,223	0	1,959,223
Swaziland	24,062	4345	24,519	48,592	8455	28,263	4552	21,008		82,263	430,555	219,215	895,827	364,697	1,260,525
United Kingdom	77,039	14,457	232,128	189,062	65,760	166,578	20,586	107,874	74,092		1,182,407	1,192,991	3,322,974	245,270	3,568,244
United States	793,370	125,687	255,673	364,398	105,045	1,595,299	139,742	473,853	293,416	1,075,336		6,983,607	12,205,426	0	12,205,426
Other Economies	218,762	178,856	1,130,488	1,533,421	810,782	1,432,246	83,081	606,807	578,461	1,396,565	4,777,138		19,376,996	1,092,846	20,469,841
Total of World	1,296,944	359,659	2,513,726	2,976,787	1,285,776	3,877,710	302,761	1,743,301	1,260,525	3,568,244	9,761,659	20,469,841	49,416,934		
Net Liabilities	192,072	470,405	399,966	0	0	0	186,389	215,922	0	0	2,443,767	0			
Total Assets	1,489,016	830,064	2,913,691	2,976,787	1,285,776	3,877,710	489,150	1,959,223	1,260,525	3,568,244	12,205,426	20,469,841			

Data Source: IMF (2016b) as of March 10, 2018.
Notes: To avoid double-counting between CPIS and LBS, only loan and deposits in LBS were extracted.

the global market in securities investments. The specific instructions for using Table 5 are as follows: if the net assets figure is positive, a zero appears in the net row, which indicates the net liabilities of the corresponding country. If the net assets figure is negative, a zero appears in the net column, which indicates the net assets of the corresponding country. After this processing, we can see the balance, that is, the total of each row is equal to the total of each column, and the sum of the rows in the matrix equals the sum of the columns. In the next section, we will use the matrix data to do an empirical analysis.

4.2. A matrix of multiple financial instruments

Based on the layout of Table 3, this section discusses how to create external stock matrices. As an example, Table 6 shows what may be possible in a GFF framework for a country to enable monitoring of financial positions at both region/nation and cross-border levels through financial instruments. Table 6 also based on W-to-W benchmark, the 'column' represents assets, and 'row' represents liabilities. The matrix here has the same number of rows as columns too, which is a square matrix.

Table 6 is an illustration of the GFF matrix as of the end of December 2016. Each row of the matrix has two statistical groupings, including countries and three financial instruments for showing the source of funds, that is, direct investment (DI), portfolio investment (PI) and other investment (OI), covering the main structural elements of external financial liabilities. Financial assets are listed by country in the columns to show fund uses, with the counterparty sectors identified for each cell. The columns of the matrix delineate 14 sectors: 11 for countries, all other economies, the total of financial instruments, and total liabilities. The total of all sector's assets or liabilities is equal to the total assets or liabilities of the world. The columns of the matrix are configured to understand the external assets for many countries, thereby displaying both national and regional perspectives. Each column corresponds to the balance sheet of the sector in question; which countries or regions should appear in the matrix depends on the specific purpose of the analysis. The data in Table 6 are derived from IMF Data Warehouse and BIS' IBS. But Financial Derivatives (FD) data are not used in Table 6 because many countries lack such data.

We used data from CDIS, CPIS, and LBS instead of OIs to compile the GFF matrices for each country. Table 6 shows cross-border liabilities of debtors (rows) and cross-border claims of asset holders (columns). The GFF matrix reveals structural equilibrium relationships as follows. First, we can determine both the distribution and scale of EAL for a country and show the basic structure of its external investment position. By analyzing the rows of the matrix, we can determine the sources of inward financial investment to a country (debtor), and thorough analysis of the columns of the matrix, we can also identify the destinations of outward financial investments from a country (creditor). At the same time, we also know that the rows in the matrix will always sum to the columns; that is, total global assets = total global liabilities. Second, the point on a row 'a country held the total liabilities of financial instruments = total liabilities of the country'; and from the point on column 'a country held the total assets of financial instruments = total assets of the country.' Therefore, we can observe the structure of EAL for a country. Third, from the balance of external financial assets and liabilities, we can get the balance relationship

Table 6. External asset and liabilities matrix (as of end-2016, millions of USD).

