DOCTORAL DISSERTATION

ESSAYS ON ENHANCEMENT OF FLOW OF FUNDS ACCOUNTS STATISTICS

（資金循環統計の精度向上と拡張に関する研究）

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List of Abbreviations

General terms

ABCP: Asset-backed commercial paper
ABS: Asset-backed securities
BIS: Bank for International Settlements
BP: Balance of payment statistics
CDS: Credit default swap
CP: Commercial paper
CSD: Central securities depository
DAMI: Direct account management institution
ECB: European Central Bank
ESCB: European System of Central Bank
FFA: Flow of funds accounts statistics
FILP: Fiscal Investment and Loan Program
IAMI: Indirect account management institution
IFC: Irving Fisher Committee on Central Bank Statistics
IIP: International investment position statistics
IMF: International Monetary Fund
ISIN: International Securities Identification Number
JASDEC: Japan Securities Depository Center
JHFA: Japan Housing Finance Agency
JSDA: Japan Securities Dealers Association
MBS: Mortgage-backed securities
MFI: Monetary financial institutions
MFSM: Monetary and Financial Statistics Manual
MCT: Monetary claim trust
NIPA: National Income and Product Accounts
OECD: Organization for Economic Co-operation and Development

PBoC: People's Bank of China
SNA: System of National Accounts
SPC: Special purpose companies
UNSD: United Nations Statistics Division
WB: World Bank

Sector names

CB: Central bank
DC: Depository corporations
FA: Financial auxiliaries
GG: General government
HH: Households
ICPF: Insurance corporations and pension funds
NFC1: Private non-financial corporations
NFC2: Public non-financial corporations
NPISH: Nonprofit institutions serving households
OFI: Other financial intermediaries
ROW: Rest of the world

List of Papers Underlying Each Chapter

Chapter 2

Sato, Yoshiko (2009), "Measuring Securitization in the Flow of Funds Accounts in Japan," COM/STD/DAF document presented at the WPFS of OECD meeting held on 2-4 November 2009.

Chapter 3

Sato, Yoshiko (2011), "Developing Database on Securities Holders Information: the Case of Japan," in Chavoix-Mannato, M. ed., "Working Party on Financial Statistics: Proceedings of the Workshop on Securitisation," OECD Statistics Working Papers, 2011/03, 139-146.

Sato, Yoshiko (2012), "Developing Database on Securities Holders Information: the Case of Japan," in "Data requirements for monitoring derivative transactions," IFC Bulletin No. 35, 102-110.

Chapter 4

Presntation by Yoshiko Sato (2011), "Whom-to-whom presentation using Japan's flow of funds accounts," at WPFS of OECD held on 24-27 October 2011. < http://www.oecd.org/dataoecd/18/42/48913462.ppt>

Hagino, Satoru, and Yoshiko Sato (2011), "Compilation Problems of Flow of Funds Accounts on a Consolidated or Nationality Basis: a Case Study of Japan," in "Residency/Local and National/Global Views of Financial Positions," IFC Working Papers, No. 8, 76-81.

Chapter 1

Scope of the Essays

1. The need for the enhancement of flow of funds accounts statistics

Flow of funds accounts (FFA) statistics are a well-recognized financial statistics and is available in most developed countries. FFA statistics illustrate all financial transactions and positions in an economy and constitute a principal data source for financial accounts under a fully integrated system of national accounts. Major countries such as the U.S., Germany, France, and Japan have been compiling flow of funds for over 60 years. Because of its comprehensiveness, minuteness, and international comparability, in addition to its high credibility regarding the central bank's data collection capacity, an abundance of time-series data have been used for a wide variety of policy analysis purposes.

Although there is no doubt that flow of funds accounts statistics are some of the most frequently used statistics in macroeconomics, the statistical accuracy and the possible enhancement of these statistics have not been studied yet. Existing studies mostly address their analytical use. An example from recent studies is the analysis of the transmission mechanism of monetary policy conducted by Christiano, Eichenbaum and Evance (1996). Their study analyzes the contractionary monetary policy responses of each institutional sector using the net funds raised as measured by flow of funds accounts statistics. It

recognizes the existence of statistical discrepancies in flow of funds accounts statistics and/or NIPA (National Income and Product Accounts) data and, for analytical robustness, conducts calculations using both measures. This example indicates that significant results are unachievable without using accurate statistics.

In this recognition, these essays aim to provide an overview of the research on the statistical accuracy and possible enhancement of flow of funds statistics. Special attention is devoted to less accurately estimated areas, such as the securitization market, securities holders' information, and interlinkages among institutional sectors of these statistics. The questions addressed include whether current flow of funds accounts can accurately capture financial sectors outside the authorities, how risks in securities held should be recognized in macroeconomic statistics, and how to present interconnectedness between sectors with limited data sources.

2. The evolving statistical requirements

The aim of these essays is also backed by the evolving requirement recently added for the flow of funds accounts statistics from the perspective of financial stability. The statistics are expected to work as not only a statistical but also a monitoring framework. These statistics traditionally reflect the financial conditions of non-banks and sometimes the so-called shadow banking sector. Shadow banking comprises the system of credit intermediation that involves entities and activities outside the regular banking system (Financial Stability

Board (2011)), including the following: finance companies, asset-backed commercial paper (ABCP) conduits, limited-purpose finance companies, structured investment vehicles, credit hedge funds, money market mutual funds, securities lenders, and government-sponsored enterprises. Because they conduct maturity, credit, and liquidity transformation without accessing the central bank liquidity or public-sector credit guarantees, they became severely strained during the financial crisis (Polzsar. et.al. (2010)). Because flow of funds accounts statistics reflect sectors categorized into shadow banks, the statistics may be able to signal a change in conditions of risks and vulnerabilities related to such sectors. Indeed, international initiatives have been undertaken to enhance the flow of funds accounts statistics to a monitoring framework.

Regarding this additional requirement for flow of funds accounts statistics, these essays are intended to illustrate the use of these statistics as a monitoring framework.

First, however, the data availability limitations should be clarified. In analysis of financial crises, one of the most important factors is the maturity mismatch, namely short-term funding and long-term investment, of relevant sectors. Currently, flow of funds accounts statistics in Japan has no source data that can yield detailed breakdowns by maturity or currency. This limitation is not immediately resolvable because the enhancement of source data takes a long time due to the additional reporting burden of the reporting institutions associated with the new data collection. In addition, flow of funds accounts statistics are compiled on a residency basis rather than a nationality, corporate group, or consolidated

basis. The transactions and positions of foreign branches and subsidiaries of resident institutions, for example, are recorded as those occurring in the rest of the world. Risks or losses incurred within a corporate group are not consolidated in flow of funds accounts statistics. The possible future alternative and associated compilation problems based on a consolidated or nationality basis are discussed in Hagino and Sato (2012).

3. Outline of the essays

The essays are structured as follows.

Chapter 2 is the extended study based on Sato (2009) presented at the Working Party on Financial Statistics (WPFS) of Organization for Economic Co-operation and Development (OECD) meeting held on 2-4 November 2009. The chapter is modified from the initial study to reflect subsequent developments. The chapter examines the extent to which Japan's FFA can capture the securitization market accurately. The financial turmoil beginning circa 2008 has led an increasing number of people to look into FFA. The statistics are primarily designed to describe a country's financial structure from a rather long-term perspective. However, the financial events in this period shifted the focus to narrowing the data gaps. In this sense, this chapter intends to assess to what extent FFA captures the securitized market size under the current statistical treatment. First, it explains the way we compile the "Special Purpose Companies (SPC) and Trust" sector and indicates that FFA provides an accurate but incomplete coverage of the sector. Secondly, this chapter

shows that FFA correctly traces the turning point of the sector in 2007 but still has room for improvement. Finally, the possible future approaches are commented upon, including the use of electronically registered data for statistical purposes, which is explained in detail in Chapter 3.

Chapter 3 is based on Sato (2011), which was presented at the Workshop on Securitization organized by OECD and Banco de España held in Madrid on 27-28 May, 2010, and Sato (2012), which was presented at the workshop on "Data requirements for monitoring derivative transactions," co-hosted by the People's Bank of China (PBoC) and the Irving Fisher Committee on Central Bank Statistics (IFC) (held in Zhengzhou, China on 27-29 September, 2010). The chapter also reflects subsequent developments. It considers the use of centralized information stored in central securities depository (CSD) as source data for flow of funds accounts statistics. Identifying the exact holder or the holding sector of securities is one of the most challenging tasks for statistical compilers. Recently, some central banks and statistical authorities have started projects to build up securities databases to store information on securities holders.

This chapter discusses the Bank of Japan's recent exploration of the CSD data as a statistical source of securities holders' information. First, it explains the features of the CSD in Japan. Second, it overviews the achievement from applying the CSD data to the flow of funds accounts statistics. Third, it argues the general challenges pertaining to CSD data as a statistical source to identify final holders of securities, sometimes referring to the

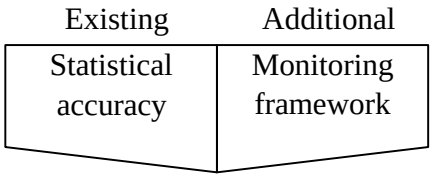
result of the survey conducted for seven OECD countries. It concludes that using CSD data can be used to solve data gap problems.

Chapter 4 is the study based on a presentation and discussion at WPFS of OECD, held on 24-27 October, 2011. The research question of this chapter is also closely related to Hagino and Sato (2011) in the working paper with the editorial review process. The need for identifying the exact holder of securities also leads to the question of who finances whom, through what type of financial instrument, from the financial stability perspective. Out of this context, Chapter 4 presents a model of compiling from-whom-to-whom statistics using flow of funds accounts. The methodology employed is a maximum entropy method commonly used in the existing literature on financial contagions, but the chapter differs from the existing work in two ways. First, it does not rely on this method exclusively; this chapter also enhances the from-whom-to-whom statistics using partially available detailed data on inter-sectoral relationships. Second, the total from-whom-to-whom statistics measure the overall exposures across institutional sectors and the coverage of transactions is not limited to a particular market, for example, the interbank market. Japan's FFA is used, which includes fine-grained breakdowns of sectors and transaction items relative to those of other countries. This feature enables more accurate and reliable estimations. The proposed from-whom-to-whom framework allows analysis of financial interlinkages. From the result estimated using 2010 data, the importance of depository corporations is highlighted in Japan's financial system and is also analyzed in the euro area. Moreover, the

intertemporal comparison between 2000 and 2010 reveals that the strength of the relationship between institutional sectors has changed according to counterparties. Depository corporations increase finances to central government, whereas public financial institutions reduce the volume of lending. The rest of the world strengthens the interconnectedness between domestic sectors.

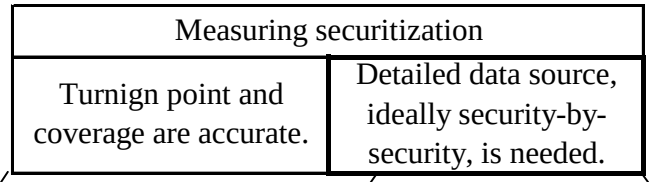
Structure of chapters

Chapter 1 The need for the enhancement of flow of funds accounts statistics

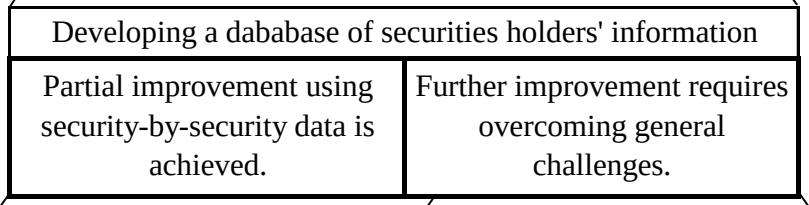


Enhancement

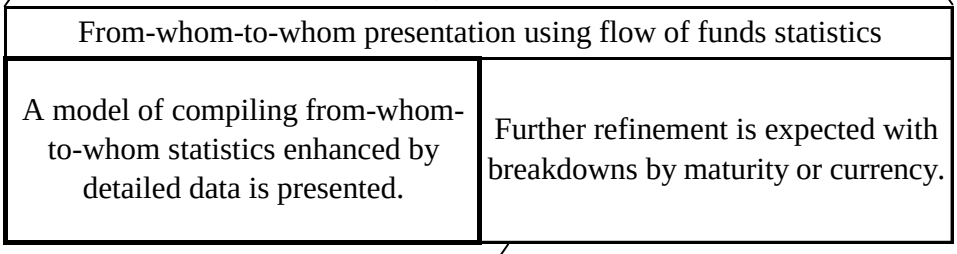
Chapter 2



Chapter 3



Chapter 4



Future studies

Enhancement of the statistics with breakdowns by maturity or currency.
Development of another flow of funds statistics on a nationality (consolidated) basis.

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Sato, Yoshiko (2012), "Developing Database on Securities Holders Information: the Case of Japan," in "Data requirements for monitoring derivative transactions," IFC Bulletin No. 35, 102-110.

Chapter 2

Measuring Securitization in the Flow of Funds Accounts in Japan

Abstract

Understanding securitization in terms of its economic mechanism is especially important given the recent financial crisis. Flow of funds accounts (FFA) statistics have great potential for providing the necessary data for the economic analysis of securitization. Moreover, the recent financial crisis has also endowed FFA with the task of providing information to narrow data gaps. Based on this knowledge, this chapter intends to investigate to what extent the statistics are able to capture the securitized market size under the current statistical treatment. First, it explains the way we compile the "Special Purpose Companies (SPC) and Trust" sector and indicates that FFA provides an accurate but incomplete coverage of the sector. Secondly, it shows that FFA correctly traces the turning point of the sector in 2007 but still has room for improvement. Finally, this chapter comments on possible future approaches, such as the use of electronically registered data for statistical purposes.