		Holder of liability (creditor)													
Issuer of liability (debtor)	Financial Instruments	Canada	China	France	Germany	Italy	Japan	Korea	Netherlands	Switzerland	United Kingdom	United States	All Other Economies	Total of Financial Instruments	Total Liabilities
Canada	Direct investment		15,933	6002	11,591	1005	21,673	1088	69,608	41,110	31,128	292,002	520,679	1,011,819	2,950,785
	Portfolio investment		5553	25,813	48,142	4041	70,860	4881	23,673	36,807	55,454	826,639	347,575	1,449,439	
	Other investment		7939	6768	1530	144	2877	994	4738	1055	59,038	187,291	217,153	489,527	
China	Direct investment	10,001		22,191	60,404	7054	142,021	95,068	29,221	11,439	19,390	70,120	2,288,239	2,755,147	4,100,460
	Portfolio investment	13,749		13,470	3510	436	15,445	11,522	12,020	4484	40,919	107,805	587,697	811,058	
	Other investment	5910		19,156		421	30,479	24,438	2837	1211	33,938	29,234	386,631	534,255	
France	Direct investment	4021	1935		63,817	19,737	16,154	839	92,986	73,634	81,927	57,187	656,318	1,068,554	5,752,377
	Portfolio investment	33,303	5431		359,306	150,859	252,108	12,083	179,248	76,318	202,251	482,972	1,575,985	3,329,863	
	Other investment	2087	14,175		103,101	38,225	56,612	1348	61,395	24,290	351,852	88,525	612,350	1,353,960	
Germany	Direct investment	2398	2313	45,526		35,418	22,968	5114	146,029	64,989	66,523	74,792	933,923	1,399,993	5,101,713
	Portfolio investment	35,534	6558	212,441		79,907	123,469	6158	215,459	83,842	200,214	372,832	1,415,632	2,752,046	
	Other investment	1112		45,990		18,516		2936	37,481	29,310	330,026	43,562	440,740	949,673	
Italy	Direct investment	96	−10	62,647	29,520		2899	404	67,952	17,685	45,350	8748	228,130	463,421	2,114,217
	Portfolio investment	6542	1079	253,093	159,755		53,148	1244	39,178	8835	63,398	92,112	648,661	1,327,044	
	Other investment	170	552	106,259	33,545		2229	495	13,033	6269	62,055	4378	94,766	323,751	
Japan	Direct investment	1328	885	27,984	3383	1013		3419	22,230	10,457	12,985	52,215	105,812	241,711	4,367,196
	Portfolio investment	60,270	11,894	98,948	23,920	5450		14,737	52,485	26,596	263,692	861,587	1,364,784	2,784,362	
	Other investment			157,169		272		4991		1719	274,711	445,855	456,406	1,341,123	
Korea	Direct investment	2202	5576	4205	6951	325	43,505		17,581	3419	14,086	31,778	59,250	188,877	813,105
	Portfolio investment	14,747	2700	8394	7836	549	23,934		11,696	9198	36,215	179,534	278,781	573,584	
	Other investment	509	3847	3391	1162	23	2591		104	884	7469	15,735	14,929	50,644	
Netherlands	Direct investment	31,081	23,827	125,078	217,940	102,944	79,262	2348		279,504	357,744	758,146	2,531,944	4,509,818	7,666,015
	Portfolio investment	19,565	3100	258,758	238,844	54,492	116,360	4174		68,477	151,937	448,078	1,088,485	2,452,271	
	Other investment	3890		37,364	80,930	6531		347		4047	217,092	54,191	299,534	703,926	
Switzerland	Direct investment	−172	0	37,212	24,762	4762	5168	0	317,138		50,729	122,028	817,299	1,378,925	3,127,697
	Portfolio investment	24,062	4345	24,519	48,592	8455	28,263	4552	21,008		82,263	430,555	369,002	1,045,615	
	Other investment	603	1888	48,450	42,905	3541	2673	929	17,913		206,399	59,773	318,083	703,157	
United Kingdom	Direct investment	19,276	2673	81,821	81,712	4098	56,170	2342	162,198	53,878		452,475	992,262	1,908,905	9,311,245
	Portfolio investment	77,039	14,457	232,128	189,062	65,760	166,578	20,586	107,874	74,092		1,182,407	1,687,973	3,817,956	
	Other investment	50,431	67,640	225,458	280,129	46,681	121,362	3945	151,447	95,066		683,013	1,859,212	3,584,384	

(*continued*).

Table 6. Continued.

		Holder of liability (creditor)													
Issuer of liability (debtor)	Financial Instruments	Canada	China	France	Germany	Italy	Japan	Korea	Netherlands	Switzerland	United Kingdom	United States	All Other Economies	Total of Financial Instruments	Total Liabilities
United States	Direct investment	371,468	27,475	252,864	291,697	30,010	421,103	40,937	355,242	310,759	555,687		4,938,882	7,596,124	28,109,384
	Portfolio investment	793,370	125,687	255,673	364,398	105,045	1,595,299	139,742	473,853	293,416	1,075,336		12,138,160	17,359,979	
	Other investment	237,018	100,432	147,273	65,118	19,703	187,022	20,288	95,393	27,198	841,526		1,412,310	3,153,281	
All other economies	Direct investment	847,853	1,276,784	977,796	1,177,824	378,822	549,395	158,659	4,293,815	723,481	689,806	5,502,381		19,524,908	30,605,792
	Portfolio investment	218,761	186,166	1,147,177	1,533,421	882,423	1,333,828	83,349	610,328	581,313	854,286	5,026,847		6,241,055	
	Other investment	169,506	384,243	452,194	746,168	69,295	315,929	86,877	305,445	212,141	1,365,417	1,107,866		4,839,829	
Total Asset of Financial Instruments	Direct investment	1,289,551	1,357,390	1,643,327	1,969,601	585,187	1,360,318	310,218	5,574,000	1,590,356	1,925,355	7,421,871	17,021,030	42,048,203	104,019,986
	Portfolio investment	1,296,943	366,969	2,530,414	2,976,787	1,357,417	3,779,292	303,029	1,746,822	1,263,376.5	3,025,965	10,011,368	15,285,890	43,944,273	
	Other investment	471,236	580,716	1,249,472	1,354,588	203,352	721,774	147,588	689,786	403,190	3,749,523	2,719,423	5,736,862	18,027,510	
Total Assets		3,057,730	2,305,075	5,423,214	6,300,975	2,145,956	5,861,384	760,834	8,010,607	3,256,922	8,700,843	20,152,662	38,043,782	104,019,986	
Net Worth		106,946	−1,795,385	−329,163	1,199,263	31,739	1,494,188	−52,271	344,592	129,225	−610,402	−7,956,722	−24,129,260		
Reserve assets		82,718	3,097,845	146,770	185,287	136,043	1,220,418	371,103	36,166	679,620	134,642	407,223			
Monetary gold		0	67,878	90,645	125,705	91,241	28,592	4795	22,824	38,780	11,505	301,090			
Special drawing rights		7578	9661	10,166	15,755	6894	18,087	2887	6031	4335	10,261	48,882			
Reserve position in the fund		2191	9597	5157	6941	2634	11,959	1719	1433	1319	6699	18,385			
Other reserve assets		72,949	3,010,708	40,802	36,886	35,275	1,161,781	361,701	5878	635,186	106,177	38,865			
Adjustment item		−34,177	647,908	−167,774	304,661	−343,971	164,637	−40,956	87,460	−38,322	416,730	−632,092			
Net Financial Position		155,487	1,950,368	−350,167	1,689,211	−176,189	2,879,243	277,876	468,218	770,523	−59,030	−8,181,591			

Data Sources: IMF (2016a, 2016b), and International Investment Position Statistics (BOP/IIP) http://data.imf.org/?sk = 7A51304B-6426-40C0-83DD-CA473CA1FD52&sId = 140,977,3422141, BIS international banking statistics, http://stats.bis.org/statx/toc/LBS.html on December 20, 2018.

Notes. LBS data on securities would lead to double-counting when adding LBS and CPIS. But there is no problem with summing CPIS and CDIS data as they refer to different financial instruments. And the data of Other Investment in Table 6 are extracted from LBS. In order to avoid double-counting between CPIS and LBS, the only LBS data used are loans and deposits.

between 'total liabilities of a country − total assets of a country = the country's net financial assets,' which can reveal the balance between domestic and foreign financial assets and liabilities.

Table 6 can further indicate the scope of external financing conditions, such as (1) the proportion of and relationship with the international financial market; (2) the risk of imbalance in external financial assets and liabilities; an (3) transmission route of impacts from the outbreak of a financial crisis in a country or region as well as a country to enable implementation of an effective financial policy in terms of the impacts arising from other countries. For brevity, we focus on China, Japan, and the U.S. to trace the effects of external financing such as DI, PIs, and bank credit funds.

5. Analysis using the GFF matrix: focus on China, Japan, and the U.S.

Table 6 can provide an overview of the distribution of DIs, securities investments, and international bank credit funds in each country. From the direction of the rows, we can understand which countries raised how much funds in what ways, and from the direction of the columns, we can grasp how many countries used how much funds in what instruments (Dawson, 1996). This information can clarify the following relationships. First, it shows the basic condition of a country's external position, holdings extent of creditor's rights and debt, through which financial instruments and counterparties, namely, from whom-to-whom and by what. Second, it shows the country's influence on the GFF, mode of financing, structure, and scale. Third, structural changes and equilibrium conditions in the direct investment market, the global bond market and international bank credit market are revealed. Fourth, the spread effect from a financial crisis in one country or a region is shown. Finally, it allows for monitoring the stability of GFF and the equilibrium state. In the next section, we will use the GFF matrix to demonstrate a statistical descriptive analysis.

5.1. Basic characteristics of the GFF between China, Japan, and the U.S.

Let us first look at the basic situation of the external net financial position in each country. The bottom row of Table 6 shows the external net assets in each country, which is the difference between total financial assets and total liabilities for each country. If this value is positive, a country's external financial assets are greater than its liabilities, meaning the country is in a position of having net financial assets (Cohen, 1987). However, if the value of net financial assets becomes negative, it means that the country is in the position of having external net liabilities. In the analysis of 11 countries at the end of 2016, countries with net external financial liabilities are France, Italy, the U.K., and the U.S., whereas the other analyzed countries have net external financial assets. The U.S. is the largest holder of external financial liabilities, having the highest net liabilities by $8.32 trillion; Japan is the largest holder of foreign financial assets by $2.99 trillion. At the same time, China holds net foreign assets of $1.8 trillion.

In order to understand the reasons for forming an external net financial position according to the structural relationships shown in Table 6, namely net worth + reserve assets + adjustment item = net financial position, we should first analyze the composition of net worth to find the cause and effect relationships. Through foreign DIs, external PIs, and OIs, which are the three forms of international capital operations, we can observe the U.S.,

Japan and China's fundamental situation regarding external financial assets and liabilities at the end of December 2016. Specifically, for the U.S., its net worth, that is, the total assets of external finance minus the total liabilities of external finance is −$2,549.1 billion. From its composition, the net assets of DI are $328.5 billion, the net liabilities of PI are $2,443.8 billion, and the net liabilities of OI are $433.9 billion. Taking the total of DI and PI and OI, combined with reserve assets and adjustment item, we can get the net financial position in the U.S., which is −$8.32 trillion as showed the result of Table 6.

Similarly, by using Table 6, we find that Japan's external net worth is $2,252.2 billion. The composition of this figure is: the net assets of DI are $1,035.38 billion, the net assets of PI are $1,836.2 billion, and the net liabilities of OI are $619.3 billion. In contrast, China's external net worth is −$2381.4 billion. Its composition is as follows: the net liabilities of DI are $1,957.4 billion, the net liabilities of PI are $470.4 billion, and the net liabilities of OI are $46.5 billion.