Key words: Flow of funds accounts; data gaps

1. Introduction

Understanding securitization in terms of its economic mechanism is especially important given the recent financial crisis beginning circa 2008. One of the most important roles of securitization is providing risk taking and risk diversification opportunities. However, this effect also increases the likelihood of financial contagion spreading rapidly across agents in addition to providing investment opportunities in various classes of assets. Unfortunately, these roles of securitization and the transmission mechanism of financial risks are not yet fully understood.

Flow of funds accounts (FFA) statistics have great potential for providing the necessary data for the economic analysis of securitization. One difficulty in studying the role of securitization and the transmission mechanism is the absence of data. With regards to the study of financial contagion, lending channels are relatively easily analyzed using existing data, but the analysis of financial contagion will require a more comprehensive dataset covering not only lending but also a full range of financial transactions. Therefore, FFA may serve as macroeconomic data to better understand securitization.

Moreover, the recent financial crisis has also bestowed upon FFA the task of providing information to narrow data gaps. The statistics are primarily designed to describe a country's financial situation from a rather long-term perspective. After the crisis, an increasing number of people start to expect the statistics to be utilized in a monitoring framework.

Based on such knowledge, this chapter starts by examining securitization in FFA as an opening study of the enhancement of the statistics. It intends to investigate the extent to which these statistics are able to capture the securitized market size under the current statistical treatment.

This chapter is organized as follows. Section 2 overviews the statistical treatment of the securitization in FFA, such as its definition, scope, and compilation method, including data sources. Based on the statistical treatment, Section 3 assesses the coverage, Section 4 discusses what we can learn from FFA data, and Section 5 considers possible future research directions. Section 6 concludes.

2. Statistical treatment

FFA is a comprehensive type of statistic that depicts the financial conditions of all economic entities under the System of National Accounts (SNA) and Monetary and Financial Statistics Manual (MFSM). To capture the securitization activity, Japan's FFA has special sector and transaction item of Special purpose companies (SPC) and Trust sector and structured-financing instruments according to the 1993 SNA framework. The sector has a long data series, which is on a fiscal-year basis starting in 1980 and on a quarterly basis from the fourth quarter of 1997.

2.1 Definition of the SPC and Trust sector and structured-financing instruments

As a sub-sector of non-banks in our FFA statistics, the Structured-financing special purpose companies and trusts (SPC and Trust) sector is established to describe the securitized market. It acquires monetary claims and issues securities backed by the claims to raise necessary funds. The sector covers SPC, including those established under the Law on Securitization of Specified Assets by Special Purpose Companies (former SPC Law), and certain monetary claims trusts. It issues structured-financing instruments as financial products.

The instruments contained in the structured-financing instruments are (1) Asset-backed securities (ABS), (2) Asset-backed commercial paper (ABCP), and (3) Monetary claim trusts (MCT). ABS refers to “securities”. More specifically, ABS consists of asset-backed domestic corporate bonds and asset-backed samurai bonds (yen-denominated bonds issued by non-residents in a domestic market). MCT, however, is a trust that is set upon the assets of Housing loans (residential mortgage loans), Loans to companies and governments, Installment credit (i.e., lease) or consumer credit, and Trade credits and foreign trade credits. Structured-financing instruments does not cover credit default swap (CDS).

2.2 Brief history of Japanese securitization

Traditionally, “trust” is the most frequently used securitization vehicle in Japan. Before the SPC Law (“Law regarding regulation of business concerning specified claims”) enacted in

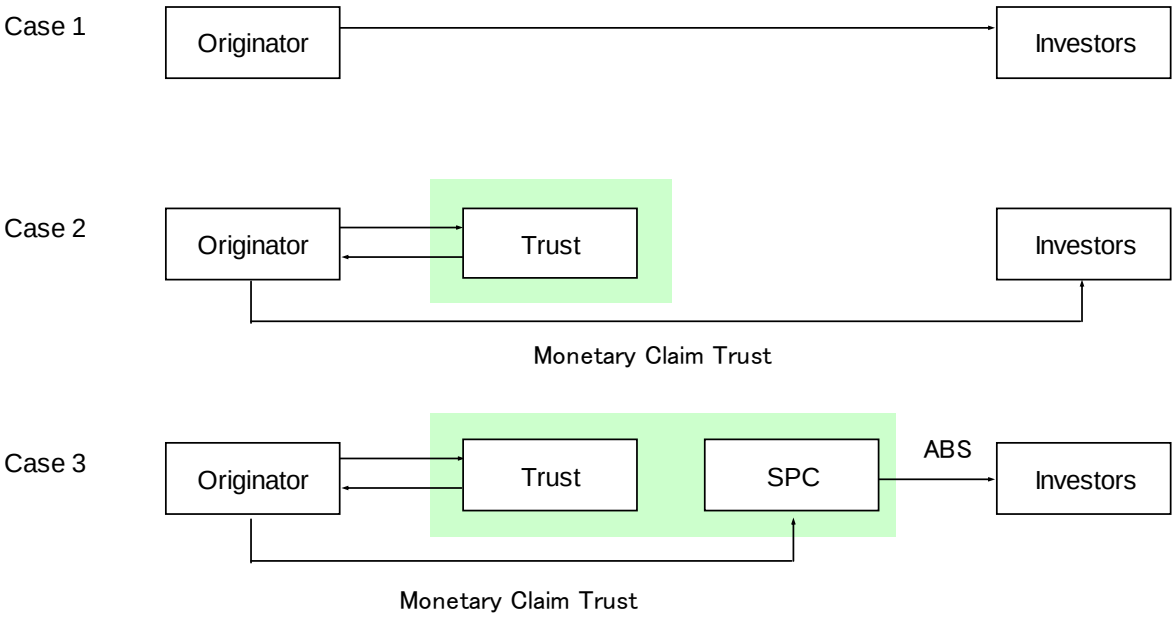
1998, investors and originator had few choices for securitization except the use of trust or SPC registered abroad. Trust is favorable in terms of protecting originators' rights regarding the fiduciary assets and avoiding double taxation (Takahashi (2009)).

2.3 Description of compilation method

2.3.1 Features

Trust is one of the most popular vehicles in securitization. MCT presents a dominant share of 80.8 % in the total amount of structured-financing instruments, while those of ABS and ABCP are 5.1% and 14.1%, respectively, in FFA as of the end of March 2009. The players in securitization are illustrated in Figure 1 as "Originator," "Investors," "Trust," and "SPC." Three cases are assumed: (1) Sales, (2) Trust, and (3) Trust plus SPC. (1) Sales are not usually regarded as securitization in a statistical sense because they are transactions in which the asset held by an originator is directly sold to an investor. However, (2) Trust and (3) Trust plus SPC are regarded as securitization. In Japan, if a securitization transaction involves SPC, it is highly likely that the transaction also involves trust, whereby it falls into the case (3) Trust plus SPC. As the shaded area is what FFA considers when compiling "SPC and Trust" sector, the sector covers as much range as the statistics should be expected to cover.

Figure 1: Typical securitization scheme in Japan



2.3.2 Sources

As Sato (2009) denotes, MCT data are not publicly disclosed and therefore must be directly reported. Twenty institutions, consisting of 4 major trust banks, 11 trust subsidiaries of financial institutions, and 5 trust companies (non-financial institutions), contribute to the MCT figures as of the end of June 2009. They provide the central bank with the detailed figures classified by the underlying assets.

In contrast to MCT, the central bank has no specific system reporting directly from SPC. Instead of direct reports or related data from regulatory authorities, market statistics are used. For ABS and ABCP, the major data source is the aggregate figure of "New Issue Volume and Value of Outstanding Bonds," which is publicly released by the Japan Security Dealers Association (JSDA). The compilers first take the relevant end-period outstanding amount in this statistics and then classify the amount by the type of underlying asset: "housing loans," "loans to companies and governments," and "trade credits and foreign trade credits." In the classification, they estimate the shares of each asset type by accumulating each individual issue's repayment schedule at the time of the issuance taken from another survey of JSDA. ABCP is estimated by assuming that it is a portion of structured-financing instruments.

The principal policy in compilation is to avoid additional reporting burdens on financial institutions. In this context, a reasonable approach is the use of publicly available data on ABS and ABCP and the supplementation of missing information with estimates.

2.3.3 Scope of the "SPC and Trust" sector

The "SPC and Trust" sector covers both private and public issues. ABS includes privately placed issues as part of asset-backed domestic corporate bonds. Privately placed ABS was once compiled based on the actual figures collected from the market arrangers or underwriters. After the primary data source of JSDA stopped collecting such privately placement information in May 2008, the compilation was shifted to estimation. In March 2011, the estimation of privately placed ABS was accomplished using data released from Japan Securities Depository Center (JASDEC) in the book-entry transfer system for corporate bonds.

"SPC and Trust" sector covers non-resident issues in domestic market as well. Domestic bonds issued by non-resident SPC are called asset-backed samurai bonds. Publicly placed asset-backed samurai bonds are included under the name of structured-financing instruments. Privately placed asset-backed samurai bonds, however, are not included but are reflected under the different heading of transaction of either "Direct investment" or "Portfolio investments in securities", which is compiled based on the Balance of Payment Statistics (BP) and International Investment Position statistics (IIP). Because they are aggregate figures, the relevant transactions of non-resident SPC are inseparable.

2.3.4 Valuation

The amount outstanding of structured-financing instruments is evaluated based on the book value, while the transactions are recorded using the term-on-term difference in the values. The book value is useful in compiling flows and may also avoid heterogeneous treatment among countries in cases of entities registered in foreign countries.

2.3.5 Holding sector information

Holding sector information is the most difficult to obtain. In FFA, for the holding sector, the holding amounts of financial institutions (asset side of their balance sheets), such as banks, insurance companies, and finance companies, and social security funds are based on the financial statement of these institutions. However, the holding amounts of non-residents are estimated by multiplying a ratio calculated from past questionnaire surveys to securities companies. The residual with no specific holding entity is posted as the portion held by private non-financial institutions.

2.3.6 Treatment of securitization by the Japan Housing Finance Agency (JHFA)

The treatment of the Japan Housing Finance Agency (JHFA) in FFA should be noted. JHFA is a government financial institution and the largest issuer of mortgage-backed securities (MBS) in Japan. The outstanding MBS (including that issued by its predecessor, the Government Housing Loan Corporation) represents 8.9 trillion yen at end-March 2009. Most of the MBS were to finance their on-balance sheet securitization in the past. It is still

possible to purchase residential loans from private financial institutions and issue MBS backed by those collaterals, although it has been essentially forbidden from providing its own new residential loans. Under the treatment of SNA, on-balance sheet securitization is not included in the "SPC and Trust" sector. Instead, it is added into the "Government financial institution" sector, to which JHFA belongs.

Another note is that although the MBS issued by JHFA is increasing, it does not necessarily mean that the securitization market is expanding at the same rate. JHFA is changing its funding source from loans through the Fiscal Investment and Loan Program (FILP) to the issuance of MBS based on the fundamental reform of FILP. The expansion pace thus includes such refinancing needs.

3. Assessment

Based on the statistical treatment described in the previous section, the securitization in Japan's FFA can be measured as follows.

First, FFA statistics have an accurate coverage regarding capturing the size of the securitization market. All major financial institutions contribute to reporting MCT, which is used quite often in Japan's securitization transactions. Privately placed ABSs are included, and ABSs issued by non-resident SPC are partly covered. Sales are not usually regarded as securitization, as shown in Figure 1; instead, they are captured as transactions between an

originator and investor. The statistical treatment is consistent with international standards.

However, FFA statistics do not necessarily provide complete coverage, which would capture the entire securitization market, in that the primary data source for the private placement of ABS is an estimate and the non-resident SPCs' private placement is inseparable from the primary data source of BP and IIP statistics.

4. What can we learn from the FFA data?

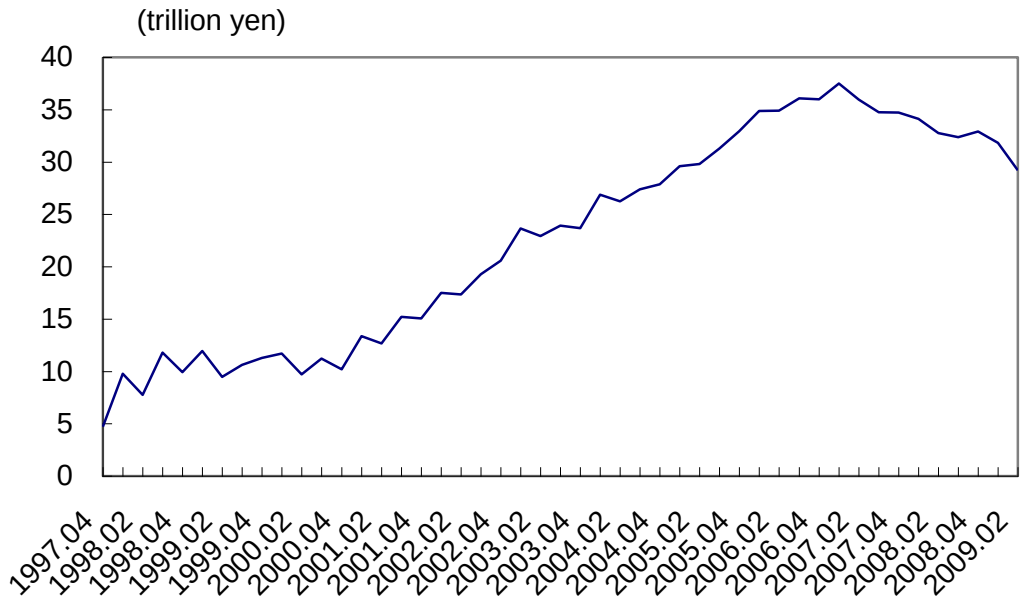
This section looks into the FFA statistics. The statistics correctly reflect the turning point of the sector in 2007; however, cross-border securitization is expected to appear in different transaction items. In addition, holdings of the structured-financial instruments may describe the true figures to a certain degree, but there is still room for improvement.