Although the U.S. has been keeping the net external financial liabilities, but compared with the data of end-2015 (see Supplementary material), China's net external financial liabilities reached $2,722.4 billion at the end-2015, that larger than the $1,947.8 billion in the U.S. China has been continuing to be a net financial debt in 2016. China is in a state of increasing financial risk caused by an increase in its net external financial liabilities. However, in terms of the elements of foreign exchange reserves, because China holds reserve assets of $3.098 trillion (higher than Japan and the U.S.), China's net external financial position is larger than that of the U.S. but lower than that of Japan.

5.2. The composition of external investment between China, Japan, and the U.S.

In order to observe the external outward investment and inward investment between China, Japan, and the U.S., we combine DI, PI, and OI in Table 6 to make Table 7. This table shows the counterparty proportion of external investment between countries by the assets side and the liabilities side.

From Table 7, we can know the composition of mutual financial investment between China, Japan, and the U.S. As in Table 6, in Table 7, 'row' means fundraising, and 'column' means fund use. By the perspective of China's 'row', DI accounts for 34% of the total investment from the U.S. to China, PI accounts for 52%, and OI accounts for 14%. In addition, DI from Japan to China amounted to $142 billion, accounting for 76% of the total financial investment from Japan to China. PI accounts for 8%, and OI accounts for 16%. As a result, we see that the U.S. focuses on securities investment, while Japan focuses on direct investment and bank loans in China. The composition of the more detailed bilateral investment between China, Japan, and the U.S. can be seen in Table 7 constructed by a W-to-W benchmark.

By the 'columns' in Table 7, we can know that China's DI to the U.S. is $27.48 billion, ranking first in China's outward investment, and accounting for 11% of the total financial investment from China to the U.S. Among them, China's PI to the U.S. is $125.69 billion, PI accounts for 49%; and OI accounts for 40% (see Table 7). China's PI in the U.S. is mainly reflected in holding of U.S. treasury bonds. Moreover, looking at the composition of Chinese investment in Japan, China's DI in Japan is $0.885 billion; Japan is the ninth largest recipient of China's outward investment, DI accounts for 7% of the total investment from China to Japan, PI accounts for 93%, and OI accounts for 0% (see Table 7). Thus, China's

Table 7. The composition of bilateral investment by W-to-W (as of end-2016, millions of USD).

	creditor	China			Japan			United States		
debtor		DI	PI	OI	DI	PI	OI	DI	PI	OI
China	DI				142021 (76%)			70,120 (34%)		
	PI					15,445 (8%)			107,805 (52%)	
	OI						30,479 (16%)			29,419 (14%)
Japan	DI	885 (7%)						52,215 (4%)		
	PI		11,894 (93%)						861,587 (63%)	
	OI									447,235 (33%)
United States	DI	27475 (11%)			421103 (19%)					
	PI		125687 (49%)			1595299 (72%)				
	OI			100803 (40%)			187022 (9%)			

Table 8. A comprehensive matrix of external asset and liabilities (as of end-2016, millions of USD.

	Holder of liability (creditor)														
Issuer of claim (debtor)	Canada	China	France	Germany	Italy	Japan	Korea	Netherlands	Switzerland	United Kingdom	United States	Other	Total of World	Net Assets	Total Liabilities
Canada		29,425	38,583	61,263	5190	95,411	6963	98,019	78,972	145,620	1,305,932	1,085,407	2,950,785	106,946	3,057,730
China	29,660	0	54,817	63,914	7911	187,945	131,028	44,078	17,134	94,247	207,159	3,262,567	4,100,460	0	4,100,460
France	39,411	21,541	0	526,224	208,821	324,874	14,270	333,628	174,242	636,029	628,684	2,844,653	5,752,377	0	5,752,377
Germany	39,044	8871	303,957	0	133,841	146,437	14,208	398,969	178,141	596,764	491,186	2,790,295	5,101,713	1,199,263	6,300,975
Italy	6808	1620	421,999	222,821	0	58,276	2143	120,163	32,789	170,803	105,238	971,557	2,114,217	31,739	2,145,956
Japan	61,599	12,779	284,101	27,303	6735	0	23,146	74,715	38,772	551,388	1,359,657	1,927,002	4,367,196	1,494,188	5,861,384
Korea	17,458	12,123	15,990	15,949	897	70,030	0	29,381	13,501	57,770	227,047	352,960	813,105	0	813,105
Netherlands	54,536	26,927	421,200	537,714	163,967	195,622	6870	0	352,028	726,773	1,260,415	3,919,963	7,666,015	344,592	8,010,607
Switzerland	24,493	6233	110,181	116,259	16,758	36,104	5481	356,059	0	339,391	612,356	1,504,384	3,127,697	129,225	3,256,922
UK	146,746	84,770	539,406	550,904	116,539	344,110	26,874	421,520	223,036	0	2,317,895	4,539,447	9,311,245	0	9,311,245
US	1,401,856	253,594	655,810	721,213	154,758	2,203,424	200,967	924,488	631,373	2,472,549	0	18,489,352	28,109,384	0	28,109,384
Other	1,236,120	1,847,193	2,577,168	3,457,413	1,330,539	2,199,153	328,885	5,209,588	1,516,935	2,909,509	11,637,094	0	30,605,792	7,437,990	38,043,782
Total of world	3,057,730	2,305,075	5,423,214	6,300,975	2,145,956	5,861,384	760,834	8,010,607	3,256,922	8,700,843	20,152,662	38,043,782	**104,019,986**		
Net Liabilities	0	1,795,385	329,163	0	0	0	52,271	0	0	610,402	7,956,722	0			
Total Assets	3,057,730	4,100,460	5,752,377	6,300,975	2,145,956	5,861,384	813,105	8,010,607	3,256,922	9,311,245	28,109,384	38,043,782			

outward investment in Japan primarily focuses on PI and DI, but haven' investment on OI. In addition to the U.S. and Japan, the UK and South Korea are also large recipients of China's external investment.