4.1 Turning point

FFA seems to reflect the turning point accurately. As of the end of June 2009, 30 trillion yen was outstanding in structured-financing instruments (Figure 2). The volume of structured financing instruments expanded during the first half of 2000s but started to decline in mid-2007. This decline roughly coincides with the start of the financial turmoil in the latter half of the 2000s, which was caused by the collapse of BNP Paribas, Bear Stearns, and then the Lehman shocks.

When we look at the proportion of underlying assets, we notice that housing loans are the largest part of the assets if MBS issued by JHFA is included (usually excluded in the "SPC and Trust" sector but adjusted for comparison). Housing loans post 40.5 % of the total underlying assets, followed by "loans to companies and governments" (25.8 %) and "trade credits and foreign trade credits" (19.0 %). If such MBS are excluded, the share of housing loans will be 22.7 %, following "loans to companies and governments" (33.5 %) and "trade credits and foreign trade credits" (24.6 %) (Figure 3). The turning points by type of underlying assets are almost the same: the first quarter of 2007 for both loans to companies and governments and trade credits and foreign trade credits and the second quarter of 2007 for housing loans (Figure 4). Installment credit (not included in consumer credit) began declining earlier in the first quarter of 2004, which might represent the contraction of the overall installment credit market. From a long-term perspective, housing loans (residential mortgage-backed securities) have not been severely damaged to date. Loans to companies and governments and trade credits and foreign trade credits have shrunk faster than housing loans in the most recent period.

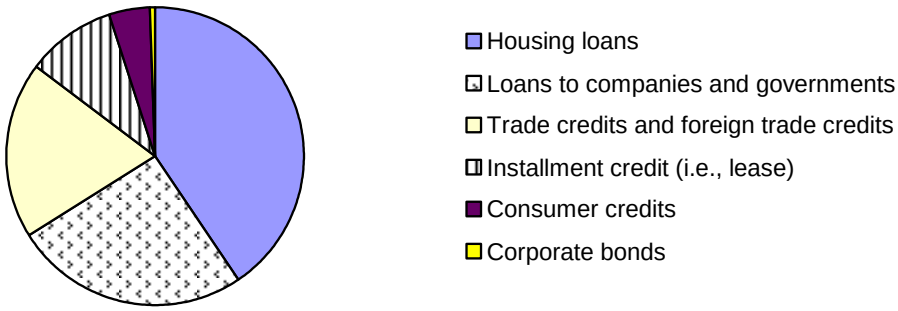
Figure 2: Total assets of the SPC and Trust sector



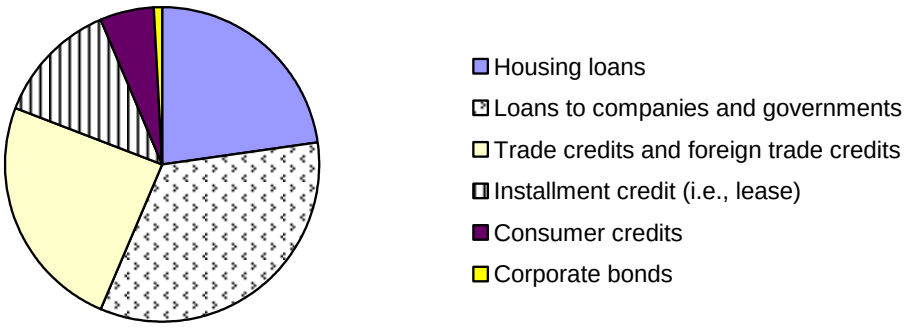
Sources: Bank of Japan, "Flow of Funds Accounts"

Figure 3: Proportion of underlying assets (end of March 2009)

"Housing loans" including MBS issued by the Japan Housing Finance Agency

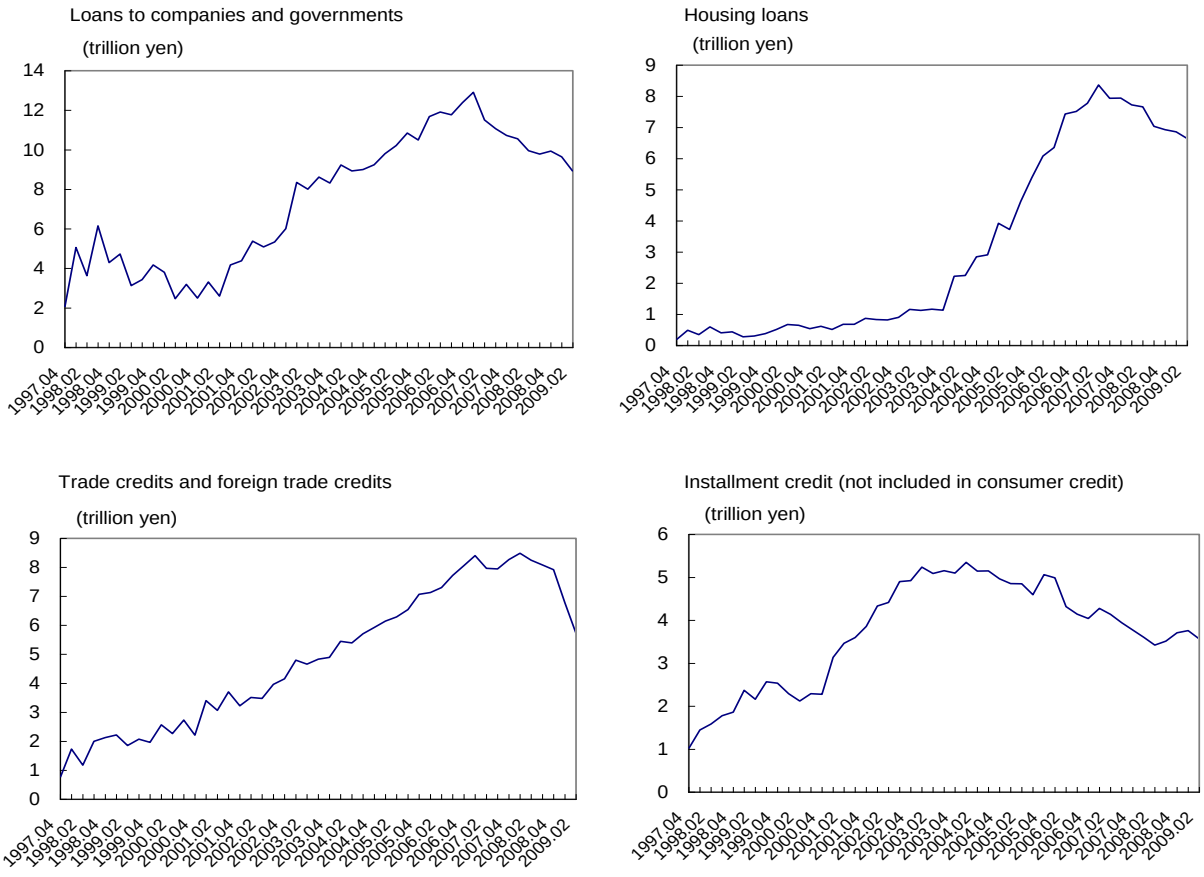


"Housing loans" excluding MBS issued by the Japan Housing Finance Agency



Sources: Bank of Japan, "Flow of Funds Accounts"
The Japan Housing Finance Agency, Disclosure 2008

Figure 4: SPC and Trust sector classified by type of underlying asset



Note: "Housing loans" excludes MBS issued by the Japan Housing Finance Agency.

Sources: Bank of Japan, "Flow of Funds Accounts"

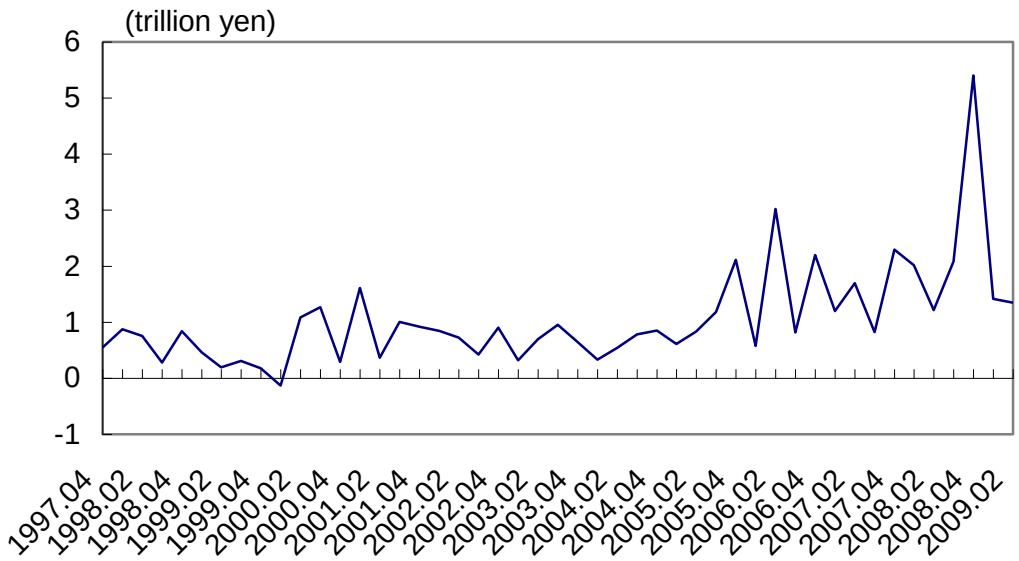
4.2. Cross-border securitization

Cross-border securitization appears in different transaction items. Looking at "Direct investment" and "Portfolio investment in securities" in Figure 5, in which transactions between non-resident SPC and residents are expected to exist, we realize that both terms increase as they approach the fourth quarter of 2008 and decrease shortly thereafter. If we assume that part of this increase should be attributed to any private placements of non-resident SPC and that we might have been able to identify them, the trend would have differed, possibly continuing to increase until the end of 2008.

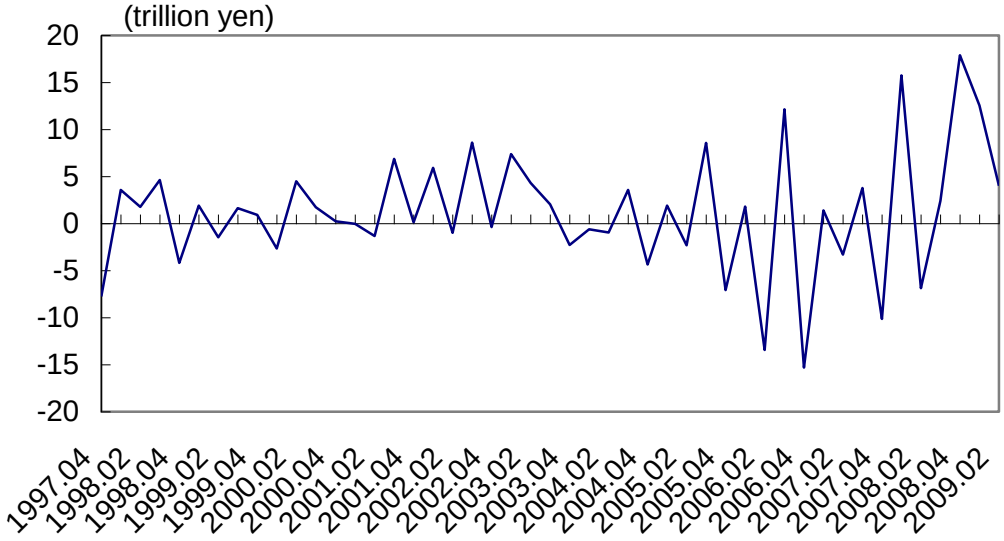
In this way, cross-border securitization also appears in the "Direct investment" or "Portfolio investment in securities." However, the surge evidenced in the fourth quarter of 2008 is said to be related to banks' recapitalization activities. Indeed, Sumitomo Mitsui Banking Corporation, Mizuho Financial Group, and Sumitomo Trust and Banking Company set up non-resident SPCs as subsidiaries, issuing preferred stock to domestic investors in the amounts of 538 billion, 355 billion, and 70 billion yen, respectively, in this period. The proceeds of the issues are used to finance back as subordinated loans to their parent companies to build up banks' capital (Figure 6). The evidenced recapitalization activity is a type of rerouted transaction using non-resident SPCs and is not related to "securitization" activity.