Regarding Japan's external investment, as shown in Table 7, DI accounts for 19% of the total investment from Japan to the U.S., PI accounts for 72%, and OI accounts for 9%. As a result, Japan and the U.S. focus on securities and direct investment, while Japan and China focus on direct investment (76%) and OI (16%). In addition to the U.S. and China, the UK and France are also larger recipients of Japan's external investments.

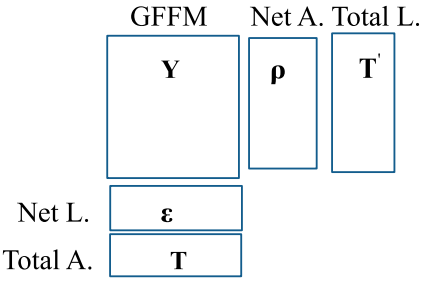
By analyzing the size and ratio of the counterparties' foreign investment in China and Japan, we can understand the external debt and creditor relationship held by the U.S. to China and Japan, based on the claims of counterparties' own debts. This triangular relationship has three basic characteristics. The first is that the financial relationship between the U.S. and Japan is far stronger than that between China and the U.S. About 31.1% of Japan's foreign financing comes from the U.S. and 37.6% of Japan's outward investment flows to the U.S. (see Table 6). However, between China and the U.S., only 5% of China's foreign investment comes from the U.S. and 11 % of China's outward investment goes to the U.S. (see Table 6). The second feature is that the emphasis of the external investment is different between the three countries. External investment by China and Japan is mainly in the form of direct investment. However, investment between the U.S. and Japan are in the form of securities investment and bank credit. In addition, investment between China and the U.S. is mainly in the form of securities investment. The third feature is that compared with the U.S. and Japan, the scale of Chinese external investment is still relatively low. Japan's is 2.5 times that of China, while the U.S.' is 8.7 times that of China. Moreover, at the end of 2016, China had net liability with Japan but had a net asset with the U.S. That is, China's net liabilities to Japan was 175.2 billion, and net assets to the U.S. was $46.4 billion, respectively. Moreover, China also had net liabilities to Japan and net assets to the U.S. at the end of 2015, which were −$176.79 billion and $4.23 billion, respectively.

5.3. *Influence and sensitivity to global flow of funds*

Events such as the Asian financial crisis in 1997 and the U.S. subprime mortgage crisis in 2008 show that a country's financial crisis can affect global financial markets (see, e.g. Kaminsky and Carmen, 1999; Castrén and Kavonius, 2009). As such, financial crises in the GFF will appear in the resulting chain reaction and give shocks to regional or national economic growth. The primary purpose of establishing GFF statistics is to observe the GFF's basic situation and the relationship between countries and measure the spread effect arising from a financial crisis in a country or a region. Accordingly, it is necessary to discuss the methods used to calculate the influence coefficient and the sensitivity coefficient used in the analysis of the flow of funds (Tsujimura and Mizoshita, 2002b).

To calculate the influence and sensitivity coefficients, we need to adjust the data in Table 6, which we then move to Table 8 in the new form that is a Comprehensive Matrix of External Asset and Liabilities. First, we omit items in Table 6 pertaining from Net Worth to the Net financial position, i.e. the bottom seven rows in Table 6. Second, we merge the three items of financial instruments of each country in Table 6 into one row. Through Table 8, we can understand and explore countries' external financial position vis-à-vis financing with other countries more clearly; this can provide a W-to-W form of financial assets

Figure 2. Schematic of Table 8.



Note: T′ is the transpose of T.

and liabilities matrix. Moreover, the total number of rows and columns in each country has not changed, which is consistent with Table 6. This method was originally used in the input–output analysis; it is defined as a standardization that uses the row's sum and the columns' sum of Leontief inverse to divide its averages. For illustrative purposes, a schematic of Table 8 is provided in Figure 2.

Influence and sensitivity coefficients are defined as follows. Set the position of two-way financial investment as y_{ij}, which is given from country i (as a row) to country j (as a column); set the number of observation objects as n, then Table 8 can be set by y_{ij} forms with the matrix **Y** of EAL formed by n rows and n columns, as shown in Table 8.

Set

$$T_i = T_j = \max(\sum_{i=1}^{n} y_{ij}, \sum_{j=1}^{n} y_{ij}),$$

$$\varepsilon_j = T_j - \sum_{i=1}^{n} y_{ij},$$

$$\rho_i = T_i - \sum_{j=1}^{n} y_{ij}.$$

T is the total of rows or the total of columns for the matrix **Y** of external assets/liabilities, and the total of the rows equals the total of the columns for each country. Designate ε_i as net liabilities of country i, and ρ_j as net assets of country j. If the net assets of country i are non-negative, we have $\varepsilon_i = 0$ and$\rho_j > 0$; and if the net assets of country i are negative, we have $\varepsilon_i > 0$, and $\rho_j = 0$. To illustrate the effect of the influence and sensitivity coefficients, we first need to define the input coefficient c_{ij}. The input coefficient c_{ij} is the ratio of funds raised from country i to the total external financing of country j. That is,

$$c_{ij} = \frac{y_{ij}}{T_j}.$$

From the direction of the rows in Table 8, we arrive at the following equilibrium equation.

$$\sum_{j=1}^{n} y_{ij} + \varepsilon_i = \sum_{j=1}^{n} c_{ij} T_j + \varepsilon_i = T_i, \tag{1}$$

where $\mathbf{C}$ is the $n \times n$ matrix composed of elements of c_{ij}. Thus, the equilibrium equations can be rewritten as

$$\mathbf{CT} + \varepsilon = \mathbf{T}. \tag{2}$$

Solving for $\mathbf{T}$ yields

$$\mathbf{T} = (\mathbf{I} - \mathbf{C})^{-1}, \tag{3}$$

where Equation 3 is the Leontief inverse. Denoting the inverse matrix as $\boldsymbol{\Gamma} = (\mathbf{I} - \mathbf{C})^{-1}$ which has elements $\gamma_{i,j}$, we can identify country j's Influence Coefficients (ICs) by μ_j^y and its Sensitivity Coefficients (SCs) by σ_i^y can be defined as follows:

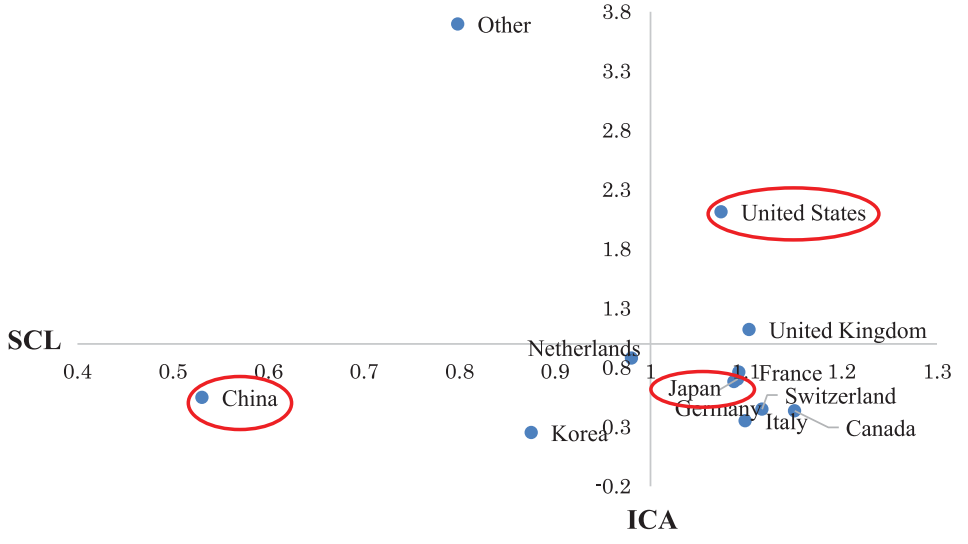
$$\mu_j^y = \frac{\sum_{i=1}^{n} \gamma_{i,j}}{\frac{1}{n}\sum_{j=1}^{n}\sum_{i=1}^{n} \gamma_{i,j}}, \tag{4}$$

$$\sigma_i^y = \frac{\sum_{j=1}^{n} \gamma_{i,j}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{i,j}}. \tag{5}$$

The numerator in Equation 4 is the sum of the eigenvector of the column (asset side for a country) of the Leontief inverse, and its denominator is the average of the total of rows in Leontief inverse, and we can get the country j's IC by Equation 4. The numerator in Equation 5 is the sum eigenvector of the row (liability side for a country) of the Leontief inverse, and the denominator is its average column total, and we can get the country i's SC by Equation 5. Thus, the IC of country j's assets is the ratio of the total of column j to the column average, and the SC of country i's liabilities is the ratio of the total of row i with the row average. The two coefficients are based on the average value of the row and column calculated in the inverse matrix. If a country's row or column total is greater than average, the ratio is greater than 1; while if a country's row or column total is lower than average, the ratio is less than 1. The Influence Coefficient of Assets (ICA) indicates that when $\mu_j^y > 1$, the degree of influence of country j's funds supply to other countries is higher than the world average. When $\mu_j^y = 1$, the degree of influence of country j's funds' supply to other countries is the world average level of influence. When $\mu_j^y < 1$, the degree of influence of country j's funds' supply to other countries is lower than the world average level. Clearly, if the ICA is higher, the influence of the country's money supply on international capital market is greater.

Similarly, the Sensitivity Coefficient of Liabilities (SCL) indicates that when $\sigma_i^y > 1$, the degree of sensitivity of country i's demand for funds from other countries is higher than the world average level. When $\sigma_i^y = 1$, its degree of sensitivity degree for funds demanded of other countries is at the world average. When $\sigma_i^y < 1$, its sensitivity to funds demanded from other countries is less than the world average. Similar to the IC, if a country has a large sensitivity coefficient, its effect on funds demanded can be strong. Conversely, it means that the total demand induced by the country in the global capital marketplace is relatively weak

Figure 3. Influence coefficient of assets & sensitivity coefficient of liabilities by GFF (as of the end of 2016).



overall. According to the above definition of the ICA and SCL, we use the data in Table 8 to calculate the IC and SC for assets and liabilities at the end of December 2016.