Figure 5: Balance of payment statistics

Direct investment

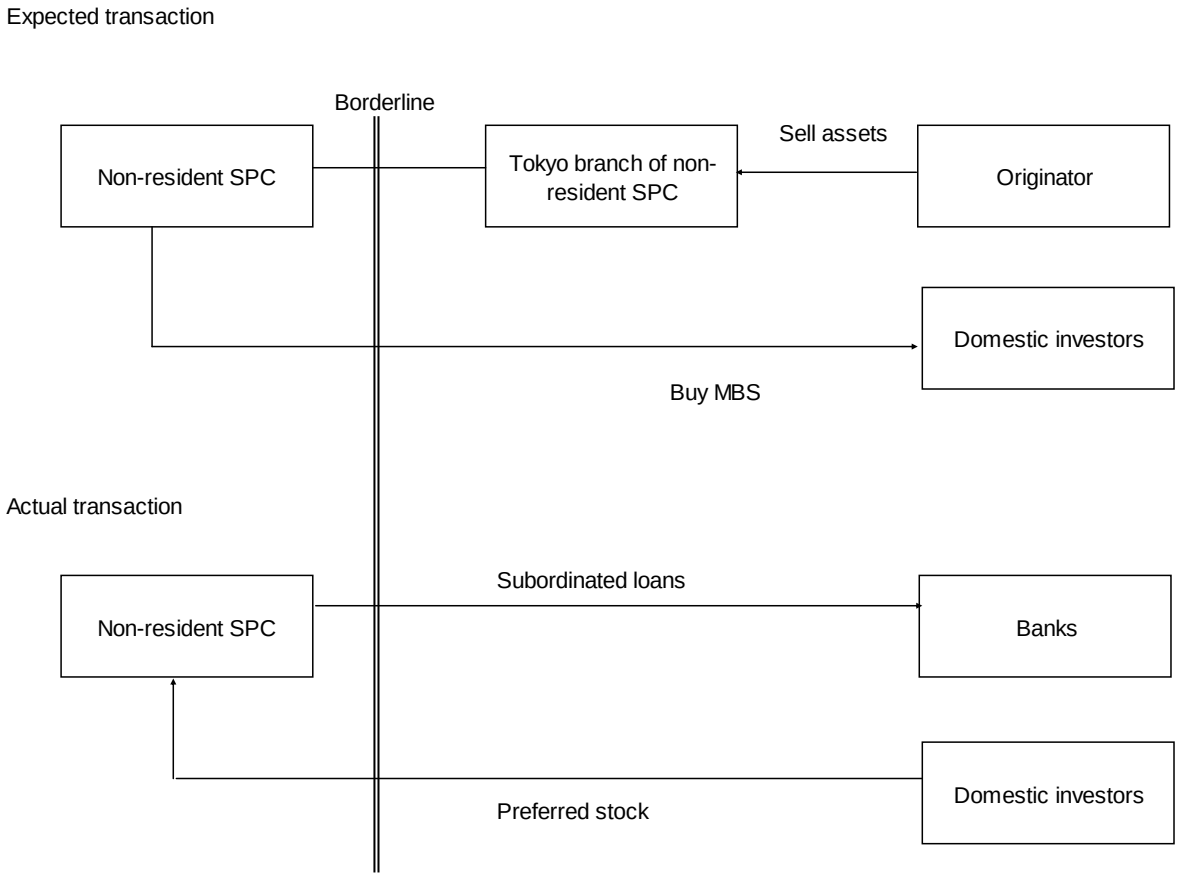


Portfolio investment



Sources: Ministry of Finance and Bank of Japan, "Balance of Payment"

Figure 6: Cross-border transaction



4.3 Holding sector of structured-financing instruments

Although we have a weak base for the information on the holding sector of structured-financing instruments, the result does not differ much from the comparable source figures. Figure 7 shows that depository corporations hold 12 trillion yen of these instruments and around 13 trillion yen of securitized products disclosed by the Financial Services Agency. Both statistics are applicable in different contexts; FFA is estimated, while that of the Financial Services Agency is surveyed.

The rest of the world (0.8 trillion yen) does not have a comparable figure outside of FFA. However, the amount may be overestimated because overseas investors may have little access to Japan's securitization market.

Figure 7: Holding sector of structured-financing instruments

The end of June 2009

(trillion yen)

Total	Financial institutions					Non-financial corporations	General Government	Rest of the world
		Depository corporations	Insurance corporations	Pension funds	Other financial			
30.5	23.0	12.0	8.6	0.9	1.5	6.7	0.0	0.8

Sources: Bank of Japan, "Flow of Funds Accounts"

5. Possible future approaches

FFA is not a survey statistic and requires various types of statistics or data as source data. The quality of FFA, therefore, depends on the quality of the primary data. Understanding this point, future approaches for improving FFA statistics will be summarized as follows.

5.1 Using electronically registered data, instead of survey data, for statistical purposes

One promising approach is the use of the existing data for statistical purposes. Fortunately in Japan, an electronically registered book-entry transfer system has been in operation since 2002. It is operated by JASDEC and concerns a wide range of securities. Based on its nature of recording the change of ownership in securities, it is supposed to contain sufficiently minute security-by-security information to be aggregated into sectoral categories in FFA.

A collective data source, ideally security-by-security data, is required for these statistical purposes in the euro area. There is an ongoing project to construct security-by-security databases for statistical purpose. Brunken (2009) explains the effort made by the European System of Central Bank (ESCB) for constructing such databases. Matos et al. (2009) introduces the case of the Bank of Portugal. Pêtre (2009) conducts an analysis using BIS's International debt securities database, which contains security-by-security information.

The usage of an existing data source is efficient. By aggregating individual data according

to the sectoral and transactional categories of FFA, the confidentiality of investors and issuers can be maintained. To this end, the database must be specified as being used for "social statistical purposes". To pursue this option, cooperation between the related bodies (industry association, depository center, and statistical authorities outside of the central bank) is a prerequisite.

5.2 International cooperation in data collection

Statistics may not improve solely by compilers' domestic efforts. There should be international cooperation in data collection as well as the synchronized improvement of the related statistics. It is especially important for identifying the cross-border securitization transaction in which a non-resident SPC plays a major role; thus, domestic authority has no direct control of posing reporting obligation.

6. Conclusion

FFA is a comprehensive statistical subset that depicts financial conditions of all economic entities under a system of national accounts. The strengths lie in the comprehensiveness or balancing process, wherein necessary figures can be estimated after taking all the other figures calculated in the matrix cells. A "data gap" means that no primary data exist. The quality of the FFA statistics is restricted on the premise that there is no primary data. Therefore, measuring securitization market more precisely requires enriching primary source data. One of the suggested future approaches is the use of electronically registered

data for statistical purpose. This point is discussed in the following Chapter 3.

One question to be answered is the following: “Which statistics or figures are best able to predict a crisis?” First, financial innovation is rapid and cannot be anticipated. In this sense, data used in prudential policy appear to be advantageous. Second, FFA describes the financial structure, which in turn shows the allocation of funds among sectors. Next, it helps to understand how financial contagion propagates across sectors over time. Considering the advantages of each figure, it is understandable that the principal role of alerting the crisis itself should be borne by a snapshot-type survey conducted by supervisory authority. FFA then is expected to incorporate the results of the survey for analyses of risk propagation in the financial system.

The securitization process is very complex and is still being developed. To understand the process precisely, the appropriate employment of various types of data is needed.

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Chapter 3

Developing a Database of Securities Holders' Information: the Case of Japan

Abstract

Identifying the exact holder or the holding sector of securities is one of the most challenging tasks for statistical compilers. Recently, some central banks and statistical authorities have started projects to build up securities databases to store information on securities holders. This chapter discusses the Bank of Japan's recent exploration of the central securities depository (CSD) database as a statistical source of securities holders' information. This chapter explains the features of the CSD in Japan, overviews the achievement from applying the CSD data to the flow of funds accounts statistics, and argues the general challenges pertaining to CSD data as a statistical source to identify final holders of securities, sometimes referring to the result of the survey conducted for seven OECD countries. This chapter concludes that using CSD data is one approach to solving data gap problems.

Key words: CSD; security by security; data gaps

1. Introduction

Identifying the exact holder or the holding sector of securities is one of the most challenging tasks for statistical compilers.

In macroeconomic statistics, such as the flow of funds (FFA) accounts, a balance sheet provides useful information on the holding amount of securities but aggregating balance sheets does not always provide a complete economic portrait. Balance sheets of non-financial corporations and some of other financial institutions, for example, are not always available, and households do not make balance sheets.

Under such constraints, the study in this chapter aims to narrow the data gaps for the securities holding in FFA by the use of security-by-security database. Because such a database contains detailed information, aggregation of individual security-by-security data improves statistical accuracy. Indeed, some central banks and statistical authorities have started projects to build up securities databases to store information on securities holders. The ECB (2009) explains its intention to establish a single authoritative data source － the centralized securities database － to meet the needs of the ECB itself. The BIS, ECB, and IMF (2010) argue the holding side of securities statistics. This type of movement is gaining ground especially after the recent financial crisis whereby risks are transmitted in the financial system. The FSB and IMF (2009) advocate the importance of knowing where risks actually lie across institutions.

This chapter discusses the Bank of Japan's recent exploration of the central securities depository (CSD) data as a statistical source of securities holders' information. This chapter is organized as follows. Section 2 explains the features of the CSD in Japan. Section 3 overviews the recent achievement as a result of applying the CSD data to the flow of funds accounts statistics. Section 4 presents the general challenges pertaining to CSD data as a statistical source for identifying the final holders of securities, sometimes referring to the result of the survey conducted for the seven Organization for Economic Co-operation and Development (OECD) countries. Section 5 concludes.

2. Features of the CSD in Japan

CSD data in general is considered to have at least two advantages in data collection. The first advantage is the centralization of information, which is elaborated in this section. The other is that the data encompassing a wider universe than that of the administratively collected data. Using administratively collected data is an accurate, powerful, and efficient way to see the conditions of a specific sector, but they can be weak in the sense that relevant data exist outside the scope of authorities.

2.1 The one and only platform of book-entry transfers except for central government bonds

Except for central government bonds, book-entry transfer services of securities are only provided by CSD in Japan, which is the Japan Securities Depository Center, Inc.

(JASDEC). Even though book-entry transfer services of central government bonds are provided by the Bank of Japan, this chapter only discusses the services by JASDEC.

The JASDEC is a privately owned stock company licensed under the Act on Transfer of Bonds, Shares, etc. (hereafter, "The Law"). It operates the book-entry transfer system for general securities such as corporate bonds, stocks, commercial paper, and investment trusts. Because the JASDEC is the only platform of book-entry transfers for those securities, the information is centralized in this system on a security-by-security basis. Therefore, the JASDEC has the potential for collective gathering of securities holders' information.

The law stipulates JASDEC's book-entry transfer business but does not require data sharing for statistical purposes. Currently, no data exchange contract exists between the JASDEC and the central bank or other statistics authorities.

The book-entry transfer system has been in operation since 2002. The rate of use of the system in commercial paper (CP) transactions is almost 100 %. That of other securities transactions is also thought to be close to 100 %.

2.2 Chain of accounts

The JASDEC system has a cascade structure of accounts. As illustrated in Figure 8, an investor who wants to make a transaction opens a customer account at either a direct account management institution (DAMI) or an indirect account management institution

(IAMI). When there is a deal, the transactional information is transferred from the institution at which the investor holds an account to the institution keeping the transactional counterparty's account. If the investor, indicated as "Participant (i)" in Figure 8, sells securities to the investor indicated as "Participant G," the information on the deal is sent through institutions E, A, the JASDEC, and finally to C, where sold securities are entered into Participant G's customer account (Case 1). However, if "Participant (i)" sells securities to "Participant (ii)," the transactional information is processed within E. IAMI E transfers the transactional amount from the Participant (i)'s account to Participant (ii)'s account, and the transaction is completed within E (Case 2).

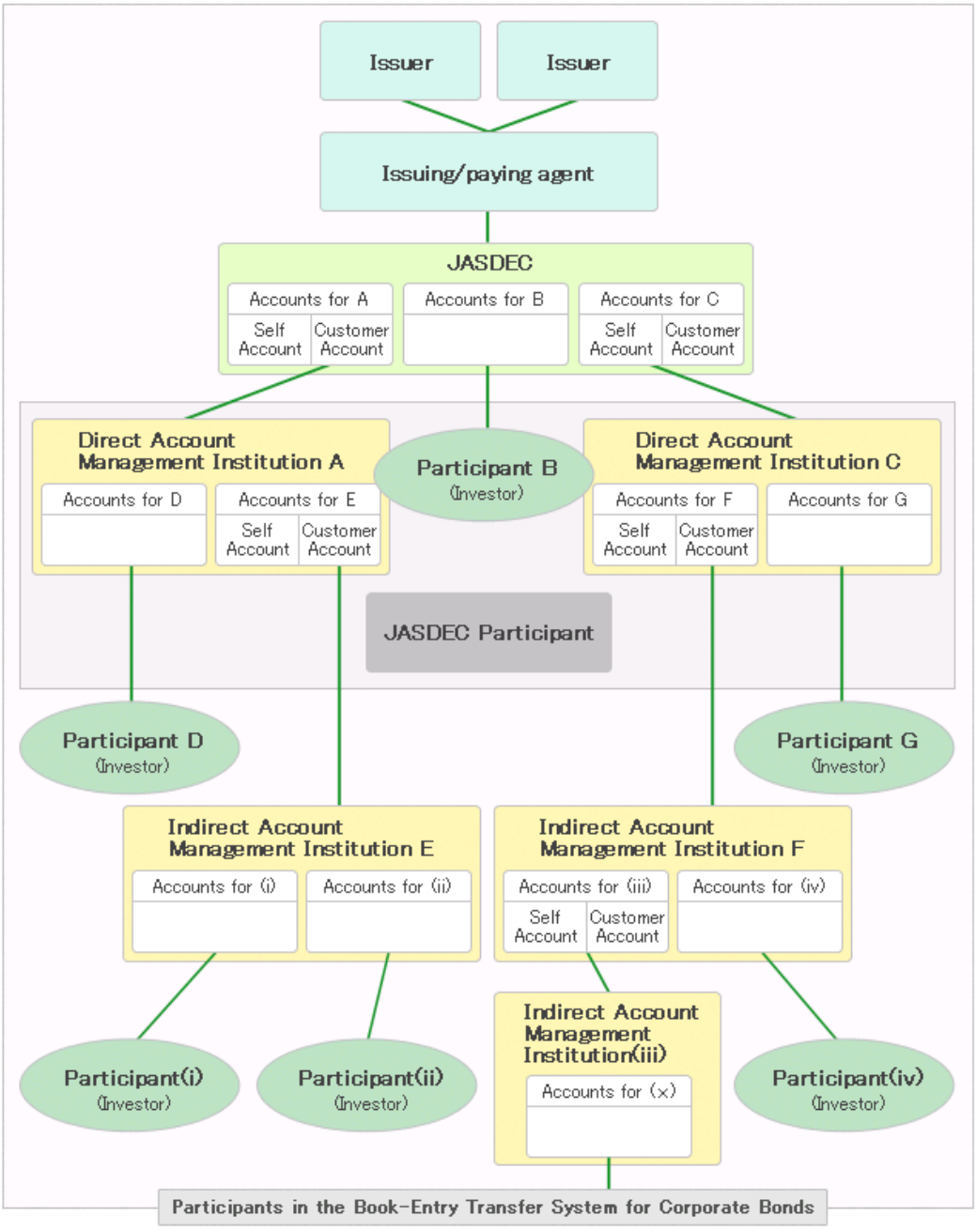
The DAMI or IAMI – usually banks or securities companies – can also hold their own accounts. These accounts, called self accounts, are separated from customer accounts in this system. As of May 2010, there are 89 DAMI and 407 IAMI in the book-entry transfer system for corporate bonds.