By the two different aspects of the supply and demand of funds, ICA and SCL both indicate the funds supplied and demanded by a country. ICA reflects the country's limits, which includes the indirect effects on the global financial market supply when a country increases its money supply. It is a relative indicator and is best used for comparisons across countries, as it is highly correlated with the external asset portfolio. Countries having a high SCL will tend to supply funds to other countries (domestic assets) when the overall demand for funds rises; so much depends on other countries' financing needs.

In Figure 3, we plot countries positions with the ICA on the horizontal axis and the SCL on the vertical axis. This enables a visual representation of the comprehensive effect of countries in the international financial market. Figure 3 can be divided into four quadrants. Counterclockwise, the ICA and SCL in the first quadrant are higher than the average value (greater than 1). In the second quadrant, the ICA is less than 1 but the SCL is greater than 1. However, in the third quadrant, both ICA and SCL are less than 1, which is below the average. In the fourth quadrant, ICA is greater than 1 but SCL is less than 1. The quadrant within which a given country lies indicates its influence tendencies within global financial markets.

Figure 3 demonstrates the following three characteristics. First, the overall distribution of ICA and SCL suggest a relatively weak negative correlation between the two variables, and the degree of change is different. The ICA rises (falls), the SCL falls (rises), but at a different scale. After compiling a financial matrix by the domestic flow-of-funds statistics (W-to-W), we did not observe this phenomenon; so, it appears to be a unique feature of GFF Matrix analysis.

Second, country distributions across quadrant show their relative status and influence in the international financial market. The U.S. and the U.K. are located in the first quadrant,

indicating their generally very strong influences on international financial markets. In particular, the ICA of the U.S. is 1.074, and its SCL is 2.113, the highest worldwide. According to Table 8, the U.S. financed $19.084 trillion through the DI, PI, and OI – 19.5% of total global financing. Its external funds used through the DI, PI and OI reached $16.536 trillion – 17% of total global assets. This means that at the end of 2016, the U.S.'s external investments represented net debt of $2.549 trillion.

We omit a discussion of Other Economies, located in the second quadrant, for the sake of brevity and move immediately to a discussion of the third quadrant where we find the ICAs and SCLs of China, the Netherlands and Korea. China's ICA and SCL were the lowest, at 0.5213 and 0.5497, respectively; indeed, they are much lower than the international average. China's total amount of financing raised $4.100 trillion through the DI, PI, and OI, accounting for 4% of total global funds. On the other hand, external funds used through the DI, PI, and OI reached $2,305 trillion or 2% of global total assets. That is, when we look at the total assets and liabilities of DI, PI, and OI, we can immediately learn that China's external investments yielded that country net debt of $1.795 trillion in 2016. Recall that China also had unexpected net debt of $2.722 billion at the end of 2015. In addition, China's relative size in global financial markets remains small, not keeping pace with its position in world's economic markets. This suggests that China has much work to do vis-à-vis opening its capital markets to the world.

Canada, Switzerland, Italy, Germany, and Japan are located in the fourth quadrant. The ICAs of these countries are greater than 1, but their SCLs were below the world average. The ICA of Japan was 1.113, and its SCL was 0.714 that was put in the second quadrant. By foreign DIs, issuing securities and international bank credit, Japan's financing funds reached $4.367 trillion or 4% of total global financing; and through foreign DI, purchasing securities, and international bank credit, Japan holdings of overseas funds reached $5.861 trillion or accounted 5.6% of total global assets. Japan's external investment yielded a net credit of $1.494 trillion in 2016.

The third characteristic is used as a reference, namely to specify that the reserve assets listed in the GFF matrix can be obtained from a balanced comprehensive judgment. From the overall equilibrium point of view, although the ICAs and SCLs of the U.S. and the U.K. are placed in the first quadrant, their net financial positions are negative – the U.S. has net external debt of $8.18 trillion (see Table 6). China's ICA and SCL are lower than the international average, but its foreign reserve assets are the world's largest at $3.10 trillion (see Table 6), for a net foreign position of $1.80 trillion (see Table 6). This shows that China has a strong external payment capacity and is able to survive most international financial risks and, thereby, keep its external financial environment relatively stable. But, by the end of 2016, China's external financial investments including DI, PI and OI had large net liabilities, as shown in Table 6. In summary, China has gradually increased its financial risks via external financial investments.

Trade friction with the U.S. could affect China's exporting future. This, in turn, could lead to a decline of Chinese foreign exchange reserves. Since the GFF matrix between China, Japan and the U.S. shows that the three countries are closely tied to each other via direct investment, portfolio investment and bank credit, the intensification of any trade friction between China and the U.S. would necessarily affect the real economy of the U.S. and Japan. This then would increase the liquidity and risk of international capital flows, which would affect the stability of the entire financial system. In light of this information,

China should improve its statistical monitoring of financial risks and increase its market transparency. Moreover, China should learn the rules of international financial investment and attain or retain skills in modern financial investment.