2.3 Finality of ownership

One of the features that is different from the CSDs of some other countries is the finality of securities ownership. In the JASDEC system, at no point do DAMI or IAMI take over the ownership of transacted securities, even though the process itself occurs in chains of accounts held by these intermediate institutions. Kanda (2009) describes the system as the "direct system." An account management institution keeps an investor account and

provides book-entry transfer services but does not take over the ownership of securities. The legal ownership of securities remains with the investor and does not move to any other institution.

Figure 8: Account structure of the JASDEC



Source: JASDEC

http://www. jasdec.com/en/system/sb/outline/image/index.html

In contradistinction to the direct system, there are some countries in which an account management institution legally holds assets and an investor keeps equitable interest in these assets. Securities entitlement is moved from an investor to an account management institution. In such a system, it might be more difficult to detect the final holder of securities than it is in the direct system.

2.4 Security by security

All data are handled on an individual issue basis in the book-entry transfer system. The information available for each issue includes the name of the issue, name of issuer, face value, maturity, etc. The current outstanding balance is also available. For example, detailed information on the corporate bonds whose data are required to be open to the public can be obtained by searching the JASDEC website using the name of the issue or the International Securities Identification Number (ISIN) code, as an identifier. Compilers usually work with aggregate data. The security-by-security nature of this database allows compilers to disaggregate the data in accordance with the sectoral and transactional classification in the System of National Accounts.

3. Application of CSD data to flow of funds accounts

The section overviews the achievement from applying the CSD data to the flow of funds accounts statistics. As Sato (2012) explains, improvements on asset-backed commercial paper (ABCP) and local government bonds were achieved to the data revision of the

statistics in March 2010. Additional improvement on privately placed asset-backed securities was also achieved in March 2011. Sato (2012) explains that the Bank of Japan started discussing the possible use of data as a statistical source with the JASDEC in late 2009, primarily motivated by the need to secure a more accurate source data for the flow of funds accounts statistics. The achievement is the result of cooperative work between the two institutions on inquiries and responses of data definition.

3.1 ABCP

Asset-backed commercial papers (ABCP), a part of structured-financing instruments, had no reliable source before the revision. Sato (2009) explains that figures for the ABCP used to be estimated by assuming that they were part of other structured-financing instruments. Cooperative work with the two institutions on data definition confirms that some data released by the JASDEC were consistent with ABCP definition of flow of funds accounts statistics. The data were adopted as new source data. As a result, the market size of the ABCP was more accurately reflected in the flow of funds accounts statistics.

3.2 Local government bonds

The information on the outstanding amount of local government bonds has not been centralized. Before the dematerialization started in 2006, the total outstanding amount had been estimated based on registered bonds. There were problems in the frequency of the data, which was once a year, and in the existence of non-registered bonds (held in

certificate), of which the amount had not been deemed negligible.

As the dematerialization proceeded, a majority of local government bonds shifted from registered bonds to those in the book-entry transfer system. Because the system is open on the web every day and the data are stored security by security, it is possible to confirm whether each issue is within the definition of the statistics at any date. Moreover, it is found that the amount of non-registered bonds still exists but not as significant as to make estimation impossible. A series of examinations ensures that the CSD's aggregate data are the most centralized and reliable primary source data to describe the total market size of local government bonds.

3.3 Privately placed asset-backed securities

Privately placed asset-backed securities are also part of structured-financing instruments together with ABCP. They were once estimated based on weak source data. Using data released from JASDEC in the book-entry transfer system for corporate bonds, the size of the market of privately placed asset-backed securities is compiled accurately.

Privately placed asset-backed securities can be identified as securities issued by special purpose companies (SPC) in the book-entry transfer system for corporate bonds. Among them, the issues backed by monetary claims are classified as structured-financing instruments in the flow of funds accounts statistics, while those backed by real estate

properties are classified as Corporate bonds. Therefore, compilers must distinguish between the two types of issues. The data stored in JASDEC enables compilers to identify such issues security by security and then to classify each issue by collateral type. Overall, the two components of Corporate bonds and structured-financing instruments improve the accuracy.

4. Challenges for the statistical development of CSD data

While CSD data have a distinct advantage in data collection because of its electronically processed centralized system, several aspects have to be considered for the development of the data into a database.

This section presents the general challenges pertaining to CSD data as a statistical source to identify final holders of securities. It sometimes refers to the result of the survey conducted for seven OECD countries in April and May 2010 to ask central banks and statistical authorities whether they use CSD data for compiling financial statistics. Seven countries (the U.S., the U.K., Australia, Germany, Spain, Chile, and Canada) responded to the survey. The result of the survey is summarized in Figure 9.

Figure 9: CSD data usages in financial statistics

	Respondent	CSD data usage				Data used other than CSD
			Holders' information	Coverage	Contract/agreement	(i.e. custodians)
U.S.	Federal Reserve	○ (1)	×	Low (ABS) High (ABCP)	○	
U.K.	Bank of England	×	–	–	–	○ (London based issuing and paying agents)
Australia	Australian Bureau of Statistics	○	×	Low (voluntary registration)	○	○
Canada	Statistics Canada	×	–	–	–	○
Germany	Deutsche Bundesbank	○	△ (Not in all cases final holders)	Low	○	○
Spain	Banco de Espana	○	△ (Debt securities issued by residents and held by non-residents)	Low (If between the non-resident and the CSD there is a resident custodian, it is the latter who declares.)	○	○ (custodians, used to identify the holdings of securities by Non-financial corporations and by Households)
Chile	Banco Central ce Chile	× →○ (2)	— → ○	–	— → ○	
Japan	Bank of Japan	○	× → ○ (i.e. local government bonds held by non-residents) (3)	High	×	×

Notes: (1) CSD data is used for bonds and stocks issued by non-financial corporate businesses along with other private vendor data. CSD data gives inadequate coverage for asset-backed bonds (probably less than 20 percent of the market), while CSD data on asset-backed CP is 100 percent of the market.
(2) Currently, the Banco Central de Chile does not use the information given from the CSD for the compilation of yearly financial accounts statistics. Nevertheless, it is working in a project of quarterly financial accounts, where CSD data will be used intensively, including the securities holders' information.
(3) It is identifiable by aggregating the amount of the tax exempt accounts which are specially allowed for non-residents.

Source: Sato (2012)

4.1 Cascade structure of accounts

The most important reason why it is difficult to identify final holders from CSD data is a practical one that exists in a cascade structure of accounts. The transactional information is transferred from one institution to another as explained in sub-section 2.2. However, detailed information on an investor such as the sector in which it is statistically classified is held only by the account management institution at which the investor holds the account. In other words, detailed information on the investors is decentralized among account management institutions in the book-entry transfer system. Participants in the system know the name, characteristics, and the amount of individual securities in the accounts they offer but do not have information about the ultimate owners of securities in case the account is a customer account. For instance, the CSD and DAMI, which are located upstream in the chain structure, do not know the change of ownership of the securities when a transaction is completed within the IAMI, as seen in Case 2 in sub-section 2.2. Therefore, for statistical purposes, compilers should take another measure to obtain the entire market information.

Most countries have access to supplementary source data other than CSD to overcome the cascade account structure problem. In countries that have an indirect system in which detecting final holders is difficult, CSD data are either selectively used or not used for compilation at all. In the U.S., CSD data are used along with private vendor data for bonds and stocks issued by non-financial corporate businesses. The amount of asset-backed securities issued is measured as the assets removed from the balance sheet of originators.

CSD data are used selectively for ABCP because they cover 100 percent of the market. Then, the amount of ABCP is used to calculate the amount of asset-backed corporate bonds by deducting it from the total amount of asset-backed securities. In the U.K., the CSD data are used as part of a quality assurance process but not for data compilation. Instead, data collected from London base issuing and paying agents are used for published securities issues statistics.

According to the results of the Bank of Japan survey, which are shown in the table of CSD data usage in financial statistics, even in the countries that appear to have a direct system, data given by intermediate institutions are also used for financial statistics. In Spain, for Balance of Payments and International Investment Position, CSD data are used for debt securities issued by residents and held by non-residents. The data incorporate the country of residency of the first-known counterpart but not the final holder. If there is a resident custodian between a non-resident and the CSD, it is the resident custodian who has the information, and the CSD data do not cover the transaction. The information provided by the resident custodians is also used, on an aggregated basis, to identify the holdings of securities by non-financial corporations and by households. In Germany, the CSD is one of approximately 2,000 reporting agents.

In Chile, Banco de Chile does not currently use information given by the CSD for the compilation of yearly financial accounts statistics. Nevertheless, it is working on a project related to quarterly financial accounts, where the CSD data will be used intensively,

including the securities holders' information.

In Japan, one of the challenges in using CSD data is obtaining supplementary information related to customer accounts in the DAMI. Currently, accounts of which JASDEC manages the outstanding amount are basically limited to those set up within the JASDEC itself, as the accounts for A, B, and C illustrated in the Figure 8. Ideally, the data should cover all the participants of the book-entry transfer system including both the DAMI and the IAMI. Most major financial institutions participate in the system as DAMIs. If the owners' information on securities in DAMIs' customer account becomes available with the cooperation of JASDEC and DAMIs, the information can be applied to the composition of customer accounts in the IAMI to estimate the amount of each type of securities held by each sector. The estimation could be conducted with certain accuracy because all DAMIs and IAMIs are registered at JASDEC, and it is well known that the chain structure does not extend to more than a few layers.

4.2 Confidentiality of customer accounts

The other reason why it is difficult to get accurate information is because of the confidentiality of customer accounts. Even if the cascade account structure problem is technically solved, the confidentiality problem remains. Two accounts exist: self accounts and customer accounts, as explained in sub-section 2.2. We can identify, in our direct system, relatively easily whether an account held by an account management institution is a

customer account or a self account. However, detailed information on a customer, which is necessary for compiling statistics, is usually hard to obtain, partly because custodians or account management institutions are commonly required to keep the accounts confidential under contracts with customers, which makes them reluctant to provide customer information.

To overcome the confidentiality problem, central banks or statistical authorities will need a contract with CSD or with custodians that states they will receive just aggregate data and will not share individual data. In the U.S., the Federal Reserve receives data from the CSD based on a contract with a confidentially clause that says it cannot share data of individual firms. From a statistical viewpoint, compilers do not need firm-level information. They just need aggregate data classified according to institutional categories of securities holders. Such data do not need to be security-by-security, as long as they are correctly reported.

4.3 Cooperation with CSD and with securities industry

The third factor is the cooperation with the CSD and with securities industry. According to our survey, all of the three countries using CSD data (the U.S., Australia, and Chile) are confirmed to have a contract or an agreement with the CSD in obtaining data, implying that the securities industry agrees to use CSD data in principle. Germany and Spain go a step further; they have official central bank regulations that stipulate a mandatory data collection scheme. Therefore, it seems that there is a general understanding regarding the

statistical value of CSD data in the economy.

In Japan, it is also understood that the development of financial and securities statistics is an important issue and will contribute to the growth of the securities market. Based on such understanding, a conference was held in late 2009 – the Japan Securities Dealers Association was the organizer – with such participants as the members of securities industry. The Bank of Japan also participated as an observer. Participants argued that the availability of additional CSD data could increase the understanding in the securities market.

5. Conclusion

This chapter has introduced the Bank of Japan's recent exploration of the CSD data as a statistical source of securities holders' information. The CSD in Japan has several features suitable for data collection: the one and only platform for book-entry; finality of ownership; and the security-by-security nature. Through communication with the CSD, the Bank of Japan has achieved statistical improvement in Japan's FFA mainly for the market size of the ABCP, local government bonds, and privately placed asset-backed securities.

While the CSD has a distinct advantage in data collection because of its electronically processed centralized system, there are issues to resolve for the development of the data as a source of final holders. General challenges are as follows: the cascade structure of

accounts; confidentiality of customer accounts; cooperation with the CSD and securities industry.

Approaches to data gaps considered upon the recent financial crisis should relate closely to the possibility of developing a wider and more reliable source of information. Although there are many challenges, CSD data will continue to be a strong candidate in shedding light on sectors such as households, non-financial corporations, and other financial institutions.

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Chapter 4

From-whom-to-whom Presentation Using Japan's Flow of Funds Accounts

Abstract

This chapter presents a model of compiling from-whom-to-whom statistics using flow of funds accounts, relying not only on the maximum entropy method but also using detailed data on inter-sectoral relationships. It shows that if flow of funds accounts statistics are compiled with a large number of transactional breakdowns and detailed data on bilateral exposures across sectors are available, from-whom-to-whom statistics can be compiled accurately. This chapter also analyzes the change of inter-sectoral relationship in Japan's financial market from 2000 to 2010. Depository corporations increase finances to central government, whereas public financial institutions reduce the volume of lending. The rest of the world strengthens interconnectedness between domestic sectors.

Key words: From-whom-to-whom; bilateral exposure; financial linkages; inter-sectoral relationship; Flow of funds accounts; data gaps

1. Introduction

Flow of funds accounts (FFA) statistics are a framework describing financial flows and positions in a national economy. This framework is primarily intended to trace money flows transacted among institutional sectors. Since Copeland's (1947) pioneering study of money flow, the idea of illustrating who finances whom has always been in the center of interest. In recent times, the demand for statistics showing inter-sectoral financial linkages has rather been intensified since the financial crisis in 2008 because the crisis occurred outside of banks. Linkages between banks and other financial institutions are not well understood. It is argued that if there had been statistics accurately showing inter-sectoral financial linkages, the crisis could have been foreseen or possibly lessened by detecting vulnerabilities in the financial system. The FSB and IMF (2009) note that the importance of sectoral data, including from-whom-to-whom information, has been highlighted by the crisis. Indeed, many international manuals of statistical standards start to present stylized framework for reporting from-whom-to-whom statistics. BIS, ECB and IMF (2010) show from-whom-to-whom presentation tables on debt securities. UNSD and ECB (2011) elaborate these for equity securities.

Although FFA is primarily intended to trace money flows, current FFA does not allow from-whom-to-whom presentation. The reason for this is because the source data necessary for compiling complete from-whom-to-whom statistics are limited. FFA is a two-dimensional framework, i.e., by sector and by transaction, whereas the

from-whom-to-whom presentation requires three-dimensional sector-by-sector information; which sector owns assets to, or incurs liabilities against, which sector. In reality, FFA is compiled based on balance-sheet data and balance-sheet data usually does not reveal counterparty information in every financial transaction.

This chapter presents a model of compiling total from-whom-to-whom statistics using flow of funds accounts. The methodology employed is a maximum entropy method commonly used in the existing financial contagion literature, but the study in this chapter differs from the existing work in two points. First, it does not rely only on this method but also enhances from-whom-to-whom statistics using partially available detailed data on inter-sectoral relationships. Second, the total from-whom-to-whom statistics measure overall exposures across institutional sectors, and the coverage of these transactions is not limited to a particular market, for example, interbank market. The data used is Japan's FFA, which has very detailed breakdowns on sectors and transaction items compared to those in other countries. This feature enables the estimation more accurate and reliable. The proposed from-whom-to-whom framework allows analysis in financial interlinkages. From the result based on estimates from 2010 data, the importance of the Depository corporation in Japan's financial system is highlighted. Moreover, the intertemporal comparison between 2000 and 2010 reveals that the strength of the relationship between institutional sectors has changed according to counterparties.

This chapter is structured as follows. Section 2 introduces the existing literature. Section 3

explains the data used to compile Japan's total whom-to-whom statistics. Section 4 elaborates upon the methodology. Section 5 explains the estimated result and analyzes the financial linkages in 2010. Section 6 conducts an intertemporal comparison between 2000 and 2010. Section 7 concludes.

2. Existing literature

Although macroeconomic statistics exhibiting inter-sectoral relationships, especially who finances from whom by means of which financial instrument, are strongly desired in terms of financial stability perspective, an integrated framework for financial flows and positions has not yet been fully developed. The System of National Accounts 2008, which is the most fundamental standards in macroeconomic statistics, is primarily a two-dimensional system of institutional sectors and transaction items, and it does not articulate three-dimensional from-whom-to-whom statistics (EC, IMF, OECD, UN, and WB (2009)). From a securities holdings perspective, BIS, ECB and IMF (2010) elaborate the detailed recordings of debt securities. These frameworks are all ideally possible but do not explain how to compile from-whom-to-whom statistics with limitation of source data.

The research on how to measure financial linkages has rather been developing in the context of financial contagion. The existing literature concerns interlinkages and contagion risks in interbank market. These papers investigate contagion risks by first estimating bilateral lending exposures using individual data of banks' balance sheets. When a

maximum entropy methodology is applied, the estimated exposures are sometimes supplemented by additional data, such as large exposure data, to reflect concentration of the market. Then, they perform scenario analysis with a shock of bank failure and estimate the extent of potential contagion. Upper and Worms (2004) use balance sheet information to estimate a matrix of bilateral credit relationships for the German banking system and test whether the breakdown of a single bank can lead to contagion. Wells (2004) estimates the exposure matrices using the data on UK-resident banks' money market loans and deposits with other UK-resident banks. Lelyveld and Liedorp (2006) compare the adequateness of using large exposure data with that of alternative sources of survey data as additional information for estimating the lending matrix in the Dutch interbank market. They conclude that large exposures data gives an adequate approximation of the actual linkages between banks. Based on the conclusions presented in these previous papers in the analysis of interbank market, this chapter applies the same method to an integrated macroeconomic framework for financial positions.

Empirical studies have been conducted by ECB (2009) and by Oesterreichische National Bank (2010). ECB (2009) applies a maximum entropy method but does not use detailed from-whom-to-whom information. It estimates balance sheet linkages between sectors in the euro area and finds that banking sector plays a crucial role in the euro area financial system. It also observes the growing role played by the other financial intermediaries sector and analyzes that a part of the growth reflects the expansion of securitization transactions.

Oesterreichische National Bank (2010) also estimates financial interlinkages in the entire economy in Austria. It does not explain the method in detail, but it seems to take the same approach as ECB. All these studies follow the same statistical classification as that used in the euro area accounts, which has a less detailed sectoral classification than Japan's FFA. The accounts do not, for example, distinguish the central bank from depository corporations.

Notably, the inter-sectoral relationships that this chapter attempts to describe should be interpreted as residency-based relationships because macroeconomic statistics, including FFA, are usually compiled based on residency information. Hagino and Sato (2011) point out that residency-based statistics are useful for capturing where financial assets and liabilities are created and held, whereas those compiled on a consolidated or nationality basis are useful for capturing who makes decisions, assumes risks, and holds capital as a buffer for losses. FFA compilation problems based on consolidated or nationality issues are detailed in the Hagino and Sato (2011) paper and are not discussed in this chapter.

3. Data

The data used are taken from flow of funds accounts statistics (FFA) in Japan. One of the attractive features of Japan's FFA is the detailed breakdowns of sectors transaction items. In the Japan's FFA, there are 45 sectors and 51 transaction items including sub-sectors and sub-categories. They are very detailed even according to international standards (Bank of

Japan (2011a)). These detailed breakdowns of sub-sectors and sub-categories are attractive features for making an accurate from-whom-to-whom matrix because a large number of transactions have only one issuing sector; thus, the allocation of assets to counterparty sectors for such transactions is uniquely determined. Therefore, this chapter keeps as great a number of transactions as possible, which is 38 transactions, to construct the total from-whom-to-whom matrix. To avoid complexity of calculation and for simplicity in interpretation, this chapter aggregates sectors into 11, as explained in the following section. Japan's FFA releases figures on both quarterly and a fiscal-year bases. This chapter uses figures on a fiscal-year basis for 2010 and 2000.

Only stock figures, not flow figures, are used because the methodology applied allows only positive figures. FFA provides three tables, "Transaction Table," "Assets and Liabilities Table," and "Reconciliation Table." Stock figures are shown in the Assets and Liabilities Tables.

The other attractive feature in using Japan's FFA is that it provides the important source data for constructing a from-whom-to-whom matrix. Detailed data for the flow of funds accounts present a partial picture in the from-whom-to-whom matrix, in which the data for loans and deposits are available with breakdowns of sectors to which the funds are directed. Shrestha et al. (2011) discover that information on a from-whom-to-whom basis is lacking in official statistics for the large majority of cases and a limited number of economies (Japan and the U.S.) disseminate financial accounts and financial balance sheets with

significant details for instruments and sub-sectors, making it possible to identify the debtor/creditor relationships in many cases. This chapter therefore utilizes the resource of Japan's detailed data on loans provided by private financial institutions.

4. Methodology

The purpose of this chapter is to construct a total from-whom-to-whom matrix. The matrix should describe the real state of cross-sectoral positions for each financial transaction item accurately and all financial transaction items.

To meet these needs, this chapter first employs maximum entropy method. The maximum entropy method is a proportional allocation method based on the knowledge that, without any additional information, the most probable distribution of an unknown variable is achieved by maximizing entropy (uncertainty). This method is applied first to produce basic tables and then to enhance them using the detailed data, cross-sectoral position data available in the flow of funds accounts statistics. In Japan, cross-sectoral positions for loans by private financial institutions are available. Who (Depository corporations, Insurance corporations and pension funds, Other financial intermediaries, and Financial auxiliaries) provides what amount of loans to whom (Households, Private non-profit institutions serving households, Private non-financial corporations, Public non-financial corporations, General government, and the Rest of the world) is known from the detailed data. An attractive feature is that these detailed data are compiled as a reference of flow of funds

accounts statistics, so it perfectly fits within an integrated framework. Shrestha et al. (2011) argue that although some recent improvements in the development of statistical methodologies and data availability have supported the compilation of partial data on a from-whom-to-whom basis; however, a fully integrated approach for financial flows and positions within the macroeconomic statistics framework is yet to be achieved, mainly due to limited sets of from-whom-to-whom data. Given the difficulty in obtaining from-whom-to-whom data, the experiment using Japan' flows of funds accounts and the detailed data provides a good model for compiling a from-whom-to-whom matrix within an integrated framework for the entire world.

The construction of the total from-whom-to-whom matrix proceeds as follows. First, basic tables are produced. There are 38 basic tables corresponding to each of 38 financial transaction items. Next, among those tables, the table of loans by private financial institutions is enhanced using the detailed data. Consistency restrictions are then imposed and re-estimated. For 2010, nine tables were re-estimated. The financial positions of the rest of the world vis-à-vis the rest of the world appear to be non-zero figures in eight tables, which is inconsistent because the from-whom-to-whom framework is a system of national accounting. Therefore, financial positions of the rest of the world vis-à-vis the rest of the world should be restricted to zero. The restriction is also imposed to the financial positions of Central Bank to Central Bank itself, which requires the re-calculation of 3 tables, 2 of which are overlapping and have already been counted in the number of the rest of the world

restrictions. Lastly, all the tables are aggregated into a single whom-to-whom matrix by summing 38 figures for each inter-sectoral relationship. Such a comprehensive from-whom-to-whom matrix describes the relationship of all financial assets and liabilities among institutional sectors.

4.1 Production of basic tables

The method used to produce the basic tables is a maximum entropy method, which is the most common in the existing literatures for financial contagions estimating bilateral exposures of banks in interbank markets (Lelyveld and Liedorp (2006), Upper and Worms (2004), Wells (2004)). The difference is that the contagion models concern balance sheets of individual banks, whereas this chapter deals with aggregated sectoral balance sheets. The inter-sectoral relationship can be represented by the following $N \times N$ matrix:

$$X = \begin{array}{c} \\ \\ \\ \\ \\ \sum_j \end{array} \begin{array}{c} \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1N} \\ \vdots & \ddots & & \iddots & \vdots \\ x_{i1} & & x_{ij} & & x_{iN} \\ \vdots & \iddots & & \ddots & \vdots \\ x_{N1} & \cdots & x_{Nj} & \cdots & x_{NN} \end{bmatrix} \\ \begin{array}{ccccc} l_1 & \cdots & l_j & \cdots & l_n \end{array} \end{array} \begin{array}{c} \sum_i \\ a_1 \\ \vdots \\ a_i \\ \vdots \\ a_N \\ \\ \end{array}$$

where x_{ij} denotes the sector i's exposure against the sector j and N is a number of sectors. The observable figures are the total assets held by a sector i, which is $a_i = \Sigma_j x_{ij}$ and the total liabilities issued by a sector j, which is $l_j = \Sigma_i x_{ij}$, and exact cross-sectoral positions of x_{ij} are

unknown. Under such constraints, the most probable distributions of x_{ij} can be estimated by assuming that financial assets of a certain instrument category are allocated to counterparty sectors in proportion to the share of liability of respective sectors within the same instrument category. As Castren and llja (2009) point out, the elements of diagonals are not restricted to zero for sectoral analyses, which is opposed to the case for interbank market analysis because intra-sectoral transactions are recorded on an unconsolidated (gross) basis, which leads to the natural consequence of non-zero intra-sectoral positions.

Eleven sectors are used in this chapter, which is Households (HH), Private non-profit institutions serving households (NPISH), Central bank (CB), Depository corporations (DC), Insurance corporations and pension funds (ICPF), Other financial intermediaries (OFI), Financial auxiliaries (FA), Private non-financial corporations (NFC1), Public non-financial corporations (NFC2), General government (GG), and the Rest of the world (ROW). These sectors are more detailed than the analysis of Castren and llja (2009), which uses the euro area accounts, but the euro area accounts has only 7 available sectors.

This chapter produces 38 basic tables according to this method. Each basic table corresponds to a financial transaction item in Japan's flow of funds accounts. The numbers of transaction items are more detailed than 13 in the euro area accounts.

4.2 Enhancement on the table of loans by private financial institutions

One of the shortcomings in a simple application of the maximum entropy method is that it lacks statistical evidence. Although the assumption of the maximum entropy method has a reasonable grounding to be used in economic analysis, it also begs the question of whether the matrix derived from this assumption really describes the exact state of the economy. The answer is no, unless the matrix is supplemented with statistical evidence.

To alleviate this problem, this chapter enhances the table of Loans by private financial Institutions with the detailed data from the flow of funds accounts. A similar approach is taken in the analyses of interbank exposures, such as Lelyveld and Liedorp (2006), which applies maximum entropy method and adds the additional information of either large exposures data or survey data. The chapter contributes to the literature by applying detailed data in a macroeconomic sectoral analysis.