6. Concluding remarks

This paper presents a new statistical approach to measure GFF and also establishes a new statistical model based on the economic theory of the GFF. This model depicts the structure and influence and sensitivity of the GFF at stock and flow levels. The approach is elaborated as are the requisite data sources; the structure and equilibrium relation of GFF matrix of 11 countries are subsequently detailed to provide a meaningful case study using a GFF matrix among three countries. Table 3, which builds on prior theoretical constructs in the research stage, is an innovation via its provision of an operational statistical system framework, is the core of the paper. That is, the data contained in Table 3 make GFF a reality, enabling useful metrics contained in Table 6 – the External Asset and Liabilities Matrix for 2016. Clearly, other financial instrument matrices can be constructed to meet the needs of policy-making authorities. The GFF matrix as presented herein is a basis for measuring the GFF, it provides a bird's eye view of the changes in international financial markets. Based on the vision of Whom-to-Whom (W-to-W), we can analyze the structure and financial stability of funds used and the financing among various countries. To the best of our knowledge, the analytical function displayed in Table 3 also has not been presented before and sheds some light on the DGI.

As an extension of GFF analysis, we also can use the data presented in Tables 5 and 6 to calculate the Influence Coefficients of Assets (ICA) and Sensitivity Coefficients of Liabilities (SCL), specifically to describe in greater depth the structure, characteristics and financial risk of direct, portfolio and other investments (DI, PI and OI, respectively) bilaterally among countries. We reserve such analysis for future research. Moreover, while some data on country of asset holders are collected, they are primarily detailed data by the country of ownership of securities (liability data) compiled from the asset- side – so-called derived liability data. The CPIS and locational banking statistics (LBS) are more complementary than are data on the asset side because security issuers might not know who owns their tradable securities.

The theoretical intention of an economics concept determines its statistical extension. In order to determine the theoretical framework of GFF statistics, this paper defines GFF, clarifies the statistical framework for measuring it, and integrates data from the IMF and BIS to compile a GFF matrix on a from-whom-to-whom basis. In addition, the paper addressed some important data gaps that remain in macroeconomic statistics. We elaborate the main attributes of integrated macroeconomic accounts and the GFF matrix. This enables a framework for compiling sectoral accounts, including financial positions and flows on a W-to-W basis. In particular, the GFF integrated framework upholds the following three consistency rules.

The core statistical structure of the GFF for external financial positions and flows focuses on showing not only who does what, but also who does what with whom. In order to observe the risk of international investment and prevent a financial crisis, we recommend that GFF statistical methods should be implemented and should incorporate

W-to-W relationships as the main underlying accounting principle when compiling and disseminating external financial positions and flows.

The advantage of using IMF and BIS data to compile a GFF matrix within the integrated SNA framework (as opposed to using fragmentary data from different sources) is that they ensure data consistency for CDIS, CPIS, International Investment Position (IIP), IBS, LBS, FFA, and BOP. This, in turn, allows for a systematic understanding of the relationships between economic flows in the real and financial spheres; financial interconnectedness as well as of the links between the domestic economic and external economic matrices.

We tabulated a sample of eleven countries, including China, Japan, and the U.S., to illustrate our proposed GFF method and summarized the sources of data that we used. Empirically, we mainly analyzed the financing of China, Japan, and the U.S. via GFF statistics. We then found we were able to learn the structural relationships of funds used and provided via the financing tools and financial market scale among China, Japan, and the U.S. We also were able to understand the external debt–credit relationship among those three nations. The financial relationship of the U.S. and Japan is much stronger than that between China and the U.S. Using the GFF, we were able to estimate the relative influence of each country vis-à-vis assets and their relative sensitivity to their set of liabilities as revealed by countries' foreign financing as well as their shares and positions within international financial markets.

China's ICA and SCL are lower than the international average. Recently, its net external investments have been persistently negative, so China has experienced gradually increasing financial risk in external financial investment.

We note that countries are likely to face difficulties in compiling GFF accounts, so progress toward full GFF implementation will undoubtedly occur stepwise, with the speed of adoption depending on the status of a country's current statistical capability, resource availability, and analytical and political need. As GFF statistics are established and improved in the near future, the following steps should also be taken:

- To establish GFF statistics, there is a need to integrate data sources that include CDIS, CPIS, IIP, and BIS statistics, in accordance with the SNA framework. There is likewise a need to set up GFF accounts to connect with the FFA in the SNA. This, however, requires additional external financial positions in new data-collection systems, as described above for GFFS databases.
- As an improvement, this study selects LBS data to replace the used CBS data which have ever used before to establish the GFF matrix. Because there is an obvious difference in the coverage of the CPIS and the CBS. Especially, CBS also includes debt security held by banks, so there are some double-counting with CPIS. Nevertheless, LBS data are based on the same concept as IIP, so its values and statistical range are more consistent with those of CDIS, CPIS, and IIP. Thus, the accuracy of any integration of these data sources will be higher.
- Improve the classification of the main sectors and instruments. Further details by subsectors and other economic flows for important countries within the GFF may also be considered. W-to-W external financial position, flows for subsectors of major financial player countries, and possibly other economic positions should be taken into account. Sectors (subsectors) and specific instruments (loans, deposits, DI, PI, OI banks, reserve position in the Fund, and foreign exchange) of financial positions and flows on a

W-to-W basis should ideally move from aggregated subsector and instrument details toward disaggregated subsector and instrument details.

- The BSA and external-sector matrices could potentially be extended to flow data to identify changes in transactions and other changes in the volume of an asset/liability. This could be a rather challenging task, given that the flow data would need to be decomposed by contributing country.
- Lastly, based on the above, it is necessary to improve the accuracy of GFF statistics and to explore and expand the set of analytical tools available to carry out a more-detailed and in-depth study of the GFF.

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