Loans by private financial institutions are provided by the 4 sectors Depository corporations, Insurance corporations and pension funds, Other financial intermediaries, and Financial auxiliaries and borrowed by 10 sectors, all of the sectors except for the Central bank. Among these 40 figures, 22 inter-sectoral positions are available from the detailed data. However, the remaining 18 positions are unavailable: 16 positions of the 4 financial institutions to themselves, and the 2 positions of Other financial intermediaries and Financial auxiliaries to General government. Therefore, the simple replacement of the estimates in the basic table with the available new detailed figures causes an imbalance

between total lending (assets) and total borrowings (liabilities).

To re-estimate the distributions of Loans by private financial institutions among the 18 unknown inter-sectoral positions, with restrictions of balancing total assets and liabilities, this chapter uses the RAS method. This method is employed as a way of obtaining approximated values of elements within a matrix in which only the row sum and column sum are available. The RAS method is explained in the Appendix.

4.3 Imposition of consistency restrictions

The other shortcoming in a simple application of maximum entropy method is that it produces an inconsistent relationship. Financial positions of the rest of the world vis-à-vis the rest of the world are estimated to be non-zero figures in 8 tables, which is inconsistent because the from-whom-to-whom framework is designed to describe transactions in which at least one counterparty is a resident. Therefore, the consistency restrictions are imposed on the financial positions of the rest of the world vis-à-vis the rest of the world, which should be always zero. An overview of transactions enhanced and restrictions imposed is summarized in Table 1.

One special treatment is needed for other external claims and debts. The assets of that transaction item held by domestic sectors are only supposed to be against the rest of the world, so they should all be allocated to the rest of the world sector. Accordingly, the

liabilities of the transaction item incurred by the rest of the world sector should all be allocated among the domestic sectors. The reallocation process, however, does not yield a consistent outcome after imposing a zero restriction on the intra-sectoral positions of the rest of the world because of the special property of this item. Other external claims and debts are compiled by financial statements for the assets side of the domestic sector, whereas it is automatically determined for liability sides as a difference between the net financial position in Japan (determined by the statistics of International Investment Positions) and all items taken from other source data, such as financial statements in the FFA, except for external claims and debts. In other words, the statistical discrepancies caused by the difference between these source data and the other items in the FFA are posted under other external claims and debts of overseas sector (Bank of Japan (2011b)). To solve this problem, the re-estimation is conducted to the final aggregated from-whom-to-whom matrix so that the final matrix applies sufficiently consistent restrictions.

The consistency restriction is also imposed to the financial positions of Central bank vis-à-vis Central bank itself.

4.4 Construction of the total from-whom-to-whom matrix

After enhancement on the table of Loans by private financial institutions and imposing restrictions except for other claims and debts, all the tables are aggregated into a single

whom-to-whom matrix. Such a total from-whom-to-whom matrix describes the relationship of all financial assets and liabilities among institutional sectors.

Table 1: Overview of enhancement and restrictions imposed at the end of March 2011

Transaction items	Enhancement	Restrictions ROW × ROW	CB × CB
Currency			
Deposits with the Bank of Japan			
Government deposits			
Transferable deposits			
Time and savings deposits		X	
Certificates of deposits			
Foreign currency deposits		X	
Deposits with the Fiscal Loan Funds			
Bank of Japan loans			
Call loans and money			
Bills purchased and sold			
Loans by private financial institutions	X		
Loans by public financial institutions			
Loans by the nonfinancial sectors		X	
Installment credit (not included in consumer credit)			
Repurchase agreements and securities lending transactions		X	X
Treasury discount bills			
Central government securities and FLIP bonds			
Local government securities			
Public corporation securities			
Bank debentures			
Industrial securities			
External securities issued by residents			
Commercial paper			
Investment trust beneficiary certificates			
Trust beneficiary rights			
Structured-financing instruments			
Mortgage securities			
Shares and other equities			
Financial derivatives		X	
Insurance and pension reserves			
Deposits money			
Trade credits and foreign trade credits		X	
Account receivable/payable		X	
Outward direct investment			
Outward investment in securities			
Other external claims and debts		X *	X *
Others			X

Note: * Re-estimation is conducted to the final aggregated from-whom-to-whom matrix

5. Estimated result

5.1 Table of loans by private financial institutions

The estimated result of the basic table of Loans by private financial institutions and the enhanced table by the detailed data of flow of funds accounts are shown in Table 2. The 18 figures estimated in RAS method are shown in the enclosed box.

Regarding loans provided by Depository corporations, major revisions are observed in the following figures. First, loans to Households provided by the Depository corporations are revised downward. The revision is a strait result of the use of the detailed data of flow of funds accounts. Second, among the 18 figures estimated using the RAS method, major upward revisions occur in the borrowings of the General government and the Rest of the world from the Depository corporations. These figures are considered to be more accurate than those estimated by a simple maximum entropy method because they have statistical evidence supporting them. Last, downward revisions are observed in loans to Private non-financial corporations (NFC1). All revisions are consistent as a result of horizontal balancing.

As for loans of Other financial intermediaries, those which are provided to Households are observed to be underestimated by a simple application of the maximum entropy method. These results show the importance of statistical evidence in constructing a from-whom-to-whom matrix.

5.2 The total from-whom-to-whom matrix

The total from-whom-to-whom matrix constructed for 2010 is shown on the Table 3. The diagonals of the matrix represent the volume of exposures within sectors. Compared with the original table, which contains only the aggregates of the basic 38 tables, the volume of exposures within Central bank and that within the Rest of the world are consistently estimated to be zero. In the total from-whom-to-whom matrix, interconnectedness across sectors is measured using a gross exposure basis that shows the amounts of both assets and liabilities between two sectors. If the amounts of both assets and liabilities are aggregated, the interconnectedness can also be summarized as aggregated exposures.

The total from-whom-to-whom matrix provides us with a good analytical source for the study of inter-sectoral relationships. Castren and llja (2009) analyze that a monetary financial institution (MFI) sector, which corresponds to the Depository corporation sector in Japan, plays a crucial role in the euro area financial system and that, given the large volume of the links connecting the MFI sector to the other sectors, MFI sector plays a "hub" in the network. The important role of the Depository corporation can also be observed in the total from-whom-to-whom matrix in Japan. Table 3 shows that the Depository corporation sector has the largest volume in both assets and liabilities (1,550 and 1,560 trillion yen) and that these assets and liabilities are distributed dispersedly among sectors in the total economy.

Table 2: Loans by private financial institutions

(100 mil. yen)

Enhanced tabel for loans by private financial institutions

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW	Total A.
HH	0	0	0	0	0	0	0	0	0	0	0	0
NPISH	0	0	0	0	0	0	0	0	0	0	0	0
CB	0	0	0	0	0	0	0	0	0	0	0	0
DC	2,146,170	77,219	0	257,502	15,517	525,465	7,092	2,043,975	94,761	502,670	386,261	6,056,632
ICPF	81,525	1,123	0	19,662	1,185	40,123	542	201,322	0	0	5,817	351,298
OFI	246,283	252	0	13,258	799	27,055	365	172,626	0	0	0	460,638
FA	624	0	0	8,098	488	16,526	223	888	0	4,769	0	31,616
NFC1	0	0	0	0	0	0	0	0	0	0	0	0
NFC2	0	0	0	0	0	0	0	0	0	0	0	0
GG	0	0	0	0	0	0	0	0	0	0	0	0
ROW	0	0	0	0	0	0	0	0	0	0	0	0
Total L.	2,474,602	78,594	0	298,520	17,989	609,168	8,222	2,418,811	94,761	507,439	392,078	

Revision from the original table

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW
HH	0	0	0	0	0	0	0	0	0	0	0
NPISH	0	0	0	0	0	0	0	0	0	0	0
CB	0	0	0	0	0	0	0	0	0	0	0
DC	-25,910	8,233	0	-4,524	-273	-9,232	-125	-79,135	11,585	57,266	42,115
ICPF	-44,460	-2,878	0	4,464	269	9,109	123	78,177	-4,824	-25,834	-14,144
OFI	81,085	-4,995	0	-6,670	-402	-13,612	-184	11,153	-6,326	-33,875	-26,174
FA	-10,714	-360	0	6,731	406	13,735	185	-10,195	-434	2,444	-1,796
NFC1	0	0	0	0	0	0	0	0	0	0	0
NFC2	0	0	0	0	0	0	0	0	0	0	0
GG	0	0	0	0	0	0	0	0	0	0	0
ROW	0	0	0	0	0	0	0	0	0	0	0

Note : sector names are shortened as listed below.

HH	: Households
NPISH	: Nonprofit institutions serving households
CB	: Central bank
DC	: Depository corporations
ICPF	: Insurance corporations and pension funds
OFI	: Other financial corporations
FA	: Financial auxiliaries
NFC1	: Private non-financial corporations
NFC2	: Public non-financial corporations
GG	: General government
ROW	: Rest of the world

Table 3: Estimated result of the total from-whom-to-whom matrix

(100 mil. yen)

Total from-whom-to-whom matrix — at the end of March 2010

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW	Total A.
HH	21,184	4,411	527,914	7,770,282	4,332,613	662,235	7,662	891,326	86,999	332,590	168,846	14,806,062
NPISH	2,229	1,392	186	252,727	431	51,418	1,648	29,238	6,346	186,093	8,494	540,203
CB	4,822	2,358	0	324,842	1,594	371,198	48	38,281	2,537	690,738	67,780	1,504,198
DC	2,177,250	88,308	460,767	2,333,974	53,106	1,527,434	23,934	2,792,778	171,818	4,067,052	1,799,149	15,495,569
ICPF	119,176	4,317	5,668	333,799	119,995	823,439	15,977	782,415	79,087	1,830,711	817,542	4,932,127
OFI	685,617	31,576	126,840	524,986	79,178	1,030,373	18,516	1,102,913	337,154	1,465,893	715,769	6,118,813
FA	673	1	0	46,627	1,189	20,156	262	14,604	1,325	37,670	423	122,930
NFC1	574,074	15,611	227,706	2,237,287	76,322	402,252	11,059	2,854,650	129,345	172,437	1,225,655	7,926,397
NFC2	4,059	122	783	115,053	12,148	12,206	609	112,229	9,092	19,060	4,546	289,907
GG	20,835	8,794	31,660	643,358	84,604	773,145	9,550	874,397	98,439	1,000,741	1,299,242	4,844,764
ROW	48,346	26,719	27,334	1,020,220	77,966	396,643	3,922	1,074,223	111,384	674,129	0	3,460,886
Total L.	3,658,265	183,608	1,408,858	15,603,154	4,839,147	6,070,499	93,187	10,567,054	1,033,524	10,477,114	6,107,446	

Original basic tables aggregated - before enhancement

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW	Total A.
HH	21,137	4,428	526,330	7,781,247	4,334,491	661,075	7,651	892,491	87,129	331,854	158,230	14,806,062
NPISH	2,392	1,533	185	255,130	433	51,822	1,644	30,386	6,485	185,936	4,256	540,203
CB	4,810	2,375	658	326,139	1,568	371,437	48	38,434	2,545	691,391	64,793	1,504,198
DC	2,205,953	80,998	462,584	2,437,808	55,500	1,550,036	24,126	2,901,261	161,570	4,027,233	1,588,501	15,495,569
ICPF	164,063	7,249	5,721	334,205	121,387	820,187	15,951	712,267	84,734	1,868,160	798,202	4,932,127
OFI	605,159	36,900	128,061	543,982	80,956	1,053,971	18,753	1,100,329	346,133	1,506,037	698,532	6,118,813
FA	11,385	361	0	40,083	789	6,401	75	24,830	1,761	35,162	2,081	122,930
NFC1	576,753	17,172	228,671	2,277,011	77,060	409,332	11,097	2,888,640	131,705	174,112	1,134,844	7,926,397
NFC2	4,053	131	782	115,357	12,194	12,225	608	112,439	9,115	19,030	3,972	289,907
GG	22,417	10,024	32,056	667,464	86,042	785,722	9,644	895,269	100,843	1,011,829	1,223,453	4,844,764
ROW	40,140	22,437	23,810	824,727	68,729	348,291	3,589	970,708	101,503	626,368	430,582	3,460,886
Total L.	3,658,265	183,608	1,408,858	15,603,154	4,839,147	6,070,499	93,187	10,567,054	1,033,524	10,477,114	6,107,446	

Increase/decrease from the original

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW
HH	47	-17	1,584	-10,966	-1,877	1,160	12	-1,165	-130	736	10,616
NPISH	-163	-141	0	-2,403	-2	-404	5	-1,148	-139	157	4,238
CB	12	-17	-658	-1,297	26	-239	-0	-153	-8	-653	2,987
DC	-28,704	7,310	-1,817	-103,834	-2,394	-22,601	-192	-108,483	10,247	39,819	210,648
ICPF	-44,887	-2,933	-53	-406	-1,392	3,253	26	70,148	-5,647	-37,450	19,340
OFI	80,457	-5,324	-1,221	-18,996	-1,778	-23,598	-237	2,584	-8,979	-40,144	17,237
FA	-10,712	-360	-0	6,544	401	13,754	186	-10,226	-437	2,508	-1,658
NFC1	-2,679	-1,561	-965	-39,724	-738	-7,079	-39	-33,990	-2,361	-1,676	90,812
NFC2	6	-9	2	-305	-46	-19	1	-210	-23	29	574
GG	-1,582	-1,230	-396	-24,106	-1,437	-12,578	-94	-20,872	-2,405	-11,088	75,789
ROW	8,206	4,281	3,524	195,493	9,237	48,352	333	103,514	9,881	47,761	-430,582

Aggregated exposures

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW
HH	21,184										
NPISH	6,640	1,392									
CB	532,736	2,544	0								
DC	9,947,532	341,035	785,609	2,333,974							
ICPF	4,451,790	4,748	7,261	386,905	119,995						
OFI	1,347,852	82,994	498,038	2,052,420	902,617	1,030,373					
FA	8,336	1,649	48	70,561	17,167	38,672	262				
NFC1	1,465,400	44,849	265,988	5,030,064	858,737	1,505,166	25,663	2,854,650			
NFC2	91,058	6,468	3,320	286,870	91,235	349,359	1,933	241,574	9,092		
GG	353,425	194,887	722,398	4,710,410	1,915,315	2,239,038	47,220	1,046,833	117,498	1,000,741	
ROW	217,192	35,213	95,114	2,819,369	895,508	1,112,411	4,345	2,299,878	115,931	1,973,371	0

See note of Table 2 for sector names.

6. Intertemporal comparison between 2000 and 2010

The total from-whom-to-whom matrix can be used for the intertemporal comparison if the total from-whom-to-whom matrices are constructed chronologically. This chapter investigates how the interconnectedness among sectors has evolved in the first decade of the twenty-first century by constructing and comparing it with another total from-whom-to-whom matrix for the 2000 fiscal year.

6.1 The changing role of depository corporations

Depository corporations (DC) decidedly play a central role in financial intermediation, as discussed in the previous section. However, looking at the changes of each position of the sector with the other counterparty sector from 2000 to 2010, the strength of relationship has changed according to counterparties (Table 4). The observation has been summarized in four points. First, in the relationship with private non-financial corporation (NFC1), assets held by DC to NFC1 have decreased by 87 trillion yen, whereas liabilities increased by 30 owed to NFC1. The decrease of the assets is attributed to the reduction of loans and the increase of liabilities is because of the increase of deposits of NFC1. Second, the change in relationship with General government (GG) is dramatic. The assets held by DC have drastically increased by 196 trillion yen. The main component of the increase is the central government securities and Fiscal Investment and Loan Program (FILP) bonds, which means Depository corporations finances central government fiercely through purchasing bonds in the 2000s. The first and second observations together indicate the shift in the form

of intermediation played by Depository corporations; funds financed by means of deposits are invested more to securities rather than loans. Third, the relationship with Other financial intermediaries (OFI) has decreased because of the overwhelming effects of Japan Post. The assets and liabilities of DC to OFI have reduced by 192 and by 65 trillion yen, respectively, which is because Deposits with the Fiscal Loan Funds deposited by Japan Post and Loans by public financial institutions borrowed by Japan Post have become almost zero. This may seem contradictory to the result in the euro area, where OFI sector has played an increasing role over the past ten years in the form of expansion of lending by non-bank financial intermediaries as well as growth of the special purpose vehicles for securitization purposes (Castren and llja (2009)). In Japan, however, loans provided by DC to the OFI sector have decreased rather than increased in this decade. Lastly, the interconnectedness with the rest of the world (ROW) has strengthened. The assets and liabilities of DC to ROW have increased by 70 and 37 trillion yen, respectively. The increase of assets is caused by the increase of outward investment in securities and other external claims and debts. The increase of liabilities stems from the increased volume of transactions such as financial derivatives, repurchase agreement and securities lending transactions.

6.2 Strengthened interconnectedness between domestic sectors and the rest of the world

The rest of the world sector has strengthened interconnectedness with most of the domestic sectors during this period. In addition to the relationship described in the previous

sub-section 6.1, General government has financed more from the rest of the world mainly in the form of treasury discount bills. Table 4 shows that the rest of the world has increased financial assets to General government by 37 trillion yen from 2000 to 2010. Disaggregation in basic tables reveals that 23 trillion yen out of 37 trillion is attributed to the increased purchase of treasury discount bills, and 6 trillion yen is attributed to the increased purchase of central government securities and FILP bonds. Private non-financial corporations have also financed more from ROW in the form of shares and other equities. The increased financial assets of the rest of the world against Private non-financial corporations is 23 trillion yen (Table 4), of which 15 trillion yen is from the increase of shares and other equities evidenced in basic tables. Other financial intermediaries increased transactions with ROW. They increased financial assets by 40 trillion yen (Table 4), of which 33 trillion yen was attributed to the increase of purchase of outward investment in securities. OFI also financed more from ROW. The increase of liabilities of OFI against ROW is 25 trillion yen (Table 4). The observation that OFI has strengthened the interconnectedness with ROW agrees with the result obtained in the euro area.

6.3 The positions of households in financial network

Table 4 shows that the changes in positions of Households in financial network have been remarkable in the relationship with Central bank, Depository corporations, and Insurance corporations and pension funds. First, Households increased financial assets in the Central bank by 19 trillion yen. This increase is due to the increase of currency held by Households.

Second, the increase of the positions against DC is 19 trillion yen, which is characterized by the increase of transferable deposits holdings. Looking at changes in the basic tables, the increase in transferable deposits of 168 trillion yen exceeds the decrease in time and savings deposits of 118 trillion yen. This observation may indicate that Households preferred transferable deposits to time and savings deposits during this period. Third, Insurance and pension reserves, which represent policyholders' claims on insurance and pension fund reserves, have increased by 35 trillion yen. Households are traditionally considered to have a close relationship with banks through deposit transactions. The analysis from the total from-whom-to-whom matrix underscores the growing importance of the interconnectedness between Households and the Insurance corporations and pension funds sector.

Table 4: Intertemporal comparison between 2000 and 2010

(100 mil. yen)

Total from-whom-to-whom matrix in 2000

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW	Total A.
HH	31,650	1,770	335,832	7,582,721	3,981,625	486,454	5,539	997,148	117,735	185,171	162,306	13,887,950
NPISH	3,584	2,984	5,259	233,529	2,170	61,651	311	50,699	9,878	64,828	19,690	454,582
CB	2,221	1,047	0	312,539	21,617	267,566	4,096	40,821	2,444	497,323	50,831	1,200,505
DC	2,097,959	109,770	171,851	2,408,255	85,829	3,450,749	151,306	3,661,613	314,518	2,102,587	1,101,409	15,655,845
ICPF	196,212	3,681	854	507,874	38,151	574,130	35,637	1,062,918	289,676	1,192,506	519,030	4,420,669
OFI	1,165,079	43,848	148,110	1,176,829	46,287	1,784,892	16,616	1,232,184	501,459	2,585,145	318,723	9,019,170
FA	1,047	1	2	98,968	3,368	89,569	22,237	8,495	596	13,915	825	239,023
NFC1	544,939	12,362	214,188	1,939,203	53,848	291,180	3,540	3,293,956	110,675	100,098	825,097	7,389,087
NFC2	5,432	190	27,992	90,069	11,492	13,468	189	46,182	2,937	6,270	3,181	207,401
GG	30,117	14,377	236,928	622,168	87,027	1,877,450	4,476	738,519	116,970	217,014	557,527	4,502,572
ROW	60,939	53,108	2,361	663,401	15,682	150,843	1,079	847,266	80,960	308,734	0	2,184,374
Total L.	4,139,179	243,139	1,143,376	15,635,555	4,347,095	9,047,951	245,027	11,979,799	1,547,848	7,273,591	3,558,618	0

Total from-whom-to-whom matrix in 2010 - revisited

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW	Total A.
HH	21,184	4,411	527,914	7,770,282	4,332,613	662,235	7,662	891,326	86,999	332,590	168,846	14,806,062
NPISH	2,229	1,392	186	252,727	431	51,418	1,648	29,238	6,346	186,093	8,494	540,203
CB	4,822	2,358	0	324,842	1,594	371,198	48	38,281	2,537	690,738	67,780	1,504,198
DC	2,177,250	88,308	460,767	2,333,974	53,106	1,527,434	23,934	2,792,778	171,818	4,067,052	1,799,149	15,495,569
ICPF	119,176	4,317	5,668	333,799	119,995	823,439	15,977	782,415	79,087	1,830,711	817,542	4,932,127
OFI	685,617	31,576	126,840	524,986	79,178	1,030,373	18,516	1,102,913	337,154	1,465,893	715,769	6,118,813
FA	673	1	0	46,627	1,189	20,156	262	14,604	1,325	37,670	423	122,930
NFC1	574,074	15,611	227,706	2,237,287	76,322	402,252	11,059	2,854,650	129,345	172,437	1,225,655	7,926,397
NFC2	4,059	122	783	115,053	12,148	12,206	609	112,229	9,092	19,060	4,546	289,907
GG	20,835	8,794	31,660	643,358	84,604	773,145	9,550	874,397	98,439	1,000,741	1,299,242	4,844,764
ROW	48,346	26,719	27,334	1,020,220	77,966	396,643	3,922	1,074,223	111,384	674,129	0	3,460,886
Total L.	3,658,265	183,608	1,408,858	15,603,154	4,839,147	6,070,499	93,187	10,567,054	1,033,524	10,477,114	6,107,446	0

Changes from 2000

	HH	NPISH	CB	DC	ICPF	OFI	FA	NFC1	NFC2	GG	ROW	Total A.
HH	-10,467	2,642	192,083	187,561	350,988	175,781	2,123	-105,822	-30,736	147,419	6,540	918,112
NPISH	-1,355	-1,592	-5,073	19,199	-1,739	-10,233	1,337	-21,460	-3,532	121,265	-11,196	85,621
CB	2,601	1,311	0	12,303	-20,023	103,632	-4,048	-2,539	92	193,415	16,949	303,693
DC	79,291	-21,462	288,916	-74,281	-32,723	**-1,923,315**	-127,372	**-868,835**	-142,701	1,964,466	697,740	−160,276
ICPF	-77,035	635	4,814	-174,075	81,844	249,309	-19,660	-280,502	-210,589	638,204	298,512	511,458
OFI	-479,462	-12,273	-21,270	-651,843	32,891	-754,519	1,900	-129,270	-164,305	-1,119,252	397,046	−2,900,357
FA	-374	0	-2	-52,341	-2,178	-69,414	-21,976	6,109	728	23,755	-402	−116,093
NFC1	29,136	3,248	13,518	298,084	22,474	111,072	7,518	-439,307	18,669	72,338	400,558	537,310
NFC2	-1,373	-68	-27,208	24,983	657	-1,262	420	66,047	6,155	12,790	1,365	82,506
GG	-9,282	-5,583	-205,268	21,190	-2,422	-1,104,305	5,074	135,878	-18,531	783,727	741,715	342,192
ROW	-12,593	-26,390	24,973	356,819	62,284	245,800	2,843	226,957	30,425	365,395	0	1,276,512
Total L.	−480,914	−59,531	265,482	−32,401	492,052	−2,977,452	−151,840	−1,412,745	−514,324	3,203,523	2,548,828	0

See note of Table 2 for sector names.

7. Conclusion

This chapter presents a model of compiling from-whom-to-whom statistics using flow of funds accounts, not relying solely on the maximum entropy method but also enhancing it by using detailed data on inter-sectoral relationships. Advantages of Japan's flow of funds accounts include the detailed breakdowns of sectors and transaction items together with the important source data on counterparty information on loans. This chapter shows that if flow of funds accounts statistics are compiled with a large number of transactional breakdowns and if detailed data on bilateral exposures across sectors are available, from-whom-to-whom statistics can be compiled accurately. It also analyzes the change in the inter-sectoral relationship in Japan's financial market from 2000 to 2010: Depository corporations increase financing to the central government, whereas Public financial institutions reduce the volume of lending, and the rest of the world strengthens interconnectedness between domestic sectors.

The limitation of the model of total from-whom-to-whom statistics exists in the availability of detailed data on securities. Detailed data for securities other than shares and for shares and other equities are currently not available in Japan's flow of funds accounts. As discussed in the Chapter 3, security databases that contain security-by-security information are currently being developed all over the world. Future studies should be extended to from-whom-to-whom presentations using detailed data on these transaction items.

Appendix

RAS method

RAS is a method used in an analysis of an input-output table to estimate the input-output coefficient matrix, part of input-output table, of a given year A^t under the condition that the input-output coefficient matrix of the initial year A^0 is given, but that for the year *t*, only the total value of the intermediate outputs (the row sum vector u^t) and the total value of intermediate inputs (the column sum vector v^t) are observed. This method was invented by Richard Stone and is explained in Stone (1962) and Stone (1963).

We start by considering that A^t is described as follows.

$$A^t = \hat{R}A^0\hat{S}$$

$\hat{R}$ is the diagonal matrix of adjustment factors in row direction, and $\hat{S}$ is the diagonal matrix of adjustment factors in column direction. The question is how to obtain $\hat{R}$ and $\hat{S}$.

Now, we try to express the row sum u^t, and column sum v^t of time *t*, using an initial matrix A^0 and the total output q^t of time *t*.

$$u^{1\prime} = A^0 q^t$$
$$v^{1\prime} = A^{0\prime} q^t$$

where $v^{t\prime}$ and $A^{0\prime}$ are transposes of v^t and A^0, respectively. In this stage, the row

sum and column sum do not satisfy the equality conditions ($u^1 \neq u^t$ and $v^1 \neq v^t$). Therefore, as a second step, we produce the first-round adjusted matrix of A^1 using the adjustment factors r_i^1 and s_j^1.

$$a_{ij}^1 = r_i^1 a_{ij}^0 s_j^1$$

where a_{ij}^1 is the element in row i and column j of A^1, $r_i^1 = u_i^t / u_i^1$, and $s_j^1 = v_j^t / v_j^1$. It is assumed that the adjustments occur proportionally in the same row and in the same column.

Using this adjusted matrix A^1, we can calculate

$$u^2 = A^1 q^t$$
$$v^2 = A^{1\prime} q^t$$

Again, $u^2 \neq u^t$ and $v^2 \neq v^t$, so we adjust A^1 using adjustment factors r_i^2 and s_j^2.
If we proceed this process infinitely until r_i^* and s_j^* converge to 1, then we can obtain $\hat{R}$ and $\hat{S}$ as a multiplication of r_i and s_j. These two adjustment matrices also enable us to calculate A^t. A^t is an estimate but is apparently an improvement from the initial matrix.

